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(71) Applicant: **TK Escalator Norte, S.A.**
33682 Mieres (ES)
(72) Inventor: **CASTAÑO LANTERO, Aurelio**
Gijón (ES)
(74) Representative: **Michalski Hüttermann & Partner**
Patentanwälte mbB
Kaistraße 16A
40221 Düsseldorf (DE)

(54) **BRAKING DEVICE FOR AN ESCALATOR**

(57) The present invention relates to a Braking device (10) for braking a shaft (12) of an escalator, the braking device comprising a brake disc (14), designed for rotationally fixed attachment to the shaft (12) of the escalator, the brake disc (14) having at least one braking surface (15) with a respective main extension plane (E); at least one friction element (18) pivotally mounted perpendicular to the main extension plane (E) for frictionally applying a braking force to the at least one braking surface (15); and an actuating means (26) for spacing the at least one friction element (18) from the at least one braking surface (15) and/or applying the at least one friction element (18) to the at least one braking surface (15).

Furthermore, the present invention relates to an escalator comprising a braking device (10) acting on a shaft (12) of the escalator.

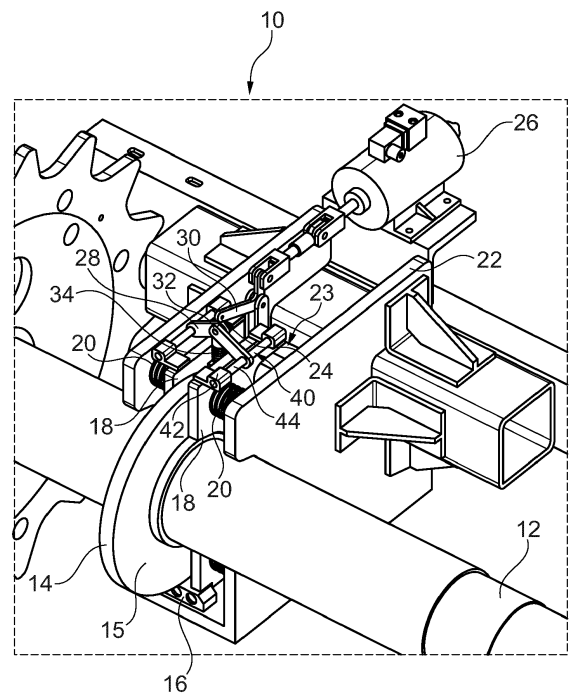


Fig. 1

Description

Technical Field

[0001] The present invention relates to a braking device for braking a shaft of an escalator.

[0002] Further, the present invention relates to an escalator having a braking device.

Background of the invention

[0003] Passenger transportation devices, in particular escalators or moving walks, are of great importance in many facilities. An escalator is a passenger transportation device for overcoming a distance. If a height distance is overcome, stair treads are formed in the device by moving segments, for example metal segments. Escalators are mainly known from public facilities with high public traffic, for example department stores, train stations and airports. Although they have a slower conveying speed than, for example, elevators, they offer the advantage that they can accommodate significantly more people. If the segments, for example metal segments, do not form a staircase but a flat surface, the means of passenger transportation is called a moving walk. Moving walks can be of horizontal or inclined design. Escalators or moving walks generally result in the accelerated and orderly transportation of people. This can serve to save time and space, for example.

[0004] The safety of persons during the use of escalators and moving walks always has top priority. In particular, escalators and moving walks must be able to stop quickly and safely in the event of danger. An essential component for the safety of escalators and moving walks is therefore a suitable braking device.

[0005] Usually, auxiliary brakes of escalators or moving walks are installed on their main drive shaft. The auxiliary brake is designed to block the rotation of the main drive shaft. For this purpose, the auxiliary brake has projections arranged on the circumference of the main drive shaft. When the auxiliary brake is actuated, at least one brake wedge is applied in the direction of the projections. In the process, the at least one brake wedge engages in at least one recess formed by two projections arranged circumferentially, causing an instantaneous stop of the main drive shaft. The abrupt stop can cause persons using the escalator or moving walkway during the braking process to fall forward due to mass inertia and injure themselves.

[0006] A braking device for an escalator is described below.

Description of the invention

[0007] Based on this situation, it is an object of the present invention to provide an improved braking device for braking an escalator.

[0008] In particular, the task is to provide a safe esca-

lator and to overcome the aforementioned disadvantages.

[0009] The task of the invention is solved by the features of the independent main claims. Advantageous embodiments are indicated in the subclaims. Where technically possible, the teachings of the subclaims may be combined as desired with the teachings of the main and subclaims.

[0010] Accordingly, the task is solved in particular by a braking device for braking a shaft of an escalator. The braking device comprises a brake disc, designed for being rotationally fixed attachment to the shaft of the escalator, the brake disc having at least one braking surface with a respective main extension plane; at least one friction element pivotally mounted perpendicular to the main extension plane for frictionally applying a braking force to the at least one braking surface; and an actuating means for spacing the at least one friction element from the at least one braking surface and/or applying the at least one friction element to the at least one braking surface. In other words, in the context of this disclosure, the actuating means is configured for disengaging and/or engaging the at least one friction element with the at least one braking surface.

[0011] A braking device for an escalator is described. The braking device can also be used for a moving walkway. Thus, the terms escalator and moving walkway are interchangeable in both the description and the claims.

[0012] Advantageous aspects are explained below and preferred modified embodiments are further described below. Explanations, particularly of advantages and definitions of features, are basically descriptive and preferred, but not limiting examples. Where an explanation is limiting, this is explicitly mentioned.

[0013] A preferred effect is that the braking device performs soft braking on an escalator. Braking by the braking device can be activated in particular manually by a person, by actuating an actuating sensor, for example a button, or automatically by a control unit of the escalator, for example by autonomously detecting a fault or a hazardous situation.

[0014] The brake disc of the braking device can be arranged on a shaft of the escalator in a rotationally fixed manner. In particular, the brake disc can be connected to the shaft for this purpose in a non-detachable manner, in particular by a welded connection or the like, or in a detachable manner, in particular by a screw connection or the like. As a result, the braking force applied by the at least one friction element can be reliably transmitted to the shaft of the escalator via the at least one braking surface of the brake disc. The at least one braking surface comprises a respective main extension plane. As a result, subsequently mentioned forces running parallel to the main extension plane act perpendicular to the normal vector of the main extension plane of the at least one braking surface. Subsequently mentioned forces running perpendicular to the main extension plane thus act parallel to the normal vector of the main extension plane of

the at least one braking surface. In geometry, a normal vector is a vector that is orthogonal (also called perpendicular or right-angled) to a plane or surface. The terms orthogonal and perpendicular are used congruently in the description and claims and are thus interchangeable. In particular, the at least one braking surface may be formed by the brake disc itself. More preferably, the at least one braking surface can be configured as an additional wear-resistant wear body. The wear body can be connected to the brake disc, in particular on the axial side, in a releasable or non-releasable rotationally fixed manner. Due to a detachable connection of the brake disc to the wear body, the wear body can be replaced quickly and inexpensively during maintenance work. Removal and replacement of the entire brake disc can thus be avoided.

[0015] The at least one friction element can be pivotally mounted at one end. The at least one friction element can comprise, in particular, a friction body for applying the braking force to the at least one braking surface. The friction body may in particular be releasably or non-releasably connected to the at least one friction element. By detachably connecting the at least one friction element to the friction body, the friction body can be quickly and inexpensively replaced during maintenance work. Removal and replacement of the entire friction element can thus be avoided.

[0016] The braking force can thus be applied to the at least one braking surface of the brake disc in a frictionally engaged manner by the at least one friction element itself or by the friction body of the at least one friction element. For this purpose, the at least one friction element can apply a braking force to the brake disc, in particular perpendicular to the main extension plane of the at least one braking surface. Thus, the braking force acts and runs parallel to the normal vector of the main extension plane of the at least one braking surface.

[0017] In other words, the fact that the brake disc is configured for being rotationally fixed attachment to the shaft means that the brake disc rotates with the shaft.

[0018] For example, the actuating means can be designed as a linear actuating means. In this case, the actuating means can transmit a linear movement at least indirectly, or directly, to the at least one friction element. In particular, the actuating means is designed as an electromagnetic actuating means. This means that the braking device can be controlled electronically. This simplifies the operation of the braking device by an actuating sensor, for example a button, or a control unit of the escalator.

[0019] The braking speed of the braking device can be adjusted via the coefficient of friction of the at least one braking surface, in particular the wear body, and the at least one friction element, in particular the friction body. A lower coefficient of friction leads to a lower braking speed. A lower braking speed thereby leads to a softer braking, which increases the comfort of use for persons on the escalator. A high coefficient of friction of the at least one braking surface, in particular the wear body,

and the at least one friction element, in particular the friction body, leads to a high braking speed. In this case, a high braking speed leads to harder braking, which brings the escalator to a halt quickly and safely. Depending on the hazard, the braking speed of the escalator can be adjusted alternatively or additionally by the actuating means during operation. If required, the actuating means can also be operated in the opposite direction and move the at least one friction element in the direction of the brake disc. As a result, the braking speed can be increased.

