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(54) **Fall-arrest safety device.**

(57) A fall-arrest safety apparatus comprising a cable (5) wound onto a drum (2) has a fixed cable guide (25) and a stop (26) which is secured to the cable (5) near its tail end. The guide prevents passage of the stop under pulling forces exerted on the cable in normal use and thereby ensures that a reserve length of cable remains on the drum. The stop is forced through the guide under the larger pulling force exerted if the worker attached to the cable falls when the stop is against or adjacent the guide.

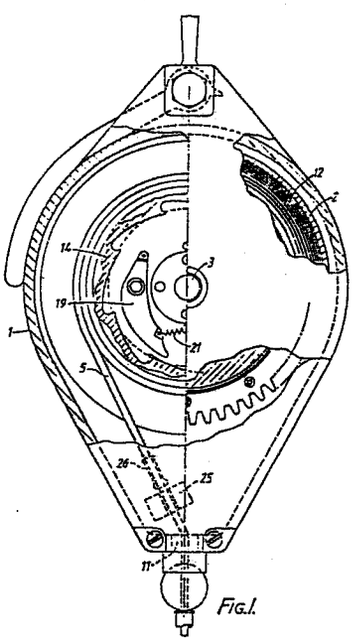

Fig.1.

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Description

Fall-Arrest Safety Device

This invention relates to apparatus comprising a rotatably mounted drum or spool on which a rope, cable or other coilable tie member can be wound, and a braking mechanism which automatically stops or retards rotation of the drum or spool if its rotational speed or acceleration rises above a certain value.

Apparatus of this kind can be used, for example, for safety lowering or fall-arrest purposes by attaching the drum or spool holder or casing to a fixture and attaching the free end of a safety line, wound onto the drum or spool, to a person or object to be protected. A particularly important use of such apparatus is for the protection of a person working at high levels above the ground, using a safety line which is attached to a personal safety belt or harness. Apparatus for such purpose customarily incorporates a drum which is self-winding by spring action so that slack in the safety line is automatically taken up and cannot accumulate and thereby create a further safety hazard.

It is important for workers using such a fall-arrest apparatus to be warned against working with the cable near to the limit of its pay-out length, because in the event of a fall the pay-out limit might be reached before the fall speed has been substantially decelerated by the brake, in which case the fall would be abruptly arrested with consequent high risk of serious personal injury.

It is known in the art to mark a tail end section of the cable length so that that section is visually identifiable as such as it emerges from the drum or drum housing. Apparatus is commercially available in which a tail end cable section of about 1 metre in length is painted red.

The marking of the tail end section of the cable is effective for its purpose only if a watch is kept for its appearance, either by the worker attached to the safety line or by another person posted as look-out. This precaution involves difficulty or inconvenience and it is in practice liable to be omitted.

The present invention provides more reliable means of warning.

According to the present invention there is provided apparatus comprising a rotatably mounted drum on which a rope, cable or other coilable tie member can be wound, and a braking mechanism which automatically stops or retards rotation of the drum if its rotational speed or acceleration in the unwinding direction rises above a certain value, characterised in that a guide through which the tie member passes is mounted at a location in the vicinity of the drum; and a stop for abutting said guide is atached to the tie member near to its tail end and serves by abutting said guide to resist further pay-out of tie member from the drum under pulling force up to a certain limit of magnitude; said guide and/or said stop being formed and/or mounted so as to yield and so allow further pay-out of the tie member under pulling forces exceeding such limit.

The magnitude of the resistance to pay-out of the tie member beyond the limiting position determined by the stop is a factor to be selected with due regard to the intended use of the apparatus. The resistance should of course be high enough to prevent passage of the stop under normal working loads on the cable.

