Title: ACTUATION MECHANISM FOR A TARPING SYSTEM

Abstract: An open-topped vehicle body (13), includes a tarping system (16) that is deployed over the body by a pivoting bail member (22). An actuation mechanism (25) applies a torque to the bail member to automatically pivot the member and deploy the tarp. The actuation mechanism includes a number of double coil spiral torsion springs (50) anchored on a shaft (67) attached to the truck body. The springs each include a right hand (54) and a left hand (52) coil portion concentrically wound about an integral center anchor portion. The shaft includes an elongated slot (69) to receive and support the centre anchor portion of each spring within the mechanism. The housing contains the double coil springs and supports a pair of reaction posts (92) extending therefrom to which the reaction ends of the double coil springs can transfer their torsional force.
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ACTUATION MECHANISM FOR
A TARPING SYSTEM

BACKGROUND OF THE INVENTION

The present invention relates to covers or tarping systems for open-topped containers. The invention concerns an apparatus for pivotally mounting a flexible cover over the bed of truck, such as a dump truck, and more specifically to an actuation mechanism for pivoting the cover over the truck bed.

Some hauling vehicles, such as dump trucks, include open-topped containers used for hauling or storing various materials. For example, in a typical dump truck application, the dump body is used to haul a variety of particulate material, such as gravel, aggregate or similar products. In addition, some hauling vehicles carry organic materials, such as grain or produce.

Depending upon the nature of the materials stored in the open-topped container, it is often desirable to provide a cover for the container. Of course, rigid covers are well known that may be hinged from one end of the container body. These rigid covers have gradually given way in the industry to flexible tarping systems because the flexible tarpaulin can be easily stowed when a cover is not necessary, such as when the dump bed is being loaded. Moreover, the flexible tarp is much easier to deploy than a rigid cover.

A variety of tarping systems have been developed that are geared to particular hauling vehicle applications. One such tarping system for use with dump trucks is the Easy Pull® Tarping System of Aero Industries, Inc. The Easy Pull® System includes a flexible tarp that is wound around a spool at one end of the dump bed. A rope attached to the free end of the tarp can be used to unwind the tarp from the roller to span the length of the dump bed.

Another cover system particular suited for open-topped containers on hauling vehicles, is the Easy Cover® Tarping System, also of Aero Industries, Inc. The Easy Cover® Tarping System includes a U-shaped bail that is pivotally mounted at its ends to the base of the container body. The horizontal section of the U-shaped bail is attached to the tarp, while the free ends of the vertical elements are pivotally mounted. In one application, the Easy Cover® Tarping
System allows the tarp to be manually pulled in a sweeping arc over the container load.

In another application of the Easy Cover® System, an actuation mechanism is provided that automatically pivots the U-shaped bail member to deploy the tarp over the load within the open-topped container. When the actuation mechanism is released, it automatically pivots the bar, thereby unfurling the tarp from the tarp roller at the front of the vehicle. A hand crank or powered motor can be provided to rotate the tarp roller to wind the tarp when it is desired to open the container top. The hand crank or motor mechanism must be capable of providing sufficient mechanical advantage to overcome the deployment force of the actuation mechanism.

A vehicle 10 is depicted in FIG. 1 having an open-topped body 13. As illustrated in FIG. 1, the vehicle can be a dump truck, with the open-topped container comprising a dump body. A tarpaulin cover 16 is shown in its deployed configuration spanning the length of the container and covering the load within. The tarp cover 16 can be wound onto a tarp roller 19. Both the tarp 16 and the roller 19 can be of a variety of known constructions, such as the Easy Cover® Tarping System.

A bail member 22 is connected to one end of the tarp 16 in the manner described above. The bail member is pivotably mounted to the truck body 13 by way of an actuation mechanism 25. This actuation mechanism can take a variety of forms in the prior art. For instance, one such mechanism relies upon extension springs that apply a linear force at some point along the bail member 22, to cause the bail member to pivot when the tarp roller 19 is released. In a similar configuration, a compression spring is used to push the bail member outward, thereby