[0020] Where the wording braking surface is used in the context of the present disclosure, this may be used for only one braking surface or for several, for example two, braking surfaces of a brake disc. The same applies at least to the friction element.

[0021] According to a modified embodiment of the braking device, it is provided that the braking device comprises at least one brake spring element for applying a spring force to the at least one friction element in the direction of the at least one braking surface in order to apply the braking force to the at least one braking surface via the at least one friction element; wherein in particular the spring force of the brake spring element acts substantially perpendicular to the main extension plane of the at least one braking surface.

[0022] The at least one brake spring element can apply the spring force of the at least one brake spring element to the at least one friction element in the direction of the at least one braking surface. For example, the at least one brake spring element is a helical spring, a disc spring or the like. In particular, the brake spring element is designed as a compression spring. As a result, safe application of the spring force to the at least one friction element can still be ensured even if the brake spring element should break during operation of the escalator. Thus, in the event of danger, the braking device would still be able to bring about braking of the escalator even with a broken spring element by pressing the at least two broken spring segments against each other. By using different brake spring elements with strong to weak spring forces, the braking speed of the escalator can be adjusted. This enables safe braking and at the same time prevents the escalator from coming to an abrupt stop and people on the escalator falling and injuring themselves. For example, a soft braking of the escalator can be set via a brake spring element with low spring force. In the event of danger, the actuating means can support the brake spring element when the at least one friction element acts on the at least one braking surface. As a result, a higher braking speed can be achieved if required.

[0023] According to a modified embodiment of the braking device, it is provided that the at least one friction element is configured to be actuated by an actuating force generated by the actuating means for spacing, that means disengaging, the at least one friction element from the at least one braking surface, wherein in particular the actuating force of the actuating means is directed parallel

to the main extension plane of the at least one braking surface; and/or wherein the at least one friction element is configured to be actuated by a clamping force generated by the actuating means for acting on the at least one friction element on the at least one braking surface, wherein in particular the clamping force of the actuating means is directed parallel to the main extension plane of the at least one braking surface.

[0024] More preferably, the actuating means is configured to cause the at least one friction element to act on the brake disc with its actuating force. In particular, the actuating means for disengaging the at least one friction element from the at least one braking surface is configured to be actuated manually by a person via an actuating sensor, for example a button, or automatically by a control unit. The actuating means can be driven electrically. Particularly preferably, the actuating means is configured to counteract the spring force of the brake spring element with its actuating force in the activated state. The actuating force generated by the actuating means may always be greater than the spring force of the brake spring element. As a result, the actuating force causes the brake spring element to be clamped. The energy stored in the brake spring element in the form of the spring force may be at least partially discharged after the actuating force ceases by at least indirectly acting on the at least one friction element. In particular, it is provided that the actuating means holds the braking device in an open position, i.e. a non-braking position, during normal operation. In a hazardous situation or power failure, the actuating means is deactivated and braking of the escalator is automatically effected by applying the spring force of the brake spring element to the at least one friction element.

[0025] Particularly preferably, the actuating means is configured to cause the at least one friction element to act on the brake disc with its clamping force. Particularly, the actuating means for applying the at least one friction element to the at least one braking surface can be controlled manually by a person via an actuating sensor, for example a button, or automatically by a control unit. The actuating means may be driven electrically. Particularly preferably, the clamping force of the actuating means is configured to act parallel to the spring force of the brake spring element. The clamping force generated by the actuating means acts together with the spring force of the brake spring element on the at least one friction element. As a result, in the event of a hazard, braking of the escalator can be performed quickly and safely by applying more force to the at least one friction element on the corresponding braking surface of the brake disc. In addition, the additional clamping force means that the brake spring element can be dimensioned smaller. This favors a space-saving and cost-effective braking device. In addition, a braking device with soft braking, caused by the spring force of the brake spring element, can be realized in a normal operation and reinforced braking, caused by the spring force of the brake spring element together with the clamping force of the actuating means, can be real-

ized in a hazardous situation.

[0026] According to a modified embodiment of the braking device, it is provided that the actuating means is operatively connected to the at least one friction element via a transmission arrangement.

[0027] The transmission arrangement allows the actuating force and/or the clamping force of the actuating means, with which the actuating means acts on the at least one friction element, to be transmitted and amplified. This means that the actuating means can be dimensioned as a smaller component. By means of the transmission arrangement, the effective direction of the actuating means can be adapted to the degrees of freedom of the at least one friction element. The transmission arrangement allows the actuating means to be arranged in any orientation relative to the at least one friction element. Thus, the transmission arrangement favors a braking device that saves installation space.

[0028] According to a modified embodiment of the braking device, it is provided that the actuating means is operatively connected to the at least one friction element via a transmission arrangement and the transmission arrangement comprises a knee lever with at least one first lever arm and at least one second lever arm for applying a force to the at least one friction element, wherein the knee lever is rotatably mounted on the at least one friction element.

[0029] The transmission arrangement allows the actuating force and/or the clamping force of the actuating means, with which the actuating means acts on the at least one friction element, to be transmitted and amplified. This means that the actuating means can be dimensioned smaller. By means of the transmission arrangement, the effective direction of the actuating means can be adapted to the degrees of freedom of the at least one friction element. The transmission arrangement allows the actuating means to be arranged in any orientation relative to the at least one friction element. The transmission arrangement thus favors a braking device that saves installation space.

[0030] The knee lever can transmit a force generated by the actuating means, for example an actuating and/or clamping force, to the friction element. The force generated by the actuating means can be deflected by the knee lever, in particular by 90 degrees plus/minus 10 degrees. In this way, for example, a vertically acting force of the actuating means can be converted into a horizontally acting force to act on the friction element.

[0031] According to a modified embodiment of the braking device, it is provided that the actuating means is operatively connected to the at least one friction element via a transmission arrangement, and wherein the transmission arrangement comprises a knee lever with at least one first lever arm and at least one second lever arm for applying a force to the at least one friction element, wherein the knee lever is rotatably mounted on the at least one friction element, wherein the first lever arm is formed as a first pair of lever arms from two lever arms

extending away from the second lever arm.

[0032] The transmission arrangement allows the actuating force and/or the clamping force of the actuating means, with which the actuating means acts on the at least one friction element, to be transmitted and amplified. This means that the actuating means can be dimensioned as a smaller component. By means of the transmission arrangement, the effective direction of the actuating means can be adapted to the degrees of freedom of the at least one friction element. The transmission arrangement allows the actuating means to be arranged in any orientation relative to the at least one friction element. The transmission arrangement thus favors a braking device that saves installation space.

[0033] The knee lever can transmit a force generated by the actuating means, for example an actuating and/or clamping force, to the friction element. The force generated by the actuating means can be deflected by the knee lever, in particular by 90 degrees plus/minus 10 degrees. In this way, for example, a vertically acting force of the actuating means can be converted into a horizontally acting force to act on the friction element.

[0034] The second lever arm can be rotatably mounted centrally on a respective first end section of the first pair of lever arms between the first pair of lever arms, either indirectly or directly. The respective second end sections of the first pair of lever arms can be rotatably mounted on a first and a second friction element. By moving the second lever arm, the angle between the two lever arms of the first pair of lever arms can be changed. This allows the second end sections of the first pair of lever arms to be moved closer together or spaced apart.

[0035] In particular, one separate friction element is provided on the braking device for each lever arm of the first pair of lever arms. Preferably, a plurality of elements of the braking device are configured mirror-symmetrically with respect to the brake disc. Here, the elements are arranged on both sides of the brake disc. The elements include, for example, the friction element, the brake spring element, a lever arm of the first lever arm pair of the first lever arm, or a support bar. In particular, at least two brake spring elements each, and more preferably three brake spring elements each, are provided axially on both sides of the brake disc for applying a spring force to the brake disc.

[0036] According to a modified embodiment of the braking device, it is provided that the actuating means is operatively connected to the at least one friction element via a transmission arrangement, and wherein the transmission arrangement comprises a knee lever with at least one first lever arm and at least one second lever arm for applying a force to the at least one friction element, wherein the knee lever is rotatably mounted on the at least one friction element, wherein the first lever arm is formed as a first pair of lever arms from two lever arms extending away from the second lever arm and wherein the second lever arm is L-shaped with two arms.

[0037] The transmission arrangement allows the actu-

ating force and/or the clamping force of the actuating means, with which the actuating means acts on the at least one friction element, to be transmitted and amplified. This means that the actuating means can be dimensioned as a smaller component. By means of the transmission arrangement, the effective direction of the actuating means can be adapted to the degrees of freedom of the at least one friction element. The transmission arrangement allows the actuating means to be arranged in any orientation relative to the at least one friction element. The transmission arrangement thus favors a braking device that saves installation space.

[0038] The knee lever may transmit a force generated by the actuating means, for example an actuating and/or clamping force, to the friction element. The force generated by the actuating means may be deflected by the knee lever, in particular by 90 degrees plus/minus 10 degrees. In this way, for example, a vertically acting force of the actuating means may be converted into a horizontally acting force to act on the friction element.