In the case of personnel fall-arrest safety apparatus, the said resistance should be high enough to resist any pull on the tie member (hereafter called "cable") which the worker is likely to exert during normal working in an attempt to move further away from the drum. The resistance must thwart any such attempt and therefore give the worker sensible warning that he is at the safety limit of the cable extension. At the same time the guide and/or the stop is required to yield in the event of a worker falling when the cable is at or approaching that limit. Therefore the yield resistance must be overcome by the smallest force which might be imposed in the event of a worker falling when the cable is at or approaching the said limit. In the case of apparatus intended to be used as personnel fall-arrest safety apparatus, it is suitable for the yield resistance, expressed in terms of the steady load which must be applied to the cable to overcome the resistance to further pay-out of the cable. to be between 50 lbs (or 22.7 Kg) and 150 lbs (or 68 Kg) and preferably the said resistance is between 80 lbs (or 36.3 Kg) and 140 lbs (or 63.6 Kg).

The yield resistance can for example be the resistance of the guide or the stop to bodily displacement under pulling force on the cable. For example, the guide can be held in place by bolts or other fastening means which yields by rupturing. Alternatively the material of which the guide or the stop is formed and/or its geometry can be such that it fractures or deforms to allow further pay-out of the cable when a predetermined pulling force is exceeded.

In preferred embodiments of the invention the stop can be forced past the guide without breakage or bodily displacement of the stop or the guide or of means holding the stop or guide in place. There is therefore in such cases no risk of broken or displaced pieces interfering with the continued operation of the apparatus.

In the most preferred embodiments of the invention the yield occurs by elastic deformation of material. The yield resistance can readily be predetermined by the use of such material and it can have a useful cushioning effect at the moment of an impact of the stop against the cable guide.

In one very satisfactory way of carrying out the invention, the guide comprises elastically deformable material which defines a guide passage through which the tie member is freely movable but through which said stop can pass only under a force large enough to cause radial expansion of said passageway by said stop.

Preferably the stop is in the form of a ferrule through which the cable extends.

The trailing end portion of the cable, which

intervenes between the cable stop and the point at which the cable is attached to the drum, should be of sufficient length to ensure that a falling load can be smoothly decelerated by the drum braking system during the unwinding of that intervening cable portion, even if the cable stop encounters the guide right at the beginning of the fall.

The drum braking mechanism can comprise a centrifugal clutch via which friction braking forces are applied in the event that the unwinding speed of the drum exceeds a predetermined value. The mechanism can be constructed so that co-operating friction braking components are forced together under a progressively increasing pressure responsive to the operation of the clutch, e.g. as described and illustrated in United Kingdom Patent 1 552 667. Preferably however the braking mechanism comprises relatively displaceable friction braking components which are permanently held pressed together, at least one of such components being fixed and the other or another of them being displaceable relative to such fixed component(s) by force which is transmitted from the drum or spool via the centrifugal clutch (see European Patent Application o 247 818).

An embodiment of the invention, selected by way of example, is illustrated in the accompanying drawings, in which:

Fig. 1 is a part sectional elevation of the apparatus; and

Fig. 2 is a detail view showing the cable stop and guide on a larger scale.

The apparatus is a so-called safety block. Except for the cable stop and guide feature of the present invention, the block is basically similar in construction and function to that described in the aforesaid European Patent Application 0 247 818. The block comprises a casing 1 within which a cable drum 2 is mounted for free rotation about a shaft 3 the ends of which are supported by the casing. At the top of the casing there is a shackle by which the block can be suspended from a fixture.

A cable 5 is wound onto the drum 2 and leads out of the casing via a bottom aperture 11 so that the free end of the cable can be attached to a person or object to be protected.

By pulling on the cable 5, the drum can be rotated in the unwinding direction, against the action of a spiral spring 12 housed within the drum. So long as the unwinding speed remains below a certain level, the block offers virtually no resistance to the unwinding of the cable other than that imposed by that spring. However if the unwinding speed increases to that level, due for example to a person attached to the cable 5 falling, the drum becomes arrested by a friction brake through the agency of a centrifugal clutch mechanism. This mechanism comprises pawls such as 19 which are pivotally connected to the drum. If the drum accelerates in the unwinding direction due to the fall of a workman attached to the cable, the pawls pivot under the centrifugal force, against the action of springs 21 into positions in which free ends of the pawls engage behind ratchet teeth of a friction braking ring 14 which is in friction-braking contact with a co-operating fixed component. The frictional resistance to rotation of the ring 14 is such that the pay-out speed of the cable is decelerated to zero at a safe rate.

