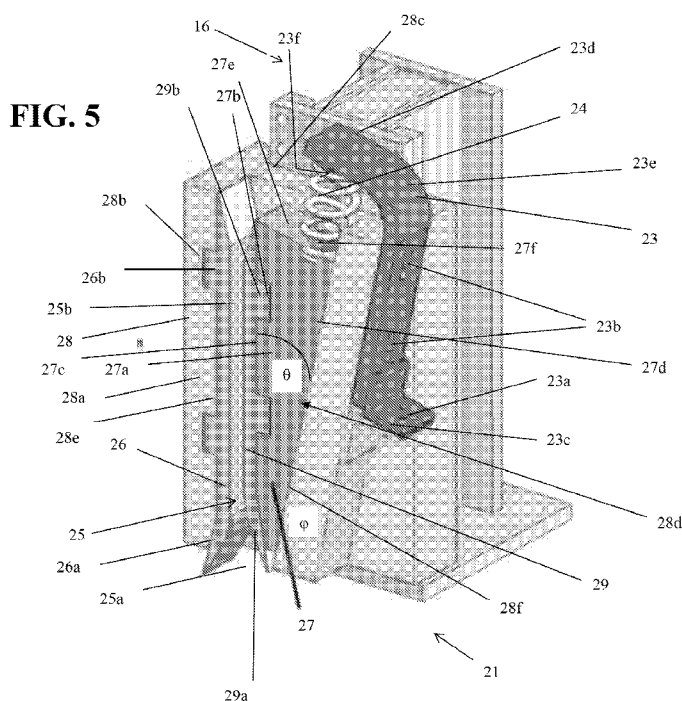


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(54) Title: CONVEYANCE CATCH APPARATUS



(57) Abstract: A conveyance apparatus can include a conveyance catch mechanism (15) that has one or more catch devices (21). The catch devices (21) can be configured to hold a conveyance device (e.g. a skip, a car, etc.) that may move adjacent to a frame (4) via a conveyance system (3) to prevent the conveyance device (7) from accidentally free falling. Each catch device (21) can be connected to a beam, rail or other structure of a frame (4) of the conveyance system (3). The conveyance catch apparatus can also include cleaning devices (31) configured to clean portions of the conveyance device (7) prior to those devices being engaged by the one or more catch devices (21). The conveyance catch apparatus can be sized and configured for utilization in conjunction with mine shaft conveyance systems or other types of conveyance systems.

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CONVEYANCE CATCH APPARATUS

FIELD OF THE INVENTION

The present invention relates to a conveyance catch apparatus. More particularly, the present invention relates to conveyance catch devices (e.g. a conveyance catch, a conveyance catch mechanism including one or more conveyance catches, etc.) that can be utilized as a safety device that can be used to help prevent a conveyance from accidentally falling down a shaft (e.g. a mine shaft, etc.) due to a mechanical malfunction, suspension rope failure, weather event (e.g. high wind conditions, a storm, etc.) or other type of emergency situation (e.g. user error causing a significant safety problem with the conveyance, a malfunction resulting in over winding of a conveyance, etc.).

BACKGROUND OF THE INVENTION

Mine shafts often utilize a conveyance system for conveying personnel and materials from an upper part of the mine shaft to a lower part of the mine shaft or vice versa. Conveyance systems can utilize one or more safety mechanisms. Examples of conveyance systems that may include at least one safety feature can be appreciated from U.S. Patent Nos. 2,122,943, 2,555,041, 2,797,834, 3,960,408, 4,444,293, 4,601,607, and 8,950,569, U.S. Patent Application Publication Nos. 2015/0360907 and 2016/0122160, Chinese Patent Publication No. CN102582633A, and International Patent Publication No. WO 2017/190235. Often, conventional conveyance systems include retractable pawls permanently mounted to a headframe that retract as the conveyance ascends past them but remain extended and catch upon lugs or catch plates to prevent downward motion of a conveyance in the event the conveyance is overwound. These retractable pawls can provide limited fallback of the conveyance in an emergency situation so the conveyance can be prevented from free-falling down the mine shaft.

SUMMARY OF THE INVENTION

I have determined that the conventional retractable pawl device can have significant drawbacks for a conveyance system. For example, I have determined that these pawls take up a significant amount of space, which can only permit a limited number of design options for where such a device can be mounted. These limited options can prevent conveyance designs in which multiple different conveyance skips may be moved adjacent to each other (e.g. one ascending while another descends). Moreover, the size of the conventional pawl-based device can add a lot of weight to a conveyance system, which can reduce the load-carrying capacity of the conveyance system and result in operational inefficiencies.

Further, conventional catch gear systems often catch a skip at defined spaced apart intervals (e.g. vertically spaced apart locations). If the skip stops its vertical ascent between these defined intervals, it will experience a free fall due to gravity to the next lowest catch point. During this free fall, the skip can accelerate until it reaches the next lowest catch point due to gravity, which can greatly increase the force that the next lowest catch point is required to support to hold the skip and prevent further free-fall of the skip. Consequently, this fall-back can create significant loads that act on the skip, catch gear, and supporting frame structure (e.g. steel structure of the supporting frame). The design of the supporting frame and other elements must be designed to safely address such significant loads, which increases the costs of such components.

I have developed a catch apparatus for a conveyance system that can be configured in different embodiments to meet a particular set of design criteria that can address one or more of these shortcomings. Many such embodiments can address all of these shortcomings. In embodiment of the catch apparatus, a catch mechanism can include a catch device that is

configured to grab a conveyance device (e.g. a skip, a car, a trolley, a cage/counterweight, or other type of conveyance, etc.) after it has reached its peak ascent or at a location that is relatively near its peak ascent. The catch device can be configured to grab and hold the conveyance device automatically and immediately upon grabbing the conveyance device so that there is no free-fall of the conveyance device and no fall-back distance that will affect the conveyance device being held by the catch device. By preventing any type of significant free-fall or fall-back, the loads applied to the conveyance device, catch mechanism, and frame of a conveyance system can be greatly reduced. Such embodiments can be used in conjunction with a conveyance system that has other safety features such as arrestors and a crash beam to help improve the safety of conveyance system operations while also permitting such systems to be built and/or maintained at a lower cost.

Some embodiments of the catch device can be provided that can be retrofitted into a pre-existing conveyance system. Such a retrofit can include installing catch devices in a conveyance system as part of a catch mechanism for the conveyance system that may include other catch elements of conveyance device safety control elements (e.g. arrestors, etc.).

Some embodiments of the catch apparatus can include a catch mechanism that has one or more catch devices. Each catch device can include a frame element attachment body sized and configured to be attached to a frame of a conveyance system. The frame element attachment body can define a catch member receiving opening. A wedge body can be positionable in the catch member receiving opening to at least partially define a gap into which a catch member of a conveyance device is passable. The wedge body can be configured to engage the catch member when the catch member passes into this gap.

Some embodiments of the catch device can include a first spring positioned adjacent the wedge body. The first spring can be provided to help account for environmental parameters that could affect operation of the catch device to help ensure a reliable function of the wedge body for engaging the catch member. Such environmental factors can include corrosion from wear and the exposure to the environment (e.g. rust formation, etc.), grime accumulation due to non-use for significant periods of time (e.g. buildup of dust, dirt, etc.), and other factors. The first spring can be configured to resiliently bias the wedge body to keep the wedge body positioned in the catch member receiving opening in response to the catch member passing into the gap to facilitate the wedge body engaging the catch member within the gap.

. In some embodiments, the wedge body can directly contact a catch member within the gap to hold the catch member. In other embodiments, the catch device can include a first abutting body attached to a first side of the wedge body to directly abut the catch member when the catch member is passed into the gap. There may also be an abutting body attached to a first side of the frame element attachment body to directly abut the catch member when the catch member is passed into the gap. This abutting body of the frame element can be considered a first abutting body when no abutting body is provided on the first side of the wedge body or could be considered a second abutting body if there is an abutting body on the first side of the wedge body. Of course, the abutting body on the first side of the wedge body could alternatively be considered a second abutting body and the abutting body of the frame element could be considered the first abutting body.

The wedge body can have a number of different wedge type shapes. In some embodiments, the wedge body can be a generally triangular shaped body. The wedge body can have a first side that extends at a pre-selected angle from a second side that is opposite the first

side. In some embodiments, this pre-selected angle can be greater than 0° and less than or equal to 45° .

In embodiments that utilize a first spring, the first spring can be a coil spring, a torsion spring, an elastomeric spring, a pneumatic spring, or other type of spring. In some embodiments, the first spring can include or have a spring body having a first length. The spring body can be compressible in response to the catch member passing into the gap to a second length that is shorter than the first length.

Embodiments that utilize a first spring can also include a spring coupling body having a first end attached to the frame element attachment body and a second end positioned above an upper side of the wedge body. The second end of the spring coupling body can be attached to a second end of the spring. The first end of the spring can abut or engage the upper side of the wedge body.

The frame element attachment body can be configured to facilitate attachment to a frame element. In some embodiments, the frame element attachment body can be configured so that the frame element attachment body is moveable laterally relative to the frame element when the frame element attachment body is attached to the frame element.

In some embodiments, the wedge body has a first side that has a plurality of grooves and the frame element attachment body defines the catch member receiving opening such that there are a plurality of grooves defined in the frame element attachment body that are in communication with the catch member receiving opening. In such embodiments, the catch device can also include a first abutting body having a plurality of first projections positioned in the grooves of the frame element attachment body for attachment to the frame element attachment body to directly abut the catch member when the catch member is passed into the

gap. A second abutting body having second projections that are positioned in the grooves of the wedge body for attachment to the wedge body to directly abut the catch member when the catch member is passed into the gap can also be included in such embodiments.