[0039] The second lever arm may be rotatably mounted centrally on a respective first end section of the first pair of lever arms between the first pair of lever arms, either indirectly or directly. The respective second end sections of the first pair of lever arms can be rotatably mounted on a first and a second friction element. By moving the second lever arm, the angle between the two lever arms of the first pair of lever arms may be changed. This allows the second end sections of the first pair of lever arms to be moved closer together or spaced apart.

[0040] In particular, one separate friction element is provided on the braking device for each lever arm of the first pair of lever arms. Preferably, a plurality of elements of the braking device are configured mirror-symmetrically with respect to the brake disc. Here, the elements are arranged on both sides of the brake disc. The elements include, for example, the friction element, the brake spring element, a lever arm of the first lever arm pair of the first lever arm, or a support bar. In particular, at least two brake spring elements each, and particularly preferably three brake spring elements each, are provided axially on both sides of the brake disc for applying a spring force to the brake disc.

[0041] Preferably, a plurality of elements of the braking device are configured in mirror symmetry with respect to the brake disc and with respect to the second lever arm.

[0042] According to a modified embodiment of the braking device, it is provided that the second lever arm rests indirectly or directly on the first lever arm pair of the first lever arm at a pivot joint, wherein the lever arms of the first lever arm pair are rotatably connected to each other at the pivot joint, wherein the second lever arm cooperates frictionally with the first lever arm pair of the first lever arm at the rotary joint to transmit an actuating force of the actuating means and to space the at least one friction element from the at least one braking surface.

[0043] In particular, the actuating force and/or clamping force of the actuating means is transmitted to the at

least one friction element via the pivot joint.

[0044] According to a modified embodiment of the braking device, it is provided that the second lever arm rests indirectly or directly on the first lever arm pair of the first lever arm at a pivot joint, wherein the lever arms of the first lever arm pair are rotatably connected to each other at the pivot joint, wherein the second lever arm cooperates frictionally with the first lever arm pair of the first lever arm at the rotary joint to transmit an actuating force of the actuating means and to space the at least one friction element from the at least one braking surface, wherein the second lever arm on the pivot joint transmits the actuating force of the actuating means to the first pair of lever arms against the return force of the return spring.

[0045] In particular, a clamping force of the actuator can also be transmitted to the at least one friction element via the pivot joint. As a result, the second lever arm on the swivel joint, together with the restoring force of the restoring spring, may transmit the clamping force of the actuator to the first pair of lever arms. For example, the return spring is a helical spring. In particular, the return spring is designed in such a way that, in the braking state, it applies a contact force via the pivot joint to the first pair of lever arms of the first lever arm and to the second lever arm. Alternatively, the return spring is not designed in such a way that it applies a contact force in the braking state, but that it only applies a return force to the toggle joint of the toggle lever in a brake-free state in such a way that the first lever arm pair is transferred more easily from the brake-free state to the braking state. The restoring force of the restoring spring acts substantially perpendicular to the spring force(s) of the brake spring element(s), which is/are designed to apply the spring force to the brake disc via the at least one friction element.

[0046] According to a modified embodiment of the braking device, it is provided that the second lever arm rests indirectly or directly on the first lever arm pair of the first lever arm at a pivot joint, wherein the lever arms of the first lever arm pair are rotatably connected to each other at the pivot joint, wherein the second lever arm cooperates frictionally with the first lever arm pair of the first lever arm at the rotary joint to transmit an actuating force of the actuating means and to space the at least one friction element from the at least one braking surface, wherein in particular the return spring is configured such that in a braking state of the second lever arm, in which the at least one friction element applies a braking force to the at least one braking surface, it does not apply a return force to the second lever arm or to the first lever arm pair, and the at least one brake spring element for applying a spring force to the at least one friction element has a greater force than the return spring.

[0047] This favors that the return spring is protected in a braking position of the second lever arm, in which the friction element applies a braking force to the braking surface. Thus, the longevity of the return spring can be improved. Thus, the braking device requires less maintenance.

[0048] According to a modified embodiment of the braking device, it is provided that the transmission arrangement comprises a return spring at the pivot joint of the knee lever for applying a return force to the knee lever, wherein the return spring is configured and arranged to counteract the actuating force at the pivot joint applied by the actuating means.

[0049] In the event of a power failure or deactivation of the actuating means, the return spring acts on the knee lever at the pivot joint in such a way as to enable the friction element to pivot in the direction of the braking surface. The return spring is preferably configured to explicitly prevent canting of the first pair of lever arms when the lever arms are oriented substantially parallel to each other. The return spring may provide additional support to the braking speed. The return spring may improve the functionality of the braking device.

[0050] According to a modified embodiment of the braking device, it is provided that the second lever arm on the pivot joint transmits the actuating force of the actuating means to the first lever arm pair against the restoring force of the restoring spring; wherein in particular the return spring is configured such that in a braking state of the braking device, in which the at least one friction element applies the braking force to the at least one braking surface, it does not apply a return force to the second lever arm or to the first lever arm pair; and wherein the spring force of the at least one brake spring element for acting on the at least one friction element is greater than the return force of the return spring.

[0051] According to a modified embodiment of the braking device, it is provided that the knee lever is rotatably mounted on the at least one friction element and is connected to the at least one friction element via at least one connecting means, wherein the at least one connecting means is immovably connected to the at least one friction element at at least one outer section, and wherein the at least one connecting means is rotatably connected to the first lever arm at an intermediate section.

[0052] In particular, the at least one connecting means comprises two outer sections. The outer sections may each be immovably connected to the friction member. An intermediate section extending orthogonally to the longitudinal direction of the outer sections may be disposed between the outer sections. The intermediate section connects the outer sections to each other. The outer sections extend away from the friction element substantially orthogonally to the axial face of the friction element. This allows the lever arms of the knee lever to be configured to be a longer component, respectively. The longer lever arms of the first lever arm enable greater movement of the friction element. As a result, the friction element is sufficiently spaced from the brake disc, in particular from the braking surface of the brake disc, whereby the braking effect of the braking device may be overridden. Due to a larger movement of the friction element, the second lever arm can also be dimensioned larger and promote a sufficient transmission of the force, in par-

ticaluating force and/or clamping force, of the actuating means to the friction element. The return spring and the at least one brake spring element can also be configured longer and thus be more easily adapted to the requirements of the braking device. In particular, the greater movement favors the use of a longer spring, in particular return spring and/or brake spring element, with a smaller spring constant and a greater spring movement. This can simplify the assembly of the braking device for the assembler. The at least one connecting means thus favors a more flexible design of the braking device, for example with regard to the design of the brake spring elements, the return spring and/or the length of the lever arms.

[0053] According to a modified embodiment of the braking device, it is provided that the braking device comprises at least one holding device for unilaterally supporting the at least one brake spring element, wherein the holding device is immovably connected to a frame of the escalator and/or a building component surrounding the escalator.

[0054] In particular, the holding device is arranged around the shaft of the escalator. For this purpose, the holding device can be configured from several support components. This allows immovable elements of the braking device, such as the actuating means, the transmission arrangement, the at least one friction element, the return spring, the at least one brake spring element or the like, to be connected to the holding device. For this purpose, the holding device can be arranged in particular on the escalator itself and/or on a building component surrounding the escalator. Advantageously, the holding device allows the braking device to be mounted on almost any shaft of the escalator.

[0055] According to a modified embodiment of the braking device, it is provided that the braking device comprises at least one holding device for unilaterally supporting the at least one brake spring element, wherein the holding device is immovably connected to a frame of the escalator and/or a building component surrounding the escalator, wherein the second lever arm is indirectly or directly connected to a support bar of the holding device in a rotatably mounted manner.

[0056] In particular, the holding device can be arranged around the shaft of the escalator. For this purpose, the holding device can be configured from several support components. This allows immovable elements of the braking device, such as the actuating means, the transmission arrangement, the at least one friction element, the return spring, the at least one brake spring element or the like, to be connected to the holding device. For this purpose, the holding device can be arranged in particular on the escalator itself and/or on a building component surrounding the escalator. Advantageously, the holding device allows the braking device to be mounted on almost any shaft of the escalator.

[0057] According to a modified embodiment of the braking device, it is provided that the braking device com-

prises at least one holding device for unilaterally supporting the at least one brake spring element, wherein the holding device is immovably connected to a frame of the escalator and/or a building component surrounding the escalator, wherein the second lever arm and/or the return spring is indirectly or directly mounted on a support bar of the holding device.

[0058] In particular, the holding device can be arranged around the shaft of the escalator. For this purpose, the holding device can be configured from several support components. This allows immovable elements of the braking device, such as the actuating means, the transmission arrangement, the at least one friction element, the return spring, the at least one brake spring element or the like, to be connected to the holding device. For this purpose, the holding device can be arranged in particular on the escalator itself and/or on a building component surrounding the escalator. Advantageously, the holding device allows the braking device to be mounted on almost any shaft of the escalator.

[0059] According to a modified embodiment of the braking device, it is provided that the braking device comprises at least one holding device for unilaterally supporting the at least one brake spring element, wherein the holding device is immovably connected to a frame of the escalator and/or a building component surrounding the escalator, wherein the second lever arm and/or the return spring is indirectly or directly mounted on a support bar of the holding device, wherein the at least one friction element is indirectly or directly connected to the holding device in a rotatably mounted manner.