Between the drum and the cable exit aperture 11 there is a fixed cable guide 25 through which the cable passes. The guide defines for the cable a passageway 25a which is 7.0 mm in diameter. The cable diameter is 5.0 mm. The guide is made of an elastomeric material: synthetic rubber, and is a one piece moulding.

A steel ferrule 26 has been swaged onto the cable at a position along the cable which is about 1.0 m from the point at which the cable is attached to the drum. The ferrule has an outer cylindrical surface 7.0 mm in diameter but its lower end is slightly enlarged so that the ferrule will not pass through the passageway 25a in the guide 25 unless the passageway is expanded by elastic distention of the passagway wall. The resistance to this elastic deformation is such that when the ferrule is in contact with the guide, with the lower end of the ferrule against the guide, and a progressively increasing axial force tending to increase the abutment pressure is applied to the part of the cable projecting from the guide, the ferrule becomes pulled through the passageway only when the loading force reaches 100 lbs (or 45.4 Kg).

This resistance imposed by the guide ensures that the cable will not be pulled beyond this pay-out position by forces exerted on the cable in consequence of normal movements of a worker attached to the cable. If the worker attempts to move further from the drum, he will sense the resistance and be alerted to the fact that he is at the limit of the regulation working range of the cable.

Should the worker fall when the cable is at or near such limit, the ferrule will be pulled through the guide by the applied load but the fall will be decelerated by the drum brake mechanism so that an abrupt destruction of kinetic energy likely to cause very serious and possibly fatal injury is avoided.

The trailing (upper) end of the ferrule may also be slightly enlarged so that once the ferrule has been pulled down past the guide the cable cannot very easily be rewound without attention being drawn to the fact that the cable has been pulled out beyond its intended working limit and that a check should therefore be made that the apparatus is in serviceable condition.

It will readily be perceived that as an alternative to the illustrated arrangement, the guide 25 can be a rigid component and the ferrule 26 can be of elastically deformable material (which can for example be moulded onto the cable) so that it can be forced through the guide by a cable loading above the predetermined limit.

As a further alternative, the ferrule 26 can be secured to the cable by pins which shear under a given cable loading exerted while the ferrule is abutting against the guide. In this case the guide can of course be of rigid material.

Claims

1. Apparatus comprising a rotatably mounted drum (2) on which a rope, cable or other coilable tie member (5) can be wound, and a braking mechanism (19,14) which automatically stops or retards rotation of the drum if its rotational speed or acceleration in the unwinding direction rises above a certain value, characterised in that a guide (25) through which the tie member (5) passes is mounted at a location in the vicinity of the drum (2); and a stop (26) for abutting said guide is atached to the tie member (5) near to its tail end and serves by abutting said guide to resist further pay out of tie member from the drum under pulling force up to a certain limit of magnitude; said guide and/or said stop being formed and/or mounted so as to yield and so allow further pay-out of the tie member under pulling forces exceeding such limit.

2. Apparatus according to claim 1, wherein said guide (25) and/or stop (26) yield(s) by deformation thereof.

3. Apparatus according to claim 2, wherein said yield occurs by elastic deformation of material.

4. Apparatus according to claim 3, wherein said guide (25) comprises elastically deformable material which defines a guide passage (25a) through which the tie member (5) is freely movable but through which said stop can pass only under a force large enough to cause radial expansion of said passageway (25a) by said stop (26).

5. Apparatus according to claim 4, wherein the stop (26) is in the form of a ferrule through which the cable extends.

6. Apparatus according to any preceding claim, wherein a steady load of between 80 lbs (or 36.3 Kg) and 140 lbs (or 63.6 Kg) must be exerted on the tie member (5) in order to overcome the said resistance to further pay-out of the tie member.