Embodiments of the catch apparatus can include other elements in addition to a catch device. For instance, embodiments can include at least one cleaning device positionable on the frame element below the catch device to abrade or clean opposed surfaces of the catch member before the catch member is passed into the gap. A catch mechanism can include the cleaning device(s) and catch device(s) as well as other elements of a catch apparatus.

A conveyance system is also provided. The conveyance system can include an embodiment of the conveyance apparatus, a conveyance mechanism and/or a conveyance device. The system can also include a frame defining a pathway conduit for a conveyance device so that the conveyance device is vertically moveable within the pathway conduit.

A method of providing a catch apparatus is also provided. The method can include installing an embodiment of the catch apparatus onto a frame element of the frame of a conveyance system adjacent to a pathway conduit for a conveyance device, passing the conveyance device upwardly along the pathway conduit such that a catch member of the conveyance device passes into the gap of each conveyance device, and each catch device engaging the catch member via the wedge body engaging the catch member in the gap to prevent the catch member from moving downwardly out of the gap.

Embodiments of the method can also include other steps. For instance, embodiments of the method can also include the first spring compressing in response to the catch member passing into the gap, removing the first spring from the catch device and/or releasing the preload of the first spring to release the catch member from the gap, and lowering the conveyance device after

the first spring is removed and/or the spring preload is released, and reattaching the first spring to the catch device after the conveyance device is lowered. Embodiments of such a method may be utilized for embodiments that utilize a catch device that includes the first spring.

Other details, objects, and advantages of the invention will become apparent as the following description of certain present preferred embodiments thereof and certain present preferred methods of practicing the same proceeds.

BRIEF DESCRIPTION OF THE DRAWINGS

Exemplary embodiments of a conveyance catch apparatus, a conveyance catch mechanism, and a catch device, are shown in the accompanying drawings and certain exemplary methods of practicing the same are also illustrated therein. It should be understood that like reference numbers used in the drawings may identify like components.

Figure 1 is a schematic illustration of a first exemplary embodiment of a conveyance system having a first exemplary embodiment of a conveyance catch apparatus.

Figure 2 is a cross-sectional view of the exemplary conveyance catch mechanism of the first exemplary embodiment of the conveyance catch apparatus. The catch mechanism can include one or more catch devices as well as other structure and elements for a catch apparatus.

Figure 3 is a fragmentary perspective view of the exemplary conveyance catch mechanism of the first exemplary embodiment of the conveyance catch apparatus with portions of the frame removed to better illustrate exemplary catch devices of the exemplary conveyance catch mechanism.

Figure 4 is a schematic fragmentary view illustrating the exemplary conveyance catch mechanism of the first exemplary embodiment of the conveyance catch apparatus aligned with

the exemplary cleaning devices for cleaning at least one clamping surface of a catch member of a conveyance device subsequent to that catch member being held by the catch device.

Figure 5 is an enlarged perspective view of an exemplary embodiment of the catch device of the exemplary catch mechanism of the first exemplary embodiment of the conveyance catch apparatus.

Figure 6 is a flow chart illustrating a first exemplary embodiment of a method of installing and using an exemplary embodiment of a catch mechanism.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

Referring to Figures 1-5, a conveyance system 3 can be positioned for conveying material, supplies, and personnel in connection with mining operations performed in a mine shaft 1. The conveyance system 3 can include a frame 4 that extends from within the mine shaft 1 to a position that is above the ground surface 2 that is outside of the mine shaft 1. The conveyance system 3 can be configured to move multiple conveyance devices such as a first conveyance device 7a and a second conveyance device 7b from adjacent the ground surface 2 and/or a dump station 9 to a lower position within the mine shaft (e.g. a load station, a bottom of the mine shaft, etc.). The first and second conveyance devices 7a, 7b, can be sized and configured as cars, service cages, or other types of conveyance devices that can retain personnel and/or material for transport within the mine shaft 1. In some embodiments, each conveyance device 7 can include a service cage that can be sized to retain personnel for transport and a conveyance device platform below the service cage that is sized to retain material (e.g. ore, minerals, stone, rock, mining supplies, etc.) for transport. As yet another option, the conveyance device 7 can be configured as another type of conveyance (e.g. a trolley, a car, a cage/counterweight, etc.)

Each conveyance device 7 can be configured to be moved via at least one cable or other type of elongated member 3f that is connected to the conveyance device 7. In some embodiments, the elongated member(s) 3f may be controlled by a hoist type mechanism (e.g. a Koepe friction type hoist) to raise and lower one or more conveyance devices 7. In some embodiments, the elongated member(s) 3f (e.g. cables, ropes, etc.) can be wound and unwound via one or more hoists or other type of winding mechanism 3e (e.g. a winder, a winch, a system of winches, a system of winders, a system of hoists, a single hoist, a hoist utilizing a single drum mechanism, a double drum mechanism, a Blair Multi-Rope mechanism, etc.) for controlling the position of the conveyance device 7 and actuating motion of the conveyance device 7 along the frame 4 within the mine shaft 1.

Each conveyance device 7 can include catch members that are positioned to move along frame elements of the frame 4 as the conveyance device is moved vertically along the frame (e.g. upwards or downwards) via the hoist(s) or other type of winding mechanism 3e. Catch members of the conveyance devices 7 can be configured as a catch bar, catch beam, catch element, catch rod, catch plate, or other type of catch member.

The hoist(s) or other type of winding mechanism 3e can be located on the ground surface 2 and be positioned remote from the frame 4 of the conveyance system 3. The sheaves 3a can be supported on a deck of the frame 4 in an upper head region of the frame 4. The sheaves 3a may be positioned between a terminal end of each elongated member 3f that is connected to the hoist(s) or other type of winding mechanism 3e and an opposite end of the elongated member 3f (e.g. rope, cable, etc.) that is connected to a conveyance device 7. The sheaves 3a can help guide the cable(s) that are moved via the hoist(s) for facilitating the path of motion for each conveyance device that is actuated via the hoist(s).

Each conveyance device 7 can be positioned to move within the frame 4 along a predefined pathway conduit 18 that is defined by the frame. The pathway conduit 18 may be an elongated opening (e.g. a channel through which the conveyance device is passable within the frame, a defined conveyance device duct through which the conveyance device passes defined in the frame, a defined shaft within the frame through which the conveyance device is passable, other type of conveyance device passageway, etc.) that extends from an upper region of the frame 4 to a lower region of the frame 4 within the mine shaft 1. The frame 4 can be configured to fully enclose the lateral sides of the pathway conduit 18 or may be configured to have a plurality of spaced apart supports that are structured to help define the pathway conduit such that a conveyance device 7 is visible from the lateral sides of the frame 4 as the conveyance device is moved vertically along the pathway conduit 18.

Each pathway conduit 18 can be defined by a plurality of spaced apart frame elements 16 of the frame. Catch members of each conveyance device 7 can be positioned to run along a respective one of the frame elements 16 of the frame 4 that define the pathway conduit 18 for the conveyance device 7 when the winding mechanism 3e is actuated to move the conveyance device vertically upwards or downwards along the pathway conduit 18. In some embodiments, the pathway conduit 18 can be polygonal in cross-sectional shape (e.g. rectangular or square in shape, hexagonal in shape, etc.) or may have another type of cross sectional shape (e.g. circular in cross-sectional shape, oval in cross-sectional shape, etc.). For such embodiments, there may be multiple frame elements 16 defined by the frame that are positioned adjacent a periphery of the pathway conduit 18 to which different catch members are positionable.

For example, as may be best seen from Figure 2, a frame 4 can include a first frame element 16a, a second frame element 16b, a third frame element 16c and a fourth frame element

16c that are positioned adjacent the pathway conduit 18 so that respective catch members of a conveyance device 7 can be positioned to run along those frame elements. Each frame element 16 can be a component of the frame structure (e.g. a beam, part of a beam, part of a steel support, etc.). While four frame elements 16 are shown, it should be appreciated that there may be more than four frame elements 16 or less than four frame elements 16 in different embodiments. Each frame element 16 can be formed via multiple interconnected frame element elements (e.g. beams, rails, rods, bars, etc.).

The frame 4 can include crash beams located below the sheave deck, arrestors 3b configured to slow the speed at which a conveyance device or other type of conveyance may move upward within the overwind section 13 of the frame 4, and a catch mechanism 15 as safety features. These crash beams and arrestors 3b can be designed to try and prevent a conveyance device or other type of conveyance from becoming overwound along the frame 4 or being raised so high that it could cause a problem for the frame 4 (e.g. mechanical failure, etc.). The catch mechanism 15 can be configured to catch any type of conveyance device 7 that may pass into the overwind section 13 of the frame so that the conveyance device is prevented from free-falling out of the overwind section 13 after passing into that upper region of the frame 4.

For example, the catch mechanism 15 can include a plurality of catch devices 21 that are attached to the frame and configured to interlock with catch members of the conveyance device to catch and hold the conveyance device 7 after the conveyance device is passed along the frame into the overwind area. Each catch device 21 can be configured to automatically catch and engage the catch members to prevent the conveyance device from moving downwardly. Once engaged, the catch device 21 can be configured to prevent release of the conveyance device catch members until a user manually disengages the catch device.

As may best be seen in Figures 2 and 3, there can be a plurality of catch devices 21 attached to a frame 4 of a conveyance system 3. Each catch device 21 can be attached to a respective frame element 16 positioned by a pathway conduit 18 for a conveyance device 7. For example, a first catch device 21a can be attached to the first frame element 16a, a second catch device 21b can be attached to the second frame element 16b, a third catch device 21c can be attached to the third frame element 16c, and a fourth catch device 21d can be attached to the fourth frame element 16d. It should be understood that a catch mechanism 15 can utilize less than four catch devices 21 or more than four catch devices 21 in different embodiments. The size and weight capacity of a conveyance device 7 can be factors that help dictate how many catch devices 21 may be utilized to help ensure sufficient safety functionality of the catch mechanism 15.