[0060] In particular, the holding device can be arranged around the shaft of the escalator. For this purpose, the holding device can be configured from several support components. This allows immovable elements of the braking device, such as the actuating means, the transmission arrangement, the at least one friction element, the return spring, the at least one brake spring element or the like, to be connected to the holding device. For this purpose, the holding device may be arranged in particular on the escalator itself and/or on a building component surrounding the escalator. Advantageously, the holding device allows the braking device to be mounted on almost any shaft of the escalator.

[0061] According to a modified embodiment of the braking device, it is provided that the braking device is configured substantially mirror-symmetrically on the axial side of the brake disk, wherein the braking device comprises two friction elements for axially applying a braking force to the respective braking surface of the brake disk on both sides, and each of the lever arms of the first pair of lever arms is connected to a respective connecting means of the respective friction element.

[0062] In other words, there are two connecting means, wherein one connecting means is connected to a lever arm of the first pair of lever arms in each case. Due to the symmetrical arrangement of the friction elements on both sides of the brake disc, the axial forces transmitted

to the brake disc by the brake spring elements and/or the actuating means via the friction elements on both sides cancel each other out. This means that one-sided axial loading of the brake disc can be avoided. The symmetrical arrangement allows the brake disc to comprise two axially opposing braking surfaces. The additional braking surface promotes greater braking performance of the braking device. As a result, the brake disc and the friction elements of the braking device can be configured as a smaller component. This favors a space-saving, easy-to-install and low-cost braking device.

[0063] According to a modified embodiment of the braking device, it is provided that the lever arms of the first lever arm pair of the first lever arm in a non-braking position in which the at least one friction element does not apply the braking force to the at least one braking surface include an obtuse angle between 170 degrees inclusive and 180 degrees inclusive, in particular an obtuse angle between 175 degrees inclusive and 180 degrees inclusive; and/or wherein the lever arms of the first pair of lever arms of the first lever arm include an obtuse angle between 100 degrees inclusive and 120 degrees inclusive, in particular an obtuse angle between 110 degrees inclusive and 120 degrees inclusive, in a braking position in which the at least one friction element applies the braking force to the at least one braking surface.

[0064] Due to the obtuse angle between the two lever arms of the first pair of lever arms, a moment acting on the lever arms can be reduced or cancelled. The moment is created by the spring force of the at least one brake spring element acting in the axial direction. The spring force is transmitted to at least one of the lever arms via the friction element. If the angle between the lever arms of the first pair of lever arms decreases, the portion of the lever arm acting on the pivot joint on which the spring force acts in the orthogonal direction increases. This also increases the moment acting on the lever arms. If the angle between the two lever arms of the first pair of lever arms is large, the moment acting on the lever arms decreases. In particular, at an angle of 180 degrees, the moment caused by the at least one brake spring element disappears completely. The spring force of the at least one brake spring element then acts essentially parallel to the longitudinal extension of the two lever arms of the first pair of lever arms. If the friction element is spaced from the braking surface of the brake disc by the actuating means, the actuating force required by the actuating means can be reduced to a minimum by the knee lever. In particular, at an angle of 180 degrees, an acting actuating force can be dispensed with entirely. As a result, the energy consumption of the actuating means required to hold the brake open can be reduced. If an additional brake spring element is used on the knee lever, the actuating means for holding the brake open can only provide an actuating force that corresponds to and counteracts the spring force of the additional brake spring element.

[0065] The alignment of the first lever arm pair with

respect to the second lever arm in the non-braking position reinforces the benefits previously described with respect to the first lever arm pair.

[0066] In particular, the lever arms of the first lever arm pair are each formed with a plane extending substantially parallel to a longitudinal direction of the second lever arm, each forming an acute angle between 0 degrees and 10 degrees inclusive, in particular an acute angle between 0 degrees and 5 degrees inclusive, and wherein the lever arms of the first lever arm pair of the first lever arm in a braking position in which the at least one friction element applies the braking force to the at least one braking surface are each formed with a plane extending substantially parallel to a longitudinal direction of the second lever arm, each forming an acute angle between 0 degrees and 10 degrees inclusive, in particular an acute angle between 0 degrees and 5 degrees inclusive, each including an obtuse angle between 100 degrees and 120 degrees inclusive, in particular an obtuse angle between 110 degrees and 120 degrees inclusive, and the lever arms of the first lever arm pair each including, with a plane extending substantially parallel to a longitudinal direction of the second lever arm, an acute angle between 30 degrees and 50 degrees inclusive, in particular an acute angle between 30 degrees and 45 degrees inclusive.

[0067] In the braking position in which the at least one friction element applies the braking force to the at least one braking surface, it is advantageous if as little force as possible has to be applied to the second lever arm via an actuating means or a means equivalent thereto in order to pivot it in the direction of the first pair of lever arms and thereby release the brake again. A reduction of the force to be applied can be achieved with advantage by the defined obtuse angles.

[0068] The alignment of the first lever arm pair with respect to the second lever arm in the non-braking position reinforces the benefits previously described with respect to the first lever arm pair.

[0069] According to a modified embodiment of the braking device, it is provided that the brake disc is configured in multiple parts; and/or wherein the at least one friction element is configured as a perforated disc, in particular as a partial section of a perforated disc.

[0070] The brake disc of the braking device can be arranged on the shaft of the escalator in a rotationally fixed manner. In particular, the brake disc may be connected to the shaft for this purpose in a non-detachable manner, in particular by a welded connection, or detachably, in particular by a screw connection or the like. As a result, the braking force applied by the at least one friction element can be reliably transmitted to the shaft of the escalator via the braking surface of the brake disc. In particular, the brake disc may be configured in multiple parts. This means that the brake disc can be retrofitted to the shaft of an existing escalator to prevent it from rotating. The shaft does not have to be removed for installation. In particular, the brake disc may be formed from two halves. This may reduce the assembly work

required for the braking device.

[0071] Due to the friction element configured as a partial section of a perforated disc, the friction element may be arranged from a radial direction on the shaft of the escalator and the brake disc so as not to contact the shaft and brake disc. In particular, the friction element is configured as a half perforated disc. Particularly, the size of the partial section may affect the size of the braking surface of the brake disc interacting with the friction element. In particular, the subsection may be configured in such a way that pivoting of the friction element in the axial direction takes place without contact with the shaft of the escalator. For this purpose, the subsection can comprise an opening which is arranged extending at least partially along the circumference of the shaft in the radial direction and is configured larger than the diameter of the shaft.

[0072] According to a modified embodiment of the braking device, it is provided that the at least one friction element is pivotally mounted on a bearing and wherein the actuating force and/or the clamping force of the actuating means acts/act on the friction element at a distance from the bearing.

[0073] For example, the bearing is arranged above a holding device on a support structure of the escalator or a building component. In particular, the bearing is located on a first side of the shaft of the escalator. For example, the position on the friction element at which the actuating force or clamping force of the actuating means acts via the knee lever may be arranged on a second side which is substantially opposite the first side. In this way, a large lever on which the actuating means acts with an actuating force or clamping force can be achieved. Thus, the actuating force and the clamping force can be smaller and still generate a sufficiently large moment acting on the friction element. This reduces the requirements on the actuating center and the transmission arrangement. Thereby, these are designed as smaller components and promote a braking device that saves installation space.

[0074] According to a modified embodiment of the braking device, it is provided that the braking device comprises one or more friction elements, which are each configured to apply the braking force to the brake disc on one side or axially on both sides.

[0075] In particular, the brake disc may comprise at least one braking surface on both axial end faces, wherein the braking surfaces of the brake disc are acted upon from both axial directions by at least one friction element in each case. For this purpose, the friction elements may be configured mirror-symmetrically along the radial extent of the brake disc. This allows the braking properties of the braking device to be further enhanced. This favors the use of smaller braking devices. In particular, this can prevent one-sided axial loading of the brake disk, which could lead to bending of the brake disk or loosening of the brake disk from the shaft. The transmission arrangement may likewise be configured in a mirror-symmetrical manner, wherein in each case one end of the first pair of lever arms is rotatably connected to a first friction element

and an opposite second friction element. Thus, a safe and space-saving braking device is realized.

[0076] According to a modified embodiment of the braking device, the actuating means is configured as a linear and/or electromagnetic actuating means.

[0077] In particular, the actuating means may be configured as a linear actuating means. The actuating force generated by the actuating means may act on the transmission arrangement in a linear direction. The clamping force generated by the actuating means may act on the transmission arrangement in a linear direction. The linear motion allows the actuating means to act in only two opposing directions. This allows a simple braking device to be realized in which the necessary actuating force acts only in a first direction to open the brake and the clamping force acts in an opposite second direction to close the brake. The actuating means may be configured in particular as an electromagnetic actuating means. As a result, the brake is activated manually by actuating an actuation sensor, for example a pushbutton, or automatically in the event of danger by the escalator control unit. In particular, the brake may also be manually deactivated by actuating an actuation sensor, for example a pushbutton, or automated in the event of danger by the escalator control unit. Thus, the braking device can be used in a variety of ways.

[0078] According to a modified embodiment of the braking device, the actuating means is designed to act with its actuating force against a direction of application of the spring force of the at least one brake spring element.