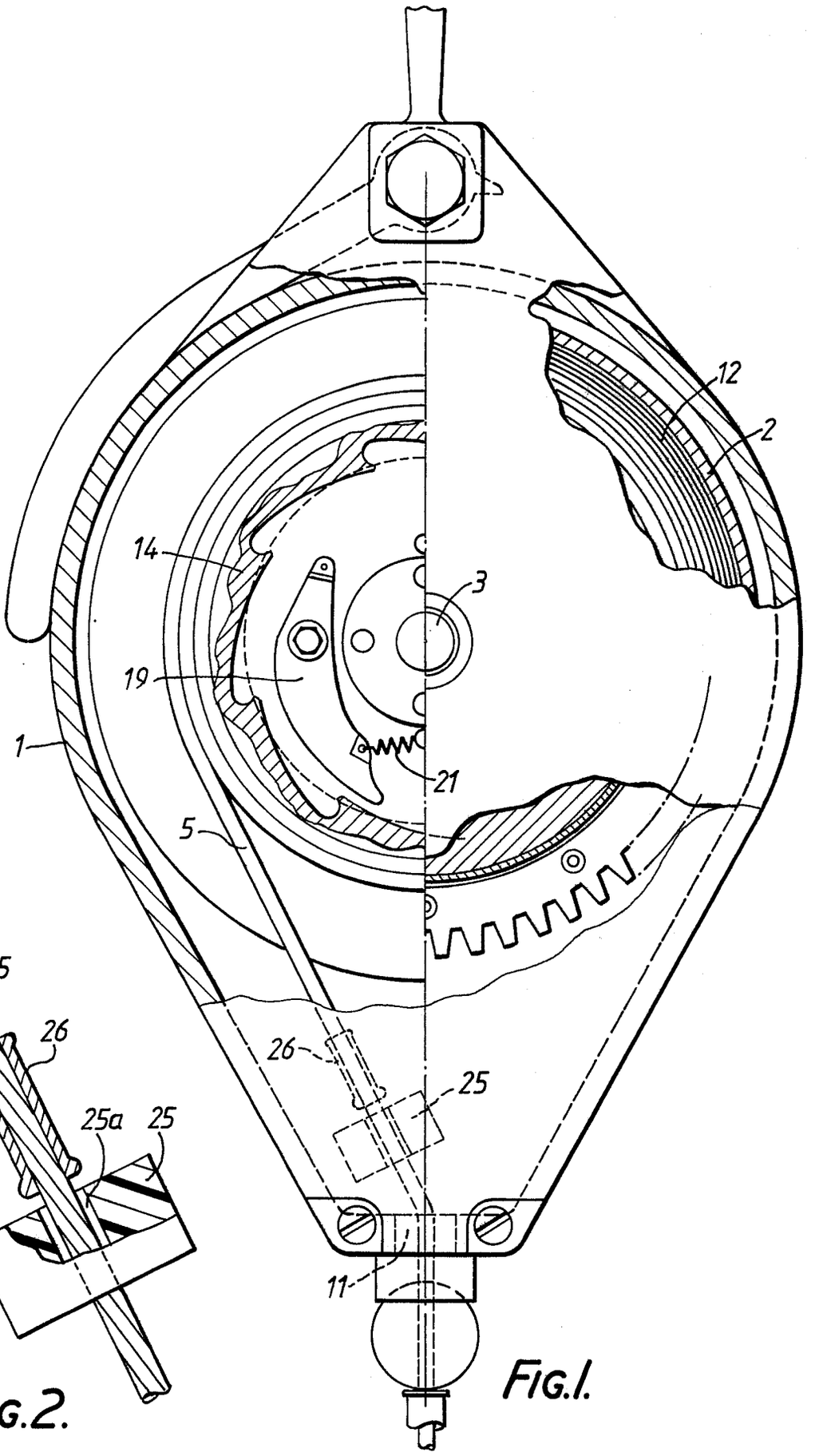

FIG.1.

FIG.2.