Each catch device 21 can include a frame element attachment body 28 that is sized and configured for attachment to a frame element 16. The frame element attachment body 28 can include a frame element receiving aperture 28c defined on a first side of the body that is sized to facilitate positioning of the frame element attachment body on a frame element 16 for attachment to the frame element 16 via welding, fasteners (e.g. bolts, screws, rivets, etc.) and/or other types of connection mechanisms. The frame element receiving aperture 28c can be defined as a particular shaped recess, cavity, opening or other type of aperture that is sized and shaped to receive the frame element within that aperture.

The frame element receiving aperture 28c can be defined so that there is a lateral adjustability gap 28g defined in the frame element receiving aperture 28c. This lateral adjustability gap 28g can be sized to permit the frame element attachment body 28 to move laterally when attached to the frame element 16. The lateral adjustable motion that can be

provided via the lateral adjustability gap 28g can accommodate misalignment of individual catch members of a conveyance device that may exist or accommodate tolerance differences that could otherwise create an alignment issue when multiple conveyance devices are positioned to receive and catch multiple different catch members of a conveyance device. Such lateral adjustable motion can permit the catch devices 21 to function without binding due to misalignment or poor alignment issues.

The lateral adjustability function of the frame element attachment body 28 can be provided by defining the frame element receiving aperture 28c so that there is at least one lateral adjustability gap 28g (e.g. one on a first side and/or one on an opposite second side of the frame element 16 to be received within the frame element receiving aperture 28c). In some embodiments, the lateral motion that can be permitted via the lateral adjustability gap(s) 28g defined by the frame element receiving aperture 28c can be between 0.2 to 5 cm. In other embodiments, the lateral motion can be a larger range or a smaller range to meet a particular set of design criteria.

Lateral adjustability can be provided via other lateral adjustment mechanisms that replace use of any lateral adjustability gap 28g and/or work in conjunction with at least one lateral adjustability gap 28g. For instance, the frame element 16 can have a projection attached thereto that is to be received within an elongated slot defined in the frame element attachment body that is in communication with the frame element receiving aperture 28c to define a track along which the frame element attachment body 28 is moveable laterally relative to the frame element 16. As yet another example, the frame element attachment body 16 can include pivotable attachment devices for attachment to the frame element to permit lateral motion of the frame element attachment body 28 relative to the frame element. The lateral motion can be horizontal motion

that moves horizontally relative to the frame element 16. In some embodiments, the lateral motion could also include a vertical component of motion via such pivoting. But, it is contemplated that any such vertical component of motion would be relatively minimal.

The frame element attachment body 28 can also define a catch member receiving opening 28d in a second side of the body. The frame element attachment body 28 can also define a one or more grooves 28b (e.g. a single groove, a plurality of grooves, etc.) that are in communication with the catch member receiving opening at a first side 28e of the catch member receiving opening 28d. The one or more grooves 28b can be defined to be recessed relative to a more linearly extending portion 28a that helps define the catch member receiving opening 28d and extends between spaced apart grooves 28b. The frame element attachment body 28 can define the catch member receiving opening 28d so that a second side 28f of the catch member receiving opening 28d that is opposite the first side 28e having the grooves 28b is angled for positioning of a wedge body 27. The angle ϕ relative to vertical at which the second side 28f of the catch member receiving opening extends from the bottom end of the catch member receiving opening to a top end of the catch member receiving opening 28d can be in a range of greater than 0° to 45° (e.g. a 5° , a 10° , a 15° , a 25° , a 30° , a 40° , a 45° , etc.). The second side 28f of the catch member receiving opening 28d can be defined so that it is a linearly extending side that extends at this angle ϕ relative to vertical as it extends upwardly from a bottom of the catch member receiving opening 28d to a top of the catch member receiving opening 28d.

The wedge body 27 can be a wedge shaped body (e.g. a body that is triangular in shape, a body that is generally triangular in shape, a body that has a wedge-like in shape, etc.) that is positionable on the second side 28e of the catch member receiving opening. The wedge body 27 can have a first side 27c that has one or more grooves 27b defined therein. The wedge body 27

can also include a linearly extending segment. For instance, there may be a linearly extending segment that extends between first and second grooves 27b in embodiments that utilize more than one groove 27b. The wedge body 27 can have a second side 27d that is opposite its first side 27 such that the first side 27c extends at an angle θ relative to the second side 27d. This angle θ can be a pre-selected angle that is within the range of greater than 0° to 45° . (e.g. a 5° , a 10° , a 15° , a 25° , a 30° , a 40° , a 45° , etc.). In some embodiments, the range for the angle θ can be a pre-selected angle in a different range such as greater than 0° to 15° , 5° to 15° , 10° to 15° , 5° to 25° , 10° to 20° , 5° to 30° , 5° to 40° , or another angle range that is within the greater than 0° to 45° range.

In some embodiments, the angle θ can be selected to be an angle that corresponds to the angle ϕ at which the second side 38f of the catch member receiving opening extends so that the sum of these angles is a value between 80° - 100° , 85° - 95° or 98° - 92° (e.g. 90°). Such an angle selection can help define the width of a gap 25 that is to receive a catch member of a conveyance device so that the gap 25 has a pre-selected width and a pre-selected cross-sectional shape.

An upper side 27e of the wedge body 27 can extend between an upper end of the first side 27c and an upper end of the second side 27d. In some embodiments, the upper side 27e can be a top side that extends linearly between the first and second sides 27c and 27d to define a generally triangularly shaped body of the wedge body 27. The lower end of the first side 27c can be in contact with or adjacent to the lower end of the second side 27d at a bottom end of the wedge body 27 that is opposite the upper side 27e of the wedge body 27.

The second side 27d of the wedge body 27 can be positioned on the portion of the frame element attachment body 28 that defines the second side 28f of the catch member receiving opening 28d. This second side 27d of the wedge shaped body 27 can be smooth or substantially

smooth and can extend linearly in some embodiments. It should be appreciated that the second side 27d of the wedge shaped body may alternatively have a rough surface. It is also contemplated that some embodiments of the wedge body 27 may not have any grooves 27b or may only have a single groove 27b instead of a plurality of grooves 27b.

The catch device 21 can also include one or more liner abutting bodies. For instance, the catch device can include a first liner abutting body 26 and a second liner abutting body 29. Each liner abutting body can be configured to directly abut and engage a catch member of a conveyance device 7 that may pass through a gap 25 defined between the spaced apart liner abutting bodies. In other embodiments, the liner abutting bodies may not be present and the wedge body 27 and a portion of the frame element attachment body 28 can be configured to directly contact and engage the catch member of the conveyance device 7 within a gap 25 defined between these elements. The catch member of the conveyance device that is sized to pass into the gap 25 can be a catch plate, a catch bar, a catch rod, or other type of catch member that may extend from a catch member or other part of the conveyance device 7 that is sized and configured to be insertable into gap 25 for being held by the catch device 21.

The cross-sectional size of the gap 25 (e.g. its width) can be sized so that the catch member is larger than the gap 25 and will provide a force that acts on the wedge body 27 when the catch member passes upwardly through the gap 25 that is transferred to the wedge body 27 via the catch member's direct contact with the second liner abutting body 29 or the catch member's direct contact with the first side 27c of the wedge body 27. This upward force that acts on the wedge body 27 can cause the catch device 21 to automatically engage the catch member for braking and holding the catch member of the conveyance device 7 to prevent the conveyance device from moving downwardly. The wedge body 27 can impart a force that

provides sufficient friction to prevent further motion of the conveyance device downwardly. In the event arrestors or other safety feature stops upward motion of the conveyance device, the wedge body 27 can be actuated via motion of the catch member into the gap 25 to engage the catch member (either directly or via at least one liner body in embodiments utilizing one or more liner bodies). So actuated, the wedge body 27 can impart a force that increases the friction on the motion of the catch member 25 within the gap 25 to automatically hold the catch member and prevent its downward motion within the gap 25.

The automatic holding of the catch member can prevent any type of significant free-fall of a conveyance device that may occur after its upward motion is stopped (e.g. via arrestors etc.) and can avoid the need for use of multiple different intervals of catch devices for catching a free-falling conveyance device.

In embodiments that utilize a spring (e.g. a first spring 24, etc.), the embodiment can be configured so that motion of the catch member within gap 25 automatically activates a first spring 24 attached to the wedge body 27 to help cause the catch device 21 to automatically engage the catch member for braking and holding the catch member of the conveyance device 7 to prevent the conveyance device from moving downwardly. Use of a biasing mechanism such as the first spring 24 can help ensure the wedge body 27 is actuated and engages a catch member to account for corrosion issues, accumulation of grime, or other environmental factors that could affect operation of the catch device over a long period of time. For instance, catch devices may not be used often and, over a long period of time of non-use, a build-up of dust or other grime can occur as well as corrosion (e.g. rust, etc.) from environmental factors. Use of a biasing mechanism that includes a first spring 24 can help ensure that such factors do not prevent the wedge body 27 from being actuated to facilitate engagement and holding of a catch member

within gap 25. For example, the first spring 24 can be configured to help ensure that there is no delay in actuation of the wedge body 27 due to grime or corrosion.

The first spring 24 is an example of a type of biasing mechanism that can be utilized to exert a force on the wedge body 27 to allow the catch device 21 to automatically engage and hold a conveyance device 7 that may have its catch member(s) engaged by catch device(s). The first spring 24 could be a coil spring, an elastomeric spring, a torsion spring, or a pneumatic spring. It is also contemplated that the first spring 24 could be another type of spring (e.g. a hydraulic spring, etc.) or be a component of another type of a biasing mechanism.