[0079] This is the brake spring element for applying the spring force to the friction element in the direction of the at least one braking surface in order to apply the braking force to the braking surface.

[0080] For example, the actuating means acts via the transmission arrangement, more preferably via the knee lever, against the direction of application of the brake spring element.

[0081] According to a modified embodiment of the braking device, at least:

- the transmission arrangement and
- force applying means, particularly the at least one brake spring element, configured to actuate the at least one friction element to apply a force to the at least one braking surface of the brake disk,

are configured to provide that the actuating force of the actuating means is smaller than the braking force applied to the at least one braking surface of the brake disk.

[0082] In other words, the system of lever arms of the braking device transmission arrangement allows a small force of the actuating means to overcome the force of the force applying means, such as the brake spring elements, that have a force being much greater than a force being applicable by the actuating means, for example a force being applicable by a coil of the actuating means.

This is achieved by providing that the lever arms of the transmission arrangement are practically parallel in an open brake position of the braking device, since it is achieved a notable force reduction.

[0083] For example, the transmission arrangement comprises two lever arms. One of the lever arms is formed in particular as a pair of lever arms, wherein the lever arms of the pair of lever arms are rotatably connected to each other at a respective first end portion at a pivot joint. The second end portions of the respective lever arms of the first pair of lever arms are rotatably mounted on the friction elements. In particular, a further lever arm of the two lever arms is L-shaped and has two legs which are oriented substantially orthogonally to each other. The two lever arms may be configured to be substantially parallel to each other when the at least one friction element is spaced from the at least one braking surface, that means when the braking device is in an open position and not actuated. Regarding the specific embodiment of the transmission arrangement, one leg of the further lever arm and the pair of lever arms of the two lever arms may be configured to be substantially parallel to each other when the at least one friction element is spaced from the at least one braking surface, that means when the braking device is in an open position and not actuated.

[0084] "substantially parallel to each other" means that the lever arms are oriented to each other with an angle in the range from 180 degrees, excluding 180 degrees, to 175 degrees, for example. Regarding the specific embodiment of the transmission arrangement, "substantially parallel to each other" means that the one leg of the further lever arm and the pair of lever arms of the two lever arms are oriented to each other with an angle in the range from 180 degrees, excluding 180 degrees, to 175 degrees, for example.

[0085] Of course, depending on the properties of the force applying means, especially depending on the force which the force applying means is able to apply and, depending on the properties of the actuating means, especially depending on the force which the force applying means is able to apply, the properties of the transmission arrangement, especially of the lever arms, more especially the angles of the lever arms, may be differently configured as previously described. According to a further modified embodiment of the braking device, it is further provided a transmission arrangement force applying means, configured to apply a force on at least one of the lever arms of the transmission arrangement to move the at least one lever arm to actuate the at least one friction element to apply a force to the at least one braking surface of the brake disk.

[0086] In other words, according to a modified embodiment of the braking device, at least:

- the transmission arrangement,
- the force applying means, particularly the at least one brake spring element, configured to actuate the

at least one friction element to apply a force to the at least one braking surface of the brake disk, and

- the transmission arrangement force applying means, configured to apply a force on at least one of the lever arms of the transmission arrangement to move the at least one lever arm to actuate the at least one friction element to apply a force to the at least one braking surface of the brake disk

are configured to provide that the actuating force of the actuating means is smaller than the braking force applied to the at least one braking surface of the brake disk.

[0087] For example, a return spring may be provided as such transmission arrangement force applying means. The transmission arrangement force applying means, especially the return spring, is configured to act in a direction, in which the lever arms, or one leg of the further lever arm and the pair of lever arms, are oriented with an angle with respect to each other, which is smaller than the angle of the substantial parallel orientation. Such return spring may act with a return force on the second lever arm of the transmission arrangement in opposition to the actuating force of the actuating means, thereby preventing the lever arms of the pair of lever arms from becoming misaligned after being substantially parallel to each other. The return spring thus enhances the safe operation of the braking device.

[0088] According to a modified embodiment, the return spring may be used to provide that the lever arms of the lever arm pair are folded and the braking device can act. In other words, depending on the properties of the transmission arrangement and the orientation of the lever arms in the opened position of the braking device, the braking device could lock up when it must brake. Thus, for such configuration of the transmission arrangement, and in case that the lever arms may be oriented almost parallel in the opened position of the brake, a small force from the transmission arrangement force applying means, especially the return spring, folds the lever arms up and ensures the functioning of the braking device.

[0089] The task is further solved by an escalator with a braking device, wherein the braking device acts on a shaft of the escalator. The escalator may have one or more shafts. The escalator is provided for traversing a conveying distance. The conveying distance may be horizontal or overcoming a height. The escalator may further comprise at least one step belt and at least one deflection mechanism. The deflection mechanism comprises, for example, deflection rollers located at each end of a conveying path. One of the shafts may, for example, be part of a deflection mechanism of the escalator for deflecting a step belt of the escalator. For each of the shafts, a braking element may be provided to act on the respective shaft.

[0090] The preferred features mentioned for the braking device may be used individually or in combination for the braking device of the escalator. In particular, an escalator for the purposes of the overall disclosure is also

considered to be an escalator.

Brief description of the drawings

[0091] In the following, the braking device is explained in more detail with reference to the attached drawings on the basis of preferred embodiment examples. The phrase figure is abbreviated in the drawings as Fig.

[0092] The drawings show

- Fig. 1 a perspective principle view of a first embodiment of the braking device for braking a shaft of an escalator;
- Fig. 2 a first side view of the first embodiment of the braking device of Fig. 1;
- Fig. 3 a second side view of the first embodiment of the braking device from Fig. 1;
- Fig. 4 a perspective principle view of a first embodiment of the brake disc for the brake device of Fig. 1; and
- Fig. 5 a perspective principle illustration of a second embodiment of the brake disc for a braking device from Fig. 1.

Detailed description of the embodiment examples

[0093] The described embodiments are merely examples that may be modified and/or supplemented in a variety of ways within the scope of the claims. Each feature described for a particular embodiment example may be used independently or in combination with other features in any other embodiment example. Any feature described for an embodiment example of a particular claim category may also be used in a corresponding manner in an embodiment example of another claim category.

[0094] Figure 1 shows a braking device 10 for braking a shaft 12 of an escalator with a brake disk 14 arranged non-rotatably on the shaft 12 and two friction elements 18 rotatably mounted on a bearing 16, each of which applies a braking force axially to a braking surface 15 of the brake disk 14. The braking surfaces 15 comprise each a main extension plane E. A spring force is applied to the friction elements 18 in the axial direction by brake spring elements 20. The brake spring elements 20 are designed as helical springs and are arranged between the friction elements 18 and a respective holding device 22. This allows the brake spring elements 20 to apply a spring force to each of the friction elements 18 in the direction of the brake disk 14.

[0095] The friction elements 18 are operatively connected to an electromagnetic actuating means 26 via a transmission arrangement 24, the actuating means 26 acting on the friction elements 18 with an actuating force counteracting the spring force of the brake spring ele-

ment 20. The actuating means 26 is designed in particular as a linear motor. The transmission arrangement 24 has a first lever arm 28 and a second lever arm 30 for transmitting the actuating force of the actuating means 26 to the friction elements 18. The transmission arrangement 24 functions in particular according to the principle of a toggle lever. The first lever arm 28 is formed in particular as a first pair of lever arms, wherein the lever arms of the first pair of lever arms are rotatably connected to each other at a respective first end portion at a pivot joint 32. The second end portions of the respective lever arms of the first pair of lever arms are rotatably mounted on the friction elements 18. In particular, the second lever arm 30 is L-shaped and has two legs which are oriented substantially orthogonally to each other. Between the legs, the second lever arm 30 is rotatably mounted on a support web 19 of the holding device 22.

[0096] At its first end portion, the second lever arm 30 may be indirectly or directly connected to the actuating means 26. At its second end portion, the second lever arm 30 is operatively connected to the first lever arm 28 at the pivot joint 32. This allows the force ratio and the direction in which the actuating force acts to be adjusted. For example, a positioning force of the actuating means 26 acting in the horizontal direction can be translated into a positioning force acting at the rotary joint 32 in the vertical direction. The actuating force acting at the pivot joint 32 in the vertical direction causes the two end portions of the first pair of lever arms to be spaced apart in the transverse direction. As a result, the application of the braking force of the friction elements 18 to the braking surface 15 can be counteracted and the braking device 10 of the escalator can be opened. A return spring 34 acts with a return force on the second lever arm 30 of the transmission arrangement 24 in opposition to the actuating force of the actuating means 26, thereby preventing the lever arms of the first pair of lever arms from becoming misaligned after being substantially parallel to each other. The return spring 34 thus enhances the safe operation of the braking device 10.

[0097] Fig. 2 shows a first side view of the braking device 10 illustrated in Fig. 1, wherein the braking device 10 is shown in an open position, that is, in a non-braking state. When the braking device 10 is open, no braking force is transmitted to the shaft 12 of the escalator. For this purpose, the friction bodies 36 of the friction elements 18 are spaced in the axial direction from the braking surfaces 15 of the brake disk 14. Thereby the lever arms of the first pair of lever arms are aligned approximately parallel to each other in the axial direction by an actuating force of the actuating means 26. The greater the angle between the lever arms of the first pair of lever arms is, the further the friction elements 18 are spaced from the brake disk 14. The brake spring elements 20 thereby counteract the actuating force at the friction elements 18.