The first liner abutting body 26 can include a lower end 26a that can extend beyond and below the catch member receiving opening 28d when the catch device is attached to a frame element 16. The second liner abutting body 29 can also include a lower end 29a that can extend beyond and below the catch member receiving opening 28d when the catch device is attached to a frame element 16. The lower ends of the first and second liner abutting bodies can help define a mouth 25a that is in communication with the gap 25 for receiving an upper portion of the catch member of the conveyance device to facilitate directing the catch member of the conveyance device (e.g. a catch element, a catch bar, a catch plate, etc.) into the gap 25 and into direct contact with the first and second liner abutting bodies 26 and 29 (or frame element attachment body and/or wedge body 27 in the event one or more liner abutting bodies are not utilized).

The first liner abutting body 26 can also include a plurality of first projections 26b that are sized and configured to be received within the grooves 28b defined in the portion of the frame element attachment body that defines the first side 28e of the catch member receiving opening 28d. The interlock between the first projections 26b and the grooves 28b can help maintain the position of the first liner abutting body 26 and also facilitate attachment of the first

liner abutting body 26 to the frame element attachment body 28 via welding, adhesion, mechanical fastening, and/or other type of connection mechanism.

The second liner abutting body 29 can also include a plurality of second projections 29b that are sized and configured to be received within the grooves 27b defined in the first side 27c of the wedge body 27. The interlock between the second projections 29b and the grooves 27b of the wedge body 27 can help maintain the position of the second liner abutting body 29 and also facilitate attachment of the second liner abutting body 29 to the wedge body 27 via welding, adhesion, mechanical fastening, and/or other type of connection mechanism.

The contacting surfaces of the first liner abutting body 26 and the second liner abutting body 29 can be smooth, substantially smooth, rough, or have another type of surface texture. For example, the surfaces of the liner abutting bodies can be dimpled, include teeth defined therein, include furrows defined therein, include a pre-selected tread profile, or other surface texture that may be designed to facilitate engagement with a portion of a catch member of a conveyance device that may be sized to pass through the gap 25.

At least one spring 24 can be connected between an upper end of the wedge body 27 and the frame element attachment body 28 via a spring coupling body 23. In some embodiments, the at least one spring 24 can only include a first spring 24. In other embodiments, there may be more than a single spring (e.g. first and second springs, more than two springs, etc.). The first spring 24 may extend along its length from the upper side 27e of the wedge body 27 to the spring coupling body 23 positioned above the wedge body 27 and above the catch member receiving opening 28d.

The spring coupling body 23 can include a first end 23c and a second end 23d. In some embodiments, the spring coupling body 23 can have an L-like shape, or J-like shape that includes

an intermediate section 23e that is curved or bent (e.g. a linear bend for defining a pre-selected angle at which the second end 23d may extend from the bent section, a curved segment, etc.).

The intermediate section can be between the first end 23c and the second end 23d of the spring coupling body 23. In some embodiments, the curved intermediate section 23e can extend from the second end 23d toward the first end 23c of the spring coupling body 23.

The first spring 24 can have a first end directly abutting the upper side 27e of the wedge body 27 and a second end that is directly attached to the second end 23d of the spring coupling body 23. The first end of the first spring 24 can be configured to mate with a particular pre-defined spring connection structure 27f that is on or in the upper side 27e of the wedge body to facilitate abutment and engagement of the first end of the first spring 24 to the upper side 27e of the wedge body. The spring connection structure 27f can include a predefined slot or recess defined in the upper side 27e and a projection that may extend within a portion of an internal channel defined by the first spring 24. In some embodiments, the projection of such a spring connection structure can be structured as a boss, a protuberance, a finger, or other type of projection. In some embodiments, the spring connection structure 27f can also be utilized to facilitate attachment between the first end of the first spring 24 and the upper side 27e of the wedge body 27. In yet other embodiments, the spring connection structure 27f can be a recess that can define a cup or pocket type opening within the upper side 27e that is sized to receive and retain the first end of the first spring 24.

In some embodiments, it is contemplated that the first end of the first spring 24 may abut a connector to attach the first end of the first spring to the upper side 27e of the wedge body. In such embodiments, the first end of the first spring can engage the wedge body 27 to provide a biasing force that acts on the wedge body 27 via the attachment provided by the connector.

The second end 23d of the spring coupling body 23 can be positioned above the catch member receiving opening 28d and above the wedge body 27. The second end of the first spring 24 can be connected to the second end 23d of the spring coupling body 23 via a spring connector structure 23f. The spring connector structure 23f can have a similar structure to the structure 27f. For example, the spring connector structure 23f of the spring coupling body 23 can include a predefined slot or recess defined in the second end 23d of the spring coupling body 23 and a projection that may extend within a portion of an internal channel defined by the first spring 24. For example, such a projection of the spring connector structure 23f of the spring coupling body can extend into an internal diameter of an upper end of the channel of the spring 24 while the projection of the spring connector structure 27f extends into the internal diameter of the lower end of the channel of the first spring 24. In some embodiments, the projection of such a spring connection structure 23f of the spring coupling body 23 can be structured as a boss, a protuberance, a finger, or other type of projection. In yet other embodiments, the spring connection structure 23f of the second end 23d of the spring coupling body 23 can be structured as a recess within the second end 23d that has a downwardly facing mouth that can define a cup or pocket type opening that is sized to receive and retain the second end of the first spring 24. In other embodiments, the second end 23d of the spring coupling body 23 can be connected to the second end of the first spring 24 via a fastener or other type of fastening mechanism.

The first spring 24 may extend along its length from the upper side 27e of the wedge body 27 to the second end 23d of the spring coupling body 23 positioned above the wedge body 27 and above the catch member receiving opening 28d. The first spring 24 can be positioned via the spring coupling body 23 to bias the wedge body 27 downwardly to help maintain the position of the wedge body 27 within the catch member receiving opening 28d. For example, the first

spring 24 can be configured and positioned so that the first spring 24 has a first length at which the spring extends between the upper side 27e of the wedge body 27 and the second end 23d of the spring coupling body 23. When a catch member is passed into the gap 25, the contact of the catch member can provide an upward force that drives the wedge body 27 upwardly due to friction and the upward motion of the catch member of the conveyance device within the gap 25. The spring 24 can be configured to compress in response to this force to a second length that is shorter than the first length. The compression of the first spring 24 can provide a biasing force via the resiliency of the spring. This biasing force of the first spring 24 provided via compression of the spring body can act on the wedge body 27 to help maintain the position of the wedge body 27 so that the wedge body 27 is kept positioned within the catch member receiving opening 28d. This biasing force can help prevent the force of the catch member moving upwardly through gap 25 from dislodging the wedge body 27. The biasing force provided by the first spring 24 can force the wedge body 27 downwardly so that the catch member within the gap 25 is automatically and actively engaged within the gap 25 so that the catch device 21 is able to engage and hold the catch member for catching the catch member to halt upward motion of the conveyance device catch member within the gap 25 and thereby also prevent downward motion of the conveyance device 7. The first and second liner abutting bodies 26 and 29 may directly contact the catch member for engagement of the catch member within the gap 25 via the biasing force of the first spring 24 and their attachments to the frame element attachment body 28 and wedge body 27. The actuation of the wedge body 27 via motion of the catch member within the gap 25 also causes the wedge body to move downwardly in the event the catch member 25 is urged to move downwardly in the gap 25. This downward urging of the catch member can result in downward motion or urging of the wedge body 27 that increases friction applied by the wedge

body 27 to increase an engagement force applied to the catch member within gap 25 to overcome such an urging of the catch member to move downwardly so that the catch member is prevented from significant downward motion and is retained and held in gap 25 in spite of the fact that gravity may act on the conveyance device of the catch member to try and urge the conveyance device and its catch members downwardly out of the gap 25. The actuation of the wedge body 27 via motion of the catch member in the gap 25 can thus result in an automatic actuation of holding of the catch member to prevent any free-fall of the conveyance device via no downward motion of the conveyance device or only a negligible slight (e.g. less than 1 mm, less than 1 cm motion, etc.) downward motion of the catch member within gap 25 before the wedge body 27 fully engages the catch member and prevents any downward motion of the catch member and conveyance device of the catch member.

In alternative embodiments that do not utilize liner abutting bodies, the first side 27c of the wedge body and a portion of the frame element attachment body 28 opposite the wedge body 27 may directly contact the catch member within the gap 25. In such embodiments, the wedge body 27 may directly contact the catch member to engage and hold the conveyance device of the catch member. The actuation of the wedge body may be driven via direct contact made between the catch member and the first side 27c of the wedge body that occurs when the catch member moves upwardly into gap 25.

The spring coupling body 23 can include a first hole 23a defined in the first end 23c of the spring coupling body 23 to facilitate attachment of the spring coupling body 23 to the frame element attachment body 28 via at least one fastener. The spring coupling body 23 can also include second holes 23b that are defined in an intermediate section (e.g. the curved intermediate section or another intermediate section between the curved intermediate section 23e and the first

end 23c). The second holes 23b can also be sized and shaped to facilitate positioning of fasteners for attachment of the spring coupling body 23 to the frame element attachment body 28. The first hole 23a and second holes 23b can be aligned with threaded holes defined in the frame element attachment body 28 for facilitating receipt of fasteners (e.g. bolts or screws etc.) for attachment of the spring coupling body 23 to the frame element attachment body 28.

The first and second holes 23a and 23b can be positioned and configured to permit a user to release the first spring 24 from the wedge body 27 by unscrewing or unbolting the fasteners via these holes. For example, bolts or other fasteners can first be loosened but not removed from the second holes 23b, then the fastener in first hole 23a can be removed and, thereafter the fasteners of the second holes 23b can be removed so that the first spring is slowly and predictably unloaded for removal of the first spring 24.

Removal of the fasteners provided via the first and second holes 23a and 23b can permit the first spring 24 to be separated from the wedge body 27 so that the biasing force provide by the first spring 24 can be removed. Once the first spring 24 is removed from the wedge body 27, the wedge body can then be removed or otherwise moved away from contact with the catch member for each and every one of the catch devices that engage catch members of a conveyance device 7 to catch the conveyance device 7 (e.g. applying an upward force on the wedge body 27 to move the wedge body 27 upwardly away from the catch member to release the catch member). Such motion can disengage the catch members within the gaps 25 of the catch devices 21 so the conveyance device can be moved downwardly and the catch members of the conveyance device 7 can be moved out of the gaps 25 and away from the catch devices 21 via actuation of the winding mechanism 3e to lower the conveyance device 7. This release activity

can occur by users to manually disengage the catch devices 21 after the emergency condition that resulted in the utilization of the catch devices 21 has been safely resolved.

After the conveyance device 7 is lowered away from the catch devices 21, the first springs 24 can be reattached to the catch devices 21 via fasteners, the spring coupling body 23, and the first and second holes 23a and 23b. For example, the sequence used to remove the first spring 24 can be reversed to reattach the first spring 24. For instance, the wedge body 27 can be repositioned in the gap 25. Then, the first spring 24 and spring coupling body can be positioned so that the first spring is above the wedge body 27 and attached via the spring connector structures 23f and 27f. Thereafter, bolts or other type of fasteners can be passed into second holes 23b. Thereafter, a fastener can be passed into first hole 23a. The fasteners in the first hole 23 and second holes 23b can then be tightened to slowly and predictably load the first spring 24 to provide the desired biasing force. In the event any of these components are found to be damaged, a new wedge body 27, new fasteners, a new first spring 24, and/or a new spring coupling body 23 can be used instead of the previously used components.

While use of a first spring 24 can help provide consistent and reliable performance of the catch device 21 over a long period of use in which corrosion or grime could affect performance of the catch device 21, it is contemplated the first spring 24 is not required. Embodiments of the catch device 21 may not need use of the first spring 24 or spring coupling body 23. For such embodiments, only a removal of the wedge body may be needed to facilitate disengagement of the catch members.

The catch mechanism 15 can also include other elements in addition to one or more catch devices 21. For example, the catch mechanism 15 can also include one or more cleaning devices 31 that can be attached to frame elements 16 below catch devices 21 to receive the catch

members of the conveyance device and clean the catch members prior to the catch members passing into the gaps 25 of the catch devices 21. Such cleaning can help improve the ability of the catch members to be engaged and held by the catch devices 21 of the catch mechanism 15.

For example, the cleaning devices 31 can include wire brushes that are connected to frame elements 16 and positioned below the catch devices 21 attached to the frame elements 16. Each set of cleaning devices 31 attached to a particular frame element 16 can be positioned so that a cleaning slot 32 is defined for receiving the catch member of the conveyance device 7 as the conveyance device is passed along the frame element to which the cleaning devices 31 are attached. The cleaning devices 31 can directly contact the catch member (e.g. catch plate, catch bar, catch rod, etc.) to abrade opposite surfaces of the catch member prior to the catch member being passed into the gap 25 of the catch device 21. This cleaning of the opposite surfaces can clean the contact surfaces of the catch member that the first and second liner abutting bodies 26, 29 contact to catch and hold the catch member. Such cleaning can help improve the ability of the catch device 21 to engage and hold the catch member by avoiding slippage that may occur due to grime, dust, water, grease, or other material that may accumulate on the catch member of the conveyance device 7 over time. It should be appreciated that such cleaning devices 31 can also be used for embodiments of the catch mechanism 15 in which catch devices that are configured to use wedge body 27 and a portion of the frame element attachment body 28 to directly contact and engage the catch member instead of liner abutting bodies.

The cleaning devices 31 can be positioned on each frame element 16 in a number of different arrangements. For example, the catch mechanism 15 can be configured so that there are multiple cleaning devices 31 positioned on a frame element to which a catch device 21 is attached at a location below the catch device 21. The arrangement of cleaning devices 31 can

include first, second, third, and fourth cleaning devices 31a, 31b, 31c, and 31d arranged in series along the frame element 16 below the catch device 21. The cleaning devices 31 can be arranged to define slots 32 that are linearly aligned so that the catch member of a conveyance device 7 is movable linearly through the slots 32 as the conveyance device is moved upwardly past the cleaning devices 31 toward the catch device 21. In some embodiments, each cleaning device 31 can include two spaced apart wire brushes that define slot 32 or can include a single wire brush that defines a slot 32 between bristles of the brush. In other embodiments, a different type of cleaning device can be utilized instead of brushes or wire brushes. It should also be appreciated that different embodiments may utilize less than four cleaning devices at each frame element (e.g. no cleaning devices, a single device, two devices, etc.) or more than four cleaning devices (e.g. five cleaning devices, more than five cleaning devices, etc.).

Each frame element 16 to which a catch device 21 is attached can include its own respective series of cleaning devices 31. For example, the first frame element 16a, second frame element 16b, third frame element 16c and fourth frame element 16d can each have a number of cleaning devices 31 (e.g. first, second, third, and fourth cleaning devices 31a-31d, etc.) attached to that frame element 16 below the catch device 21 attached to that frame element 16. For example, there may be a first set of cleaning devices 31 attached to the first frame element 16a below the first cleaning device 21a, a second set of cleaning devices 31 attached to the second frame element 16b below the first cleaning device 21b, a third set of cleaning devices 31 attached to the third frame element 16c below the third cleaning device 21c, and a fourth set of cleaning devices 31 attached to the fourth frame element 16d below the fourth cleaning device 21d.

It should be understood that embodiments utilizing more than four frame elements 16 having catch devices 21 may have additional sets of cleaning devices 31 for those additional frame elements. Similarly, there may be less than four sets of cleaning devices 31 for embodiments using less than four frame elements 16 having catch devices 21.

The cleaning devices 31 can be positioned so that they clean catch members of the conveyance device whenever the conveyance device is moved past those cleaning devices 31 (e.g. via upward motion and also via downward motion). In other embodiments, it is contemplated that the cleaning devices can be configured and positioned so that they may only functionally abrade opposed surfaces of the catch members when the catch members move upwardly through slots 32. It is contemplated that such a one-way cleaning function can be provided by positioning the cleaning devices so that abrading elements of the cleaning devices that are to contact the catch members to abrade away dirt, grime or other material (e.g. wire filaments, elongated cleaning members, etc.) are angled to abradably contact the catch member only when the catch member is moved upwardly through the slots 32 of the cleaning devices.

An exemplary method of using the catch mechanism is shown in Figure 6. In a first step 101, the catch devices 21 can be attached to frame elements 16 adjacent to a conveyance device pathway conduit 18 for installation of a catch mechanism 15. Cleaning devices 31 can also be attached to the frame elements 16 as an option for installing the catch mechanism 15. A conveyance device 7 may then be raised upwardly via a winding mechanism 3e in a second step 102 such that the conveyance device 7 passes upwardly from within the mine shaft 1 and into an overwind section 13 of the frame 4. In so doing, the catch members of the conveyance device 7 pass through slots 32 of cleaning devices 31 (if present) for abrading opposed surfaces of the catch members and thereafter can be passed into gaps 25 of the catch devices 21. The gaps 25

are sized so that the catch members contact the first and second liner abutting bodies 26 and 29 to apply an upward force that acts on the wedge bodies 27 of the catch devices 21. In embodiments of the catch devices 21 that do not use such liner abutting bodies, the catch members may instead directly contact the wedge bodies 27 to provide this upward force.

In this second step 102, the first springs 24 of the catch devices 21 can respond to the upward force applied to the wedge bodies 27 via insertion of the catch members within the gaps 25 by compressing and providing biasing forces on the upper sides 27e of the wedge bodies 27 to cause the catch devices 21 to engage and hold the catch members to stop motion of the catch members (and thus the conveyance device 7) and also hold the catch members to prevent downward motion of the conveyance device 7. In embodiments that do not utilize first springs 24, the wedge bodies 27 may instead engage the catch members within gaps 25 due to gravity in response to a downward urging of the catch members within gaps 25 after the upward motion of the conveyance device 7 is halted (e.g. via arrestors or other safety feature) in the second step 102.

After the conveyance device 7 is stopped and safety conditions are addressed, a user may separate the first springs 24 from the wedge bodies 27 in a third step 103 via the fasteners positioned in the first and second holes 23a and 23b of the spring coupling bodies 23. Once the first springs 24 are removed from the wedge bodies 27 of the catch devices 21, the conveyance device 7 can be raised slightly to take up any slack that could affect the conveyance device position and the wedge bodies 27 can then be raised or removed to disengage the catch members in the third step 103. Once the catch members are disengaged, the conveyance device 7 can be lowered via the winding mechanism 3e away from the catch bodies 21 and out of the overwind section 13 of the frame 4 in a fourth steps 104 so that the conveyance device 7 can be lowered

into the mine shaft 1 and used in future conveyance operations. Thereafter, the wedge bodies can be repositioned in a fifth step 105. The first springs 24 can also be repositioned via the fasteners or new fasteners via the first and second holes 23a, 23b of the spring coupling body 23 in the fifth step 105 for embodiments utilizing the first spring 24. In the event the wedge body 27, spring coupling body 23, first spring 24, and/or fasteners are found to be damaged, they may be replaced with new components instead of re-using the previously used components in this fifth step 105.