[0098] In Fig. 3, a second side view of the brake device 10 according to Fig. 1 is shown, wherein the brake device

10 is shown in a closed position, i.e. in a braking state. When the braking device 10 is closed, a braking force is transmitted from the friction elements 18 via the brake disc 14 to the shaft 12 of the escalator. In this case, the actuating means 26 is in particular deactivated or disconnected from the power supply and no longer acts on the transmission arrangement 24 with the actuating force. The brake spring elements 20 each act on the friction elements 18 with a spring force acting in an axial direction with respect to an axis of rotation of the shaft 12. The return spring 34 acts on the transmission arrangement 24 substantially perpendicularly to the brake spring elements 20 and additionally promotes the braking process in that the return spring 34 indirectly or directly applies a return force in the vertical direction to the first pair of lever arms, which are in the form of a toggle lever, at the rotary joint. As a result, the two end portions of the first pair of lever arms approach each other, whereby the friction elements 18 are each acted upon in the direction of the brake disc 14. In particular, the actuating means 26 can also apply a clamping force, which opposes the actuating force, to the friction elements 18 via the transmission arrangement 24. In this way, the braking speed of the braking device 10 is additionally increased in the event of danger and safe braking of the escalator is brought about.

[0099] Fig. 4 and Fig. 5 show a brake disc 14, which may be formed in one piece (Fig. 4) or in several pieces (Fig. 5) and may be attached to the shaft 12 of the escalator in a rotationally fixed manner. The one-piece brake disc 14 may be preassembled on the shaft 12 by sliding the brake disc 14, which is designed as a perforated disc, axially onto the shaft 12. Subsequently, the brake disc 14 may be bolted and/or welded to the shaft 12 in a rotationally fixed manner. The multi-part brake disc 14 formed from partial sections 38 of a perforated disc may, in particular, be subsequently arranged on the shaft 12 in a rotationally fixed manner. As soon as the braking surfaces 15 or their respective main extension planes E are in a common axial plane, the partial sections 38 can be screwed and/or welded to the shaft 12 in a rotationally fixed manner.

List of reference signs

[0100]

10	Braking device
12	Shaft
14	Brake disc
15	Braking surface
16	Bearing
18	Friction element
20	Brake spring element
22	Holding device
23	Support bar
24	Transmission arrangement
26	Actuating means

28	First lever arm
30	Second lever arm
32	Pivot joint
34	return spring
5 36	Friction body
38	Section of a brake disc
40	Connecting means
42	Outer section
44	Intermediate section
10 E	Main extension plane

Claims

- 15 1. Braking device for braking a shaft (12) of an escalator, the braking device comprising a brake disc (14), designed for being rotationally fixed attachment to the shaft (12) of the escalator, the brake disc (14) having at least one braking surface (15) with a respective main extension plane (E);

at least one friction element (18) pivotally mounted perpendicular to the main extension plane (E) for frictionally applying a braking force to the at least one braking surface (15); and
an actuating means (26) for spacing the at least one friction element (18) from the at least one braking surface (15) and/or applying the at least one friction element (18) to the at least one braking surface (15).
- 20 2. Braking device according to claim 1, wherein the braking device (10) comprises at least one brake spring element (20) for applying a spring force to the at least one friction element (18) in the direction of the at least one braking surface (15) to apply the braking force to the at least one braking surface (15) via the at least one friction element (18); wherein in particular the spring force of the brake spring element (20) is configured to act substantially perpendicular to the main extension plane (E).
3. Braking device according to claim 1 or 2,

wherein the at least one friction element (18) is configured to be actuated by an actuating force generated by the actuating means (26) for spacing the at least one friction element (18) from the at least one braking surface (15), wherein in particular the actuating force of the actuating means (26) is directed parallel to the main extension plane (E); and/or
wherein the at least one friction element (18) is configured to be actuated by a clamping force generated by the actuating means (26) for acting on the at least one friction element (18) on the at least one braking surface (15), wherein in particular the clamping force of the actuating means

(26) is directed parallel to the main extension plane (E).

4. Braking device according to at least one of the preceding claims,

wherein the actuating means (26) is operatively connected to the at least one friction element (18) via a transmission arrangement (24); or the actuating means (26) being operatively connected to the at least one friction element (18) via a transmission arrangement (24) and the transmission arrangement (24) comprising a knee lever with at least one first lever arm (28) and at least one second lever arm (30) for applying a force to the at least one friction element (18), wherein the knee lever is rotatably mounted on the at least one friction element (18); or the actuating means (26) is operatively connected to the at least one friction element (18) via a transmission arrangement (24), and wherein the transmission arrangement (24) comprises a knee lever with at least one first lever arm (28) and at least one second lever arm (30) for applying a force to the at least one friction element (18), wherein the knee lever is rotatably mounted on the at least one friction element (18), wherein the first lever arm (28) is formed as a first pair of lever arms from two lever arms extending away from the second lever arm (30).

5. Braking device according to claim 4, wherein the second lever arm (30) rests indirectly or directly on the first lever arm pair of the first lever arm (28) at a pivot joint (32), wherein the lever arms of the first lever arm pair are rotatably connected to each other at the pivot joint, wherein the second lever arm (30) cooperates frictionally with the first lever arm pair of the first lever arm (28) at the rotary joint (32) to transmit an actuating force of the actuating means (26) and to space the at least one friction element (18) from the at least one braking surface (15).

6. Braking device according to claim 5, wherein the transmission arrangement (24) comprises a return spring (34) at the pivot joint (32) of the knee lever for applying a return force to the knee lever, wherein the return spring (34) is configured and arranged to counteract the actuating force at the pivot joint (32) applied by the actuating means (26).

7. Brake device according to claim 5 or 6,

wherein the second lever arm (30) on the pivot joint (32) transmits the actuating force of the actuating means (26) to the first lever arm pair against the restoring force of the restoring spring

(34);

wherein in particular the return spring (34) is configured such that in a braking state of the braking device (10), in which the at least one friction element (18) applies the braking force to the at least one braking surface (15), it does not apply a return force to the second lever arm (30) or to the first lever arm pair; and wherein the spring force of the at least one brake spring element (20) for acting on the at least one friction element (18) is greater than the return force of the return spring (34).

8. Braking device according to at least one of claims 4 to 7, wherein the knee lever is rotatably mounted on the at least one friction element (18) and is connected to the at least one friction element (18) via at least one connecting means (40), wherein the at least one connecting means (40) is immovably connected to the at least one friction element (18) at at least one outer section (42), and wherein the at least one connecting means (40) is rotatably connected to the first lever arm (28) at an intermediate section (44).

9. Braking device according to at least one of claims 2 to 8, wherein the braking device (10) comprises at least one holding device (22) for unilaterally supporting the at least one brake spring element (20), wherein the holding device (22) is immovably connected to a frame of the escalator and/or a building component surrounding the escalator.

10. Braking device according to claim 8 or 9, wherein the braking device (10) is configured substantially mirror-symmetrically on the axial side of the brake disk (14), wherein the braking device (10) comprises two friction elements (18) for axially applying a braking force to the respective braking surface (15) of the brake disk (14) on both sides, and each of the lever arms of the first pair of lever arms (28) is connected to a respective connecting means (40) of the respective friction element (18).

11. Braking device according to at least one of the preceding claims 4 to 10,

wherein the lever arms of the first lever arm pair of the first lever arm (28) in a non-braking position in which the at least one friction element (18) does not apply the braking force to the at least one braking surface (15) include an obtuse angle between 170 degrees inclusive and 180 degrees inclusive, in particular an obtuse angle between 175 degrees inclusive and 180 degrees inclusive; and/or wherein the lever arms of the first pair of lever

arms of the first lever arm (28) include an obtuse angle between 100 degrees inclusive and 120 degrees inclusive, in particular an obtuse angle between 110 degrees inclusive and 120 degrees inclusive, in a braking position in which the at least one friction element (18) applies the braking force to the at least one braking surface (15).

12. Braking device according to at least one of the preceding claims, 10

comprising one or more friction elements (18), which are each configured to apply the braking force to the brake disc (14) on one side or axially on both sides; and/or 15
wherein the brake disc (14) is configured in multiple parts; and/or
wherein the at least one friction element (18) is configured as a perforated disc, in particular as a partial section of a perforated disc. 20

13. Braking device according to at least one of the preceding claims, 25

wherein the at least one friction element (18) is pivotally mounted on a bearing (16) and wherein the actuating force and/or the clamping force of the actuating means (26) acts/act on the friction element (18) at a distance from the bearing (16). 30

14. Braking device according to at least one of the preceding claims, 35

wherein at least:

- the transmission arrangement (24) and
- force applying means, particularly the at least one brake spring element (20), configured for applying a force to the at least one friction element (18) in the direction of the at least one braking surface (15) to apply the braking force to the at least one braking surface (15) via the at least one friction element (18), 40
- and particularly a transmission arrangement force applying means, configured to apply a force on at least one of the lever arms of the transmission arrangement (24) to move the at least one lever arm to actuate the at least one friction element (18) to apply a force to the at least one braking surface (15) of the brake disk (14), 45

are configured to provide that the actuating force of the actuating means (26) is smaller than the braking force applied to the 50
55

at least one braking surface (15) of the brake disk (14).

15. Escalator with a braking device (10) according to one of the preceding claims, wherein the braking device (10) acts on a shaft (12) of the escalator.

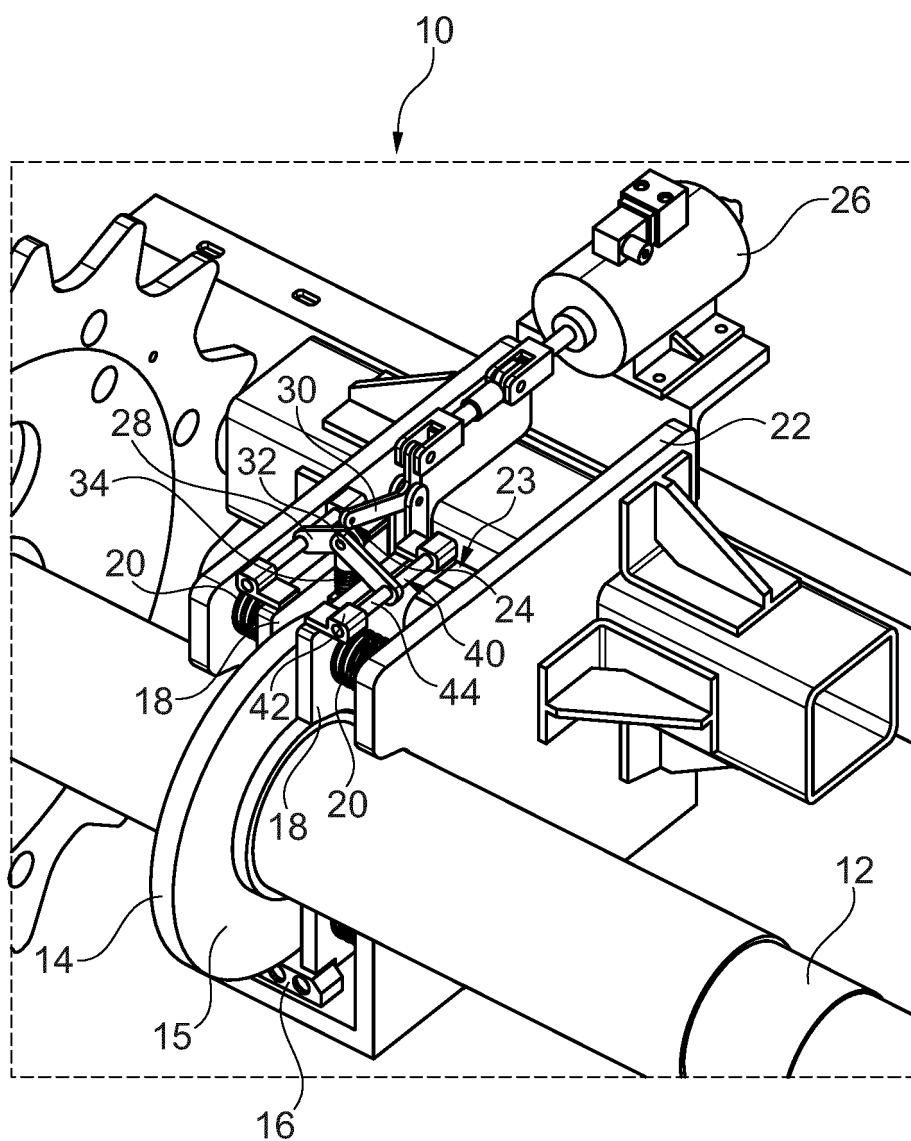


Fig. 1

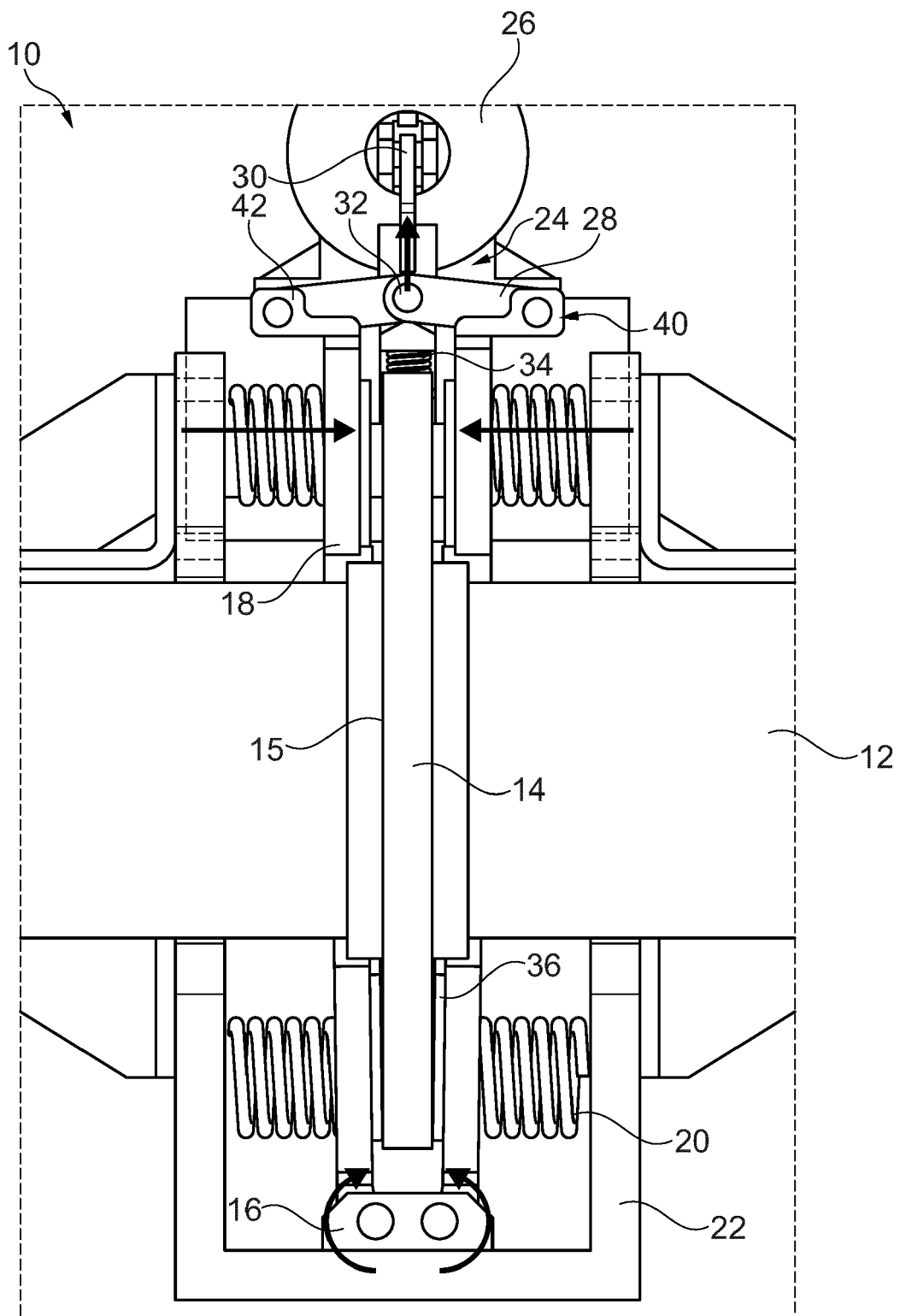


Fig. 2

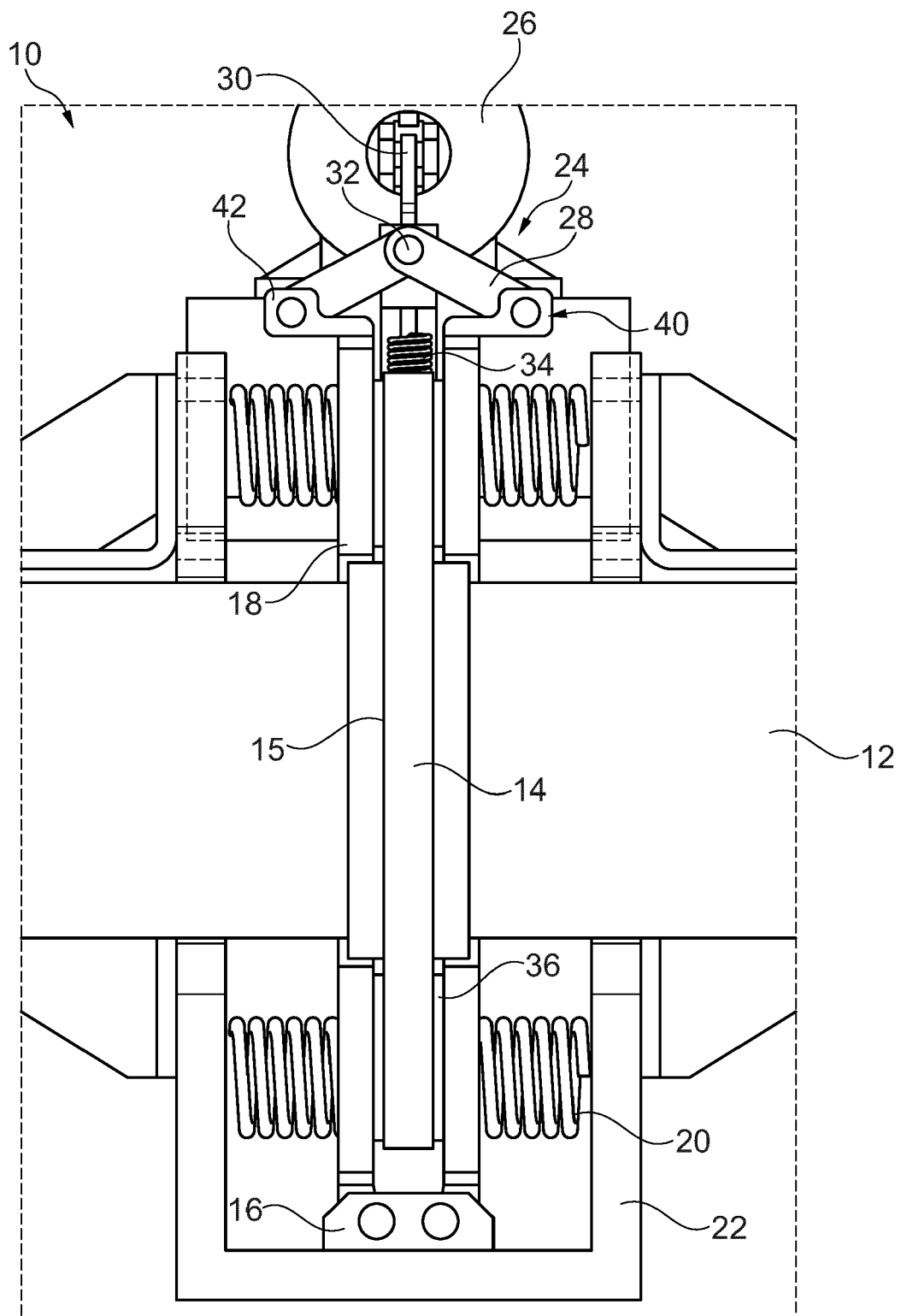


Fig. 3

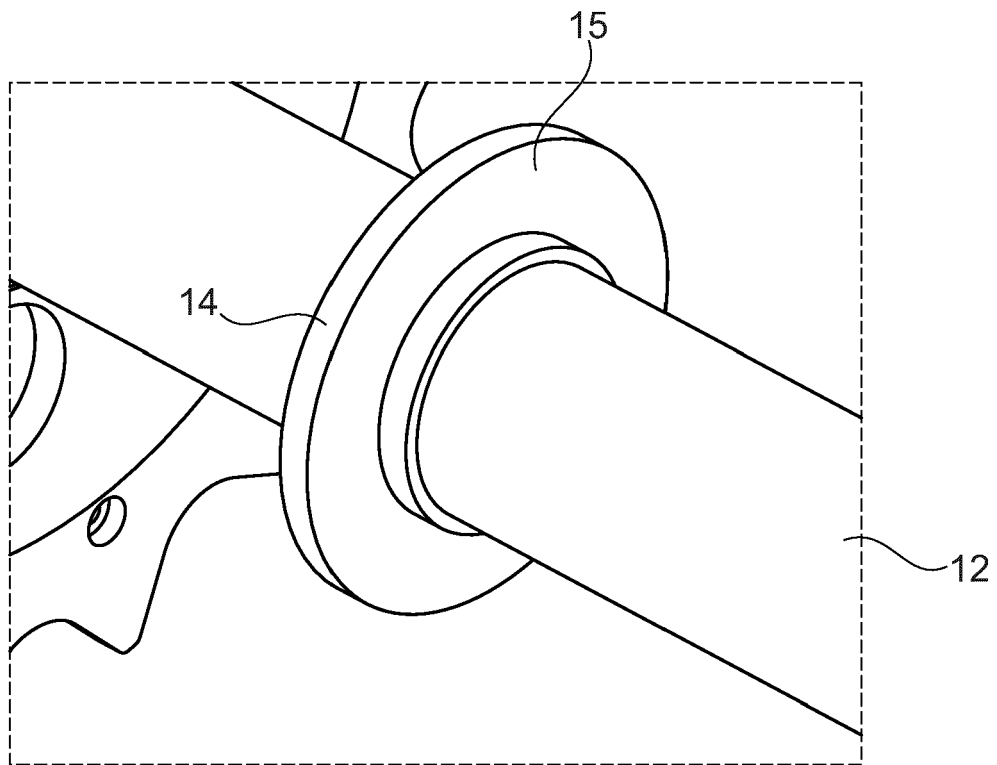


Fig. 4

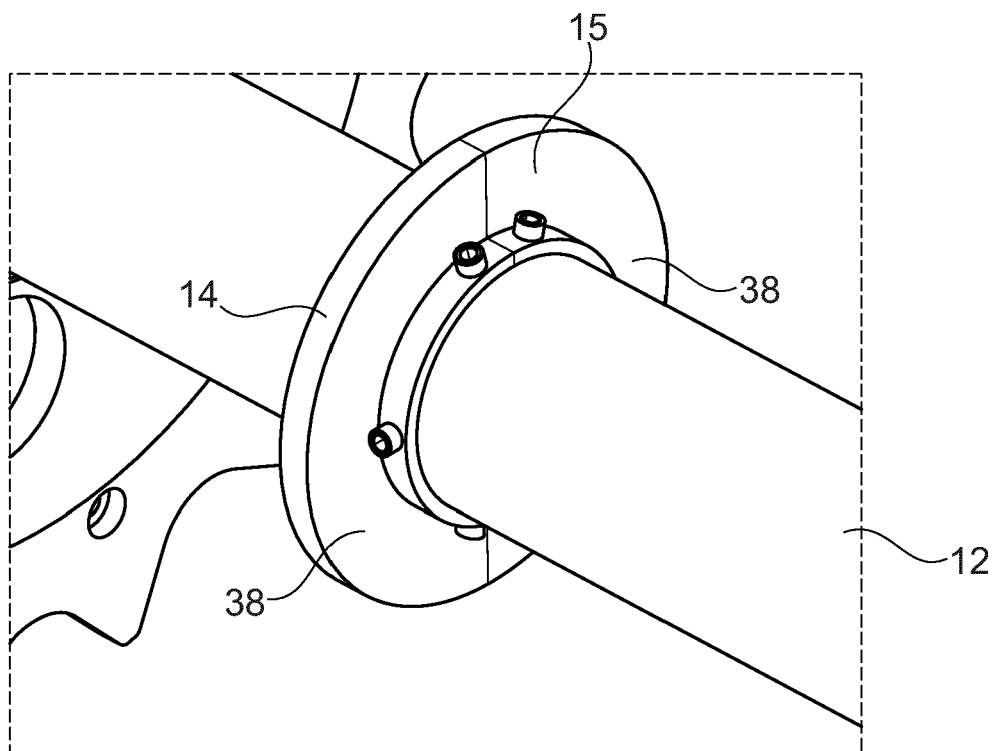


Fig. 5



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EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 3 866 725 A (GREUTTER WILFRIED) 18 February 1975 (1975-02-18)	1-3, 12-15	INV. B66B29/00
A	* columns 1-5; figure 1 * -----	4-11	
X	DE 24 54 060 A1 (ORENSTEIN & KOPPEL AG) 20 May 1976 (1976-05-20)	1-3, 15	
A	* pages 1-6; figures 1-3 * -----	4-14	
A	JP 2014 055620 A (HITACHI LTD) 27 March 2014 (2014-03-27) * the whole document * -----	1-15	
			TECHNICAL FIELDS SEARCHED (IPC)
			B66B
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 21 June 2023	Examiner Lohse, Georg
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

EP 23 38 2081

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

21-06-2023

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3866725 A	18-02-1975	AU 467412 B2	27-11-1975
		BE 802717 A	24-01-1974
		CA 982958 A	03-02-1976
		CH 537539 A	31-05-1973
		DE 2337397 A1	07-02-1974
		DK 135182 B	14-03-1977
		ES 417287 A1	01-04-1976
		FI 56887 B	31-12-1979
		FR 2193755 A1	22-02-1974
		GB 1377917 A	18-12-1974
		IT 991406 B	30-07-1975
		NL 7310362 A	29-01-1974
		NO 137855 B	30-01-1978
		SE 387099 B	30-08-1976
		TR 17820 A	13-04-1976
		US 3866725 A	18-02-1975
		YU 204673 A	28-02-1981
DE 2454060 A1	20-05-1976	DE 2454060 A1	20-05-1976
		JP S5172086 A	22-06-1976
JP 2014055620 A	27-03-2014	CN 103663075 A	26-03-2014
		JP 5841923 B2	13-01-2016
		JP 2014055620 A	27-03-2014