Embodiments of the catch devices can be sized so that they are relatively small – particularly as compared to conventional pawl catch gear devices. The catch devices 21 can therefore require significantly less space to permit a much number of design options for where such catch devices 21 can be mounted. The significant reduction in spacing can also greatly improve the number of design options for conveyance designs to permit the use of multiple different conveyance devices 7 that can be moved vertically adjacent to each other (e.g. at least one conveyance device 7 ascending while at least one other conveyance device 7 descends at the same time, etc.). The significantly smaller size of the catch devices 21 can be significantly lighter than the weight of conventional pawl based catch gears. This reduction in weight that is added to a conveyance system by use of catch devices 21 can improve the load-carrying capacity of the conveyance system and improve the operational efficiencies of the conveyance system.

Embodiments of the catch devices 21 can be configured to grab and hold the conveyance device 7 automatically and immediately upon grabbing the conveyance device so that there is no free-fall of the conveyance device 7 and/or no fall-back distance that will affect the conveyance device being held by the catch device (e.g. no fall-back distance or only a negligible fall-back distance – a negligible fall back distance can include a fall of less than 1 cm or less than 1 mm,

for example as it will have a relatively minimal (e.g. insignificant) impact on the load undertaken by the catch devices). By preventing any type of significant free-fall or fall-back, the loads or forces that may be applied to the conveyance device(s) 21, catch mechanism 15, and frame 4 of a conveyance system in emergency type situations can be greatly reduced. This feature can also reduce the size and weight requirements for other components of a conveyance system (e.g. frame, etc.) and/or improve the load-carrying capacity of the system.

It should be appreciated that different embodiments of the catch apparatus, catch mechanism, catch device, conveyance system, and methods of making and using the same can be modified to meet different sets of design criteria. For example, the number of catch devices 21 used and their size may be adjusted to meet different sets of design criteria. As another example, the presence of cleaning devices 31, number of cleaning devices 31 used, and the presence of liner abutting bodies can be adjusted to meet a particular set of design criteria. For example, only the second liner abutting body 29 may be present in some embodiments (in which case the second liner abutting body 29 can be considered a first liner abutting body). In other embodiments no liner abutting bodies may be utilized.

As yet another example, the size and shape of the wedge body 27 can be adjusted to meet a particular set of design criteria (e.g. conveyance device speeds, weights, etc.). As yet another example, the design of the frame element attachment bodies 28 and their attachment to frame elements 16 can be configured to utilize different types of fastening mechanisms to meet a particular set of design criteria. As yet another example, the type of springs used as a biasing mechanism (e.g. coil spring, elastomeric spring, hydraulic spring, etc.), the number of such springs utilized, and the means by which the springs may be connected between a wedge body

27 and the frame element attachment body 28 can be any of a number of different arrangements for meeting a particular set of design criteria.

As yet another example, it is contemplated that a particular feature described, either individually or as part of an embodiment, can be combined with other individually described features, or parts of other embodiments. The elements and acts of the various embodiments described herein can therefore be combined to provide further embodiments. Thus, while certain exemplary embodiments of a conveyance system, a conveyance catch apparatus, a conveyance catch mechanism, a catch device, and methods of making and using the same have been shown and described above, it is to be distinctly understood that the invention is not limited thereto but may be otherwise variously embodied and practiced within the scope of the following claims.

What is claimed is:

1. A catch apparatus (1) for a conveyance system (3) comprising:

a catch mechanism (15), the catch mechanism (15) comprising a catch device (21), the catch device (21) comprising:

a frame element attachment body (28) sized and configured to be attached to a frame element (16) of a frame (4) of a conveyance system (3), the frame element attachment body (28) defining a catch member receiving opening (28d); and

a wedge body (27) positionable in the catch member receiving opening (28d) to at least partially define a gap (25) into which a catch member of a conveyance device (7) is passable, the wedge body (27) configured to engage the catch member when the catch member passes into this gap (25) to hold the catch member within the gap (25).

2. The catch apparatus of claim 1, also comprising:

a first spring (24) positioned adjacent the wedge body (27), the first spring (24) configured to resiliently bias the wedge body (27) to keep the wedge body (27) positioned in the catch member receiving opening (28d) in response to the catch member passing into the gap (25) so that the catch member is engageable within the gap (25).

3. The catch apparatus of claim 2, wherein the first spring (24) includes a spring body having a first length, the spring body being compressible in response to the catch member passing into the gap (25) to a second length that is shorter than the first length.

4. The catch apparatus of claim 2, wherein the catch device (21) also comprises:

a spring coupling body (23) having a first end (23c) attached to the frame element attachment body and a second end (23d) positioned above an upper side (27e) of the wedge body (27), the second end (23d) of the spring coupling body (23) attached to a second end of the spring, the first end of the spring abutting or engaging the upper side (27e) of the wedge body (27).

5. The catch apparatus of claim 1, wherein the catch device (21) also comprises at least one of:
a first abutting body (26) attached to a first side (28a) of the frame element attachment body (28) to directly abut the catch member when the catch member is passed into the gap (25);
and
a second abutting body (29) attached to a first side (27c) of the wedge body (27) to directly abut the catch member when the catch member is passed into the gap (25).
6. The catch apparatus of claim 1, wherein the catch device also comprises:
a first abutting body (29) attached to a first side (27c) of the wedge body (27) to directly abut the catch member when the catch member is passed into the gap (25).
7. The catch apparatus of claim 1, wherein the wedge body (27) is generally triangular shaped.
8. The catch apparatus of claim 1, wherein the wedge body (27) has a first side (27c) that extends at a pre-selected angle (θ) from a second side (27d) that is opposite the first side (27c), the pre-selected angle (θ) being greater than 0° and less than or equal to 45° .
9. The catch apparatus of claim 1, wherein the frame element attachment body (28) is configured so that the frame element attachment body (28) is moveable laterally relative to the frame element (16) when the frame element attachment body (28) is attached to the frame element (16).
10. The catch apparatus of claim 1, wherein the wedge body (27) has a first side (27c) that has a plurality of grooves (27b) and the frame element attachment body (28) defines the catch member receiving opening (28d) such that there are a plurality of grooves (28b) defined in the frame element attachment body (28) that are in communication with the catch member receiving opening (28d); and wherein the catch device (21) also comprises:
a first abutting body (26) having a plurality of first projections (26b) positioned in the grooves (28b) of the frame element attachment body (28) for attachment to the frame element

attachment body (28) to directly abut the catch member when the catch member is passed into the gap (25); and

a second abutting body (29) having second projections (29b) that are positioned in the grooves (27b) of the wedge body (27) for attachment to the wedge body (27) to directly abut the catch member when the catch member is passed into the gap (25).

11. The catch apparatus of claim 1, comprising:

at least one cleaning device (31) positionable on the frame element (16) below the catch device (21) to abrade opposed surfaces of the catch member before the catch member is passed into the gap (25).

12. A conveyance system (3), the conveyance system (3) comprising:

the conveyance apparatus (1) of claim 1;

the frame (4), the frame (4) defining a pathway conduit (18) for the conveyance device (7) so that the conveyance device (7) is vertically moveable within the pathway conduit (18).

13. A method of providing a catch apparatus (1), comprising:

installing the catch apparatus (1) of claim 1 onto the frame element (16) of the frame (4) of the conveyance system adjacent to a pathway conduit for a conveyance device (7);

passing the conveyance device (7) upwardly along the pathway conduit (18) such that a catch member of the conveyance device passes into the gap (25); and

the catch device (21) engaging the catch member via the wedge body (27) engaging the catch member in the gap (25) to prevent the catch member from moving downwardly out of the gap (25).

14. The method of claim 13, wherein the catch apparatus also includes a first spring (24) positioned adjacent the wedge body (27), the first spring (24) configured to resiliently bias the wedge body (24) to keep the wedge body positioned in the catch member receiving opening (28d) in response to the catch member passing into the gap (25) to facilitate engagement of the catch member within the gap (25) via the wedge body (27), the method also comprising:

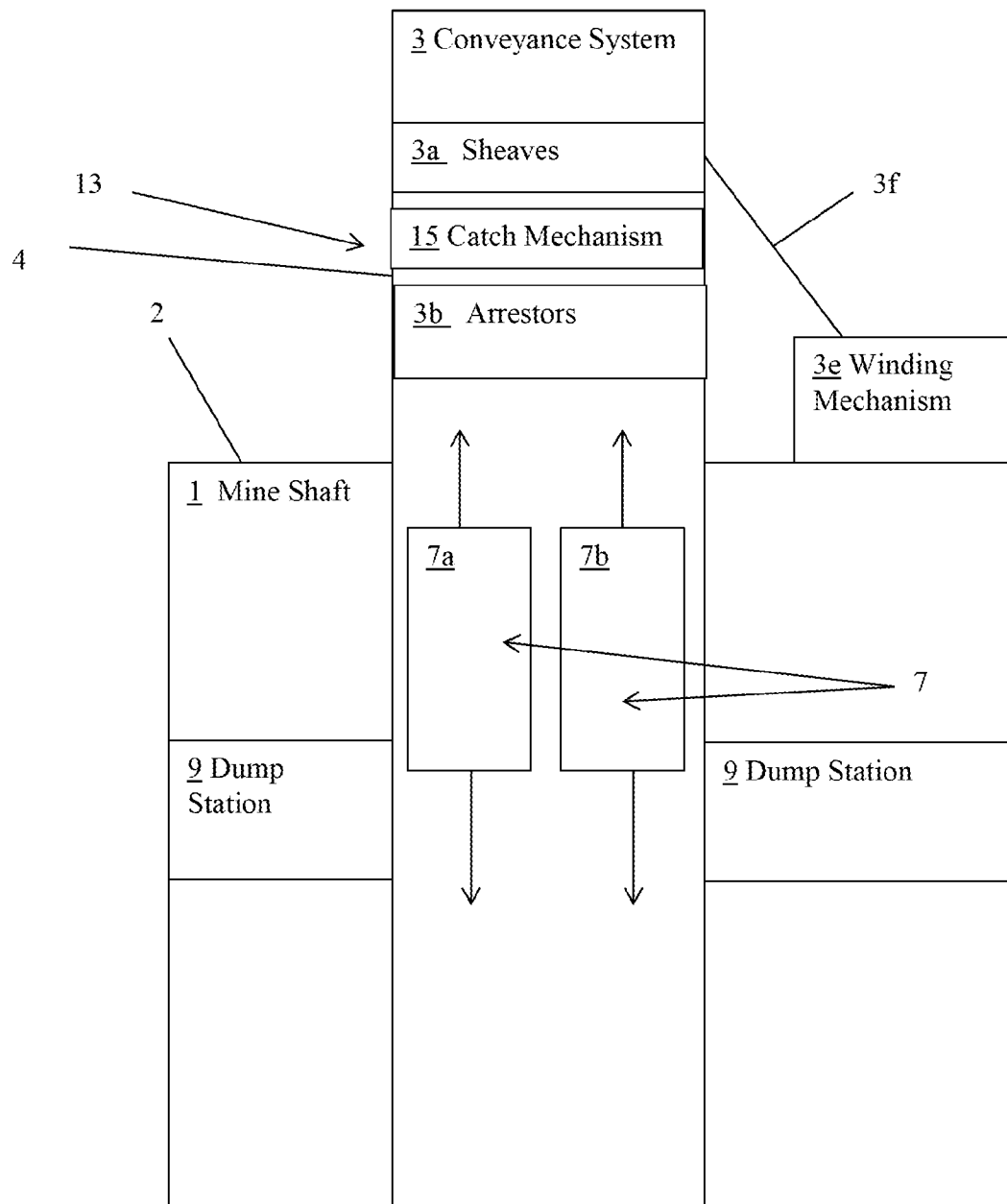
the first spring (24) compressing in response to the catch member passing into the gap (25);

removing the first spring (24) from the catch device (21) to release the catch member from the gap (25); and

lowering the conveyance device (7) after the first spring (24) is removed.

15. The method of claim 14, comprising:

reattaching the first spring (24) to the catch device (21) after the conveyance device (7) is lowered.

**FIG. 1**

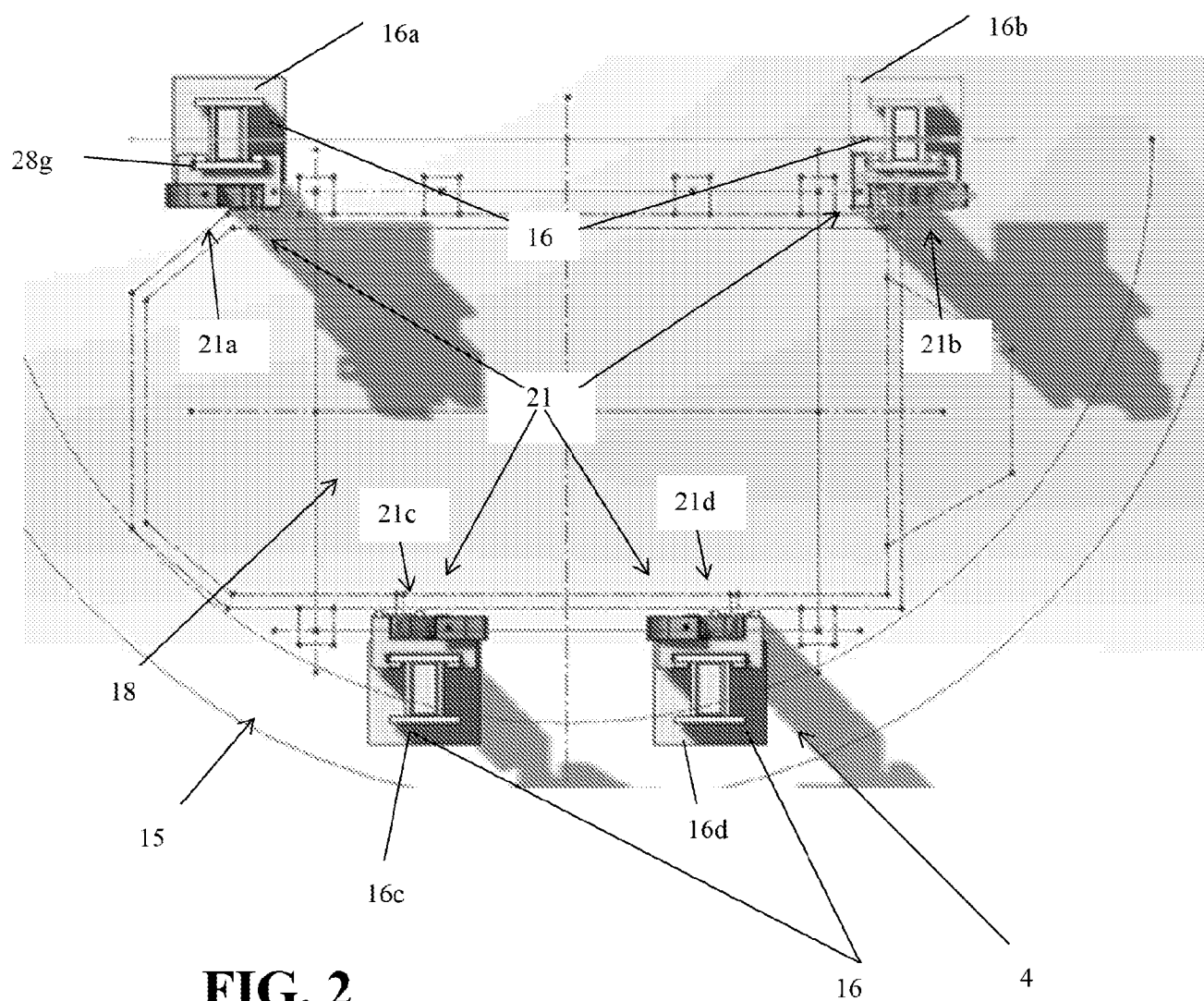


FIG. 2

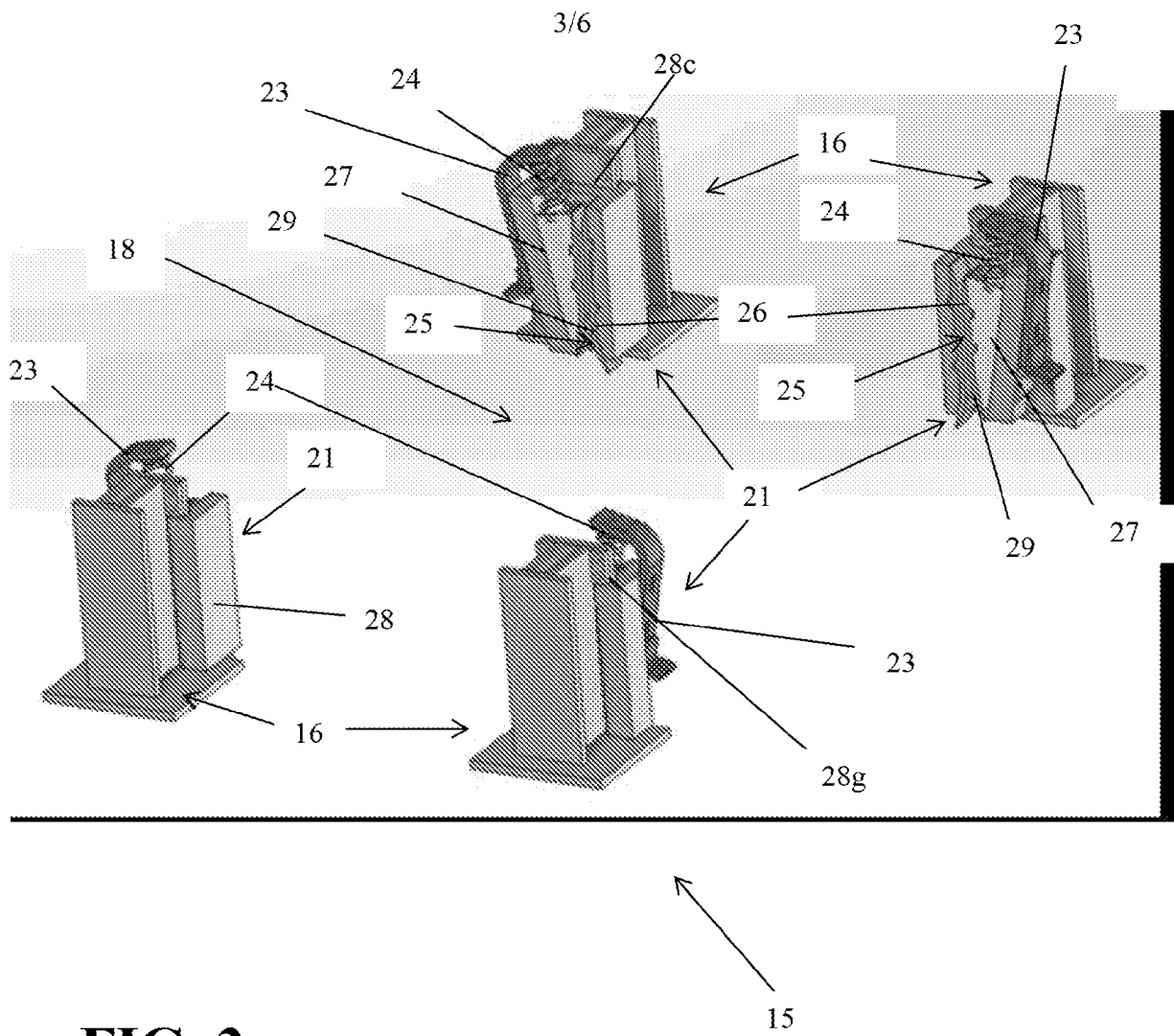


FIG. 3

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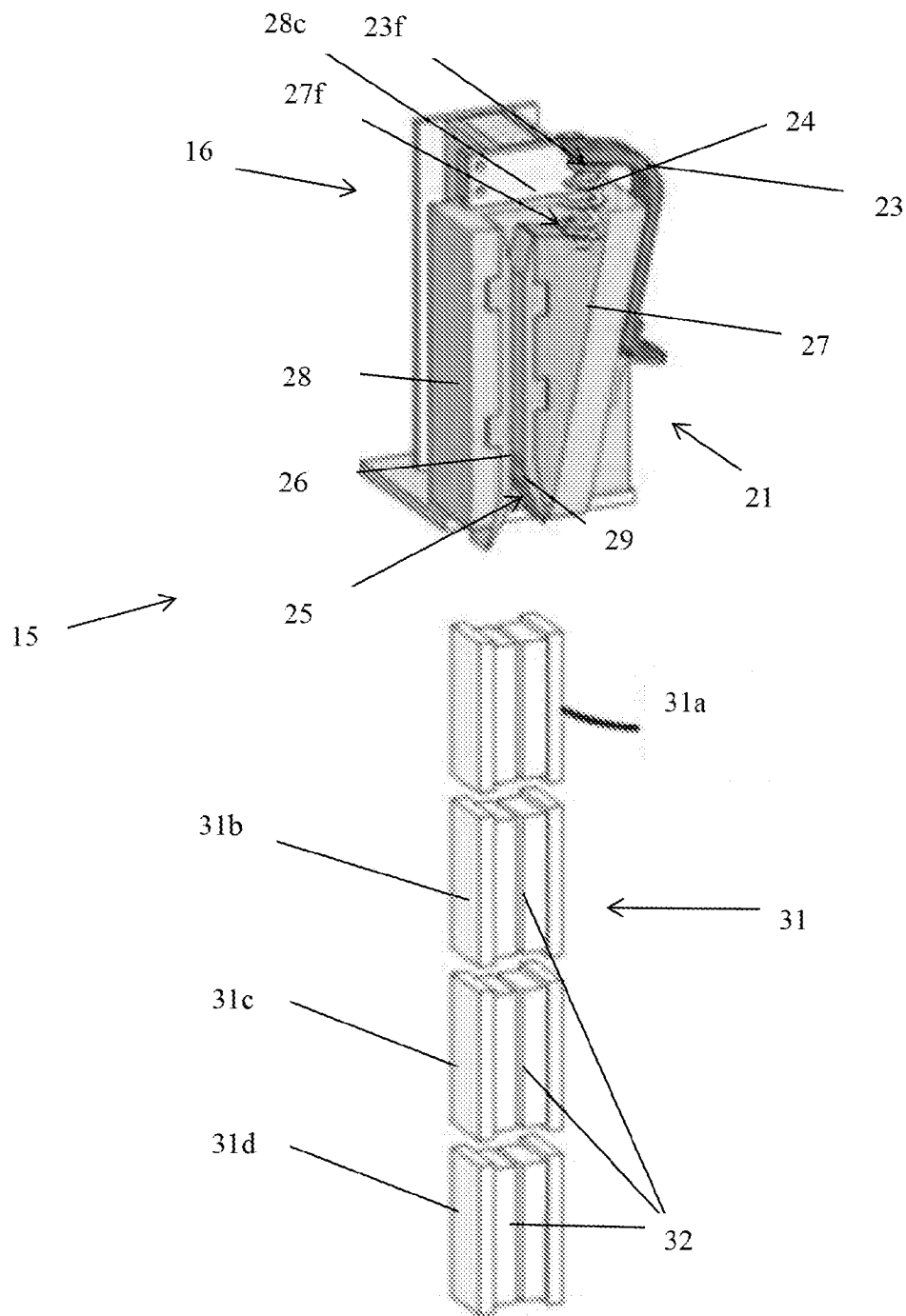


FIG. 4

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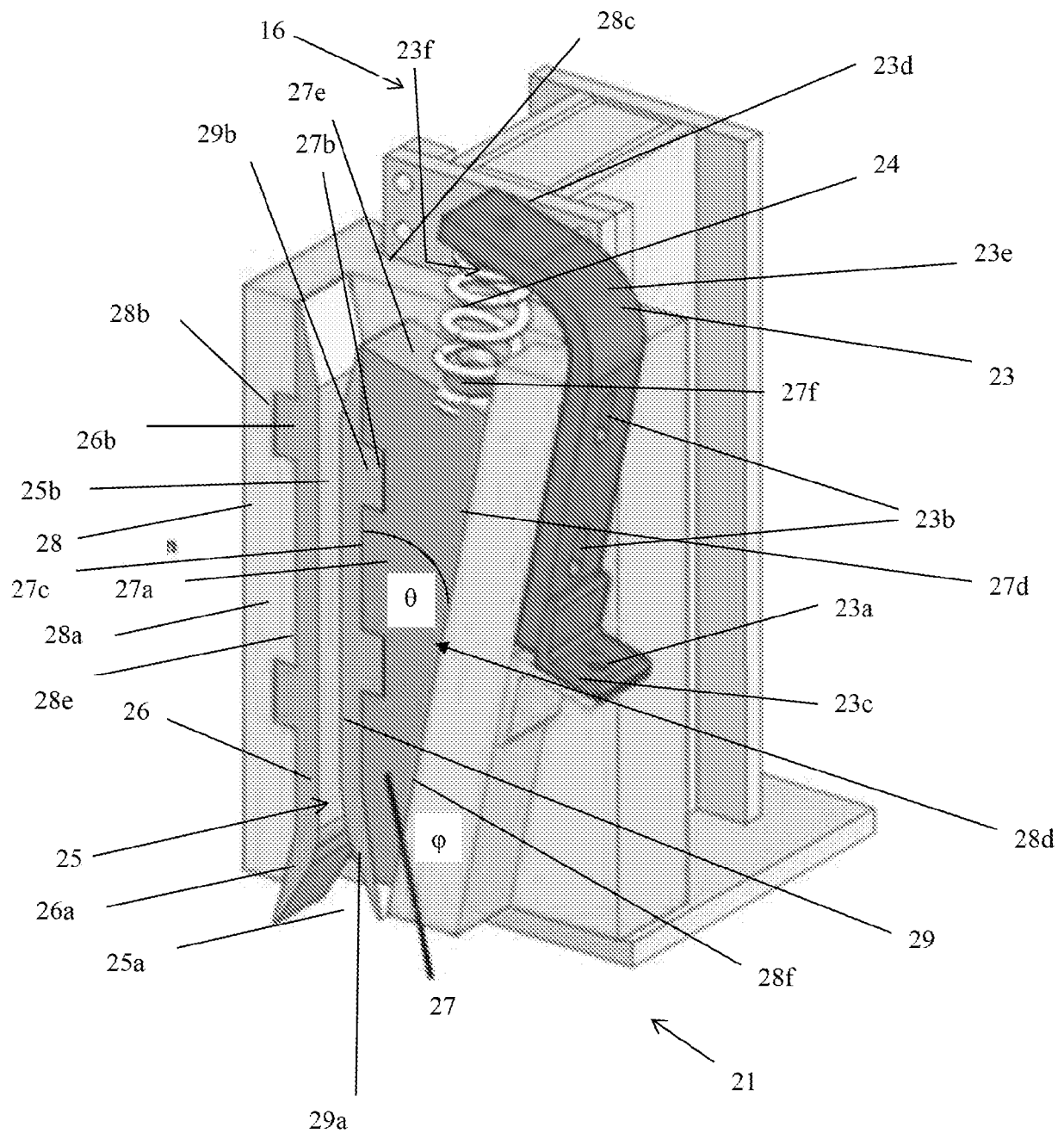
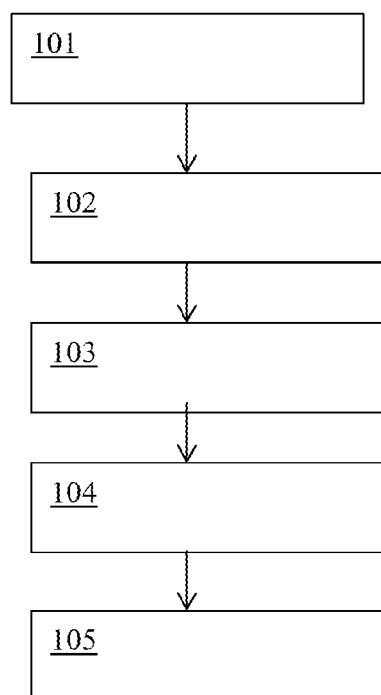


FIG. 5

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**FIG. 6**

INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2020/054349

A. CLASSIFICATION OF SUBJECT MATTER
INV. B66B5/08 B66B5/22
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B66B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	US 996 049 A (BENNETT SAMUEL GREEN [GB]) 27 June 1911 (1911-06-27) figures 1, 2 page 1, lines 85-105 -----	1,2,5-9, 12-15 3,4,10, 11
X	US 1 581 459 A (LINDQUIST DAVID L) 20 April 1926 (1926-04-20) figures 1-7 page 2, lines 17-21 page 5, lines 13-46 -----	1-3,6-9
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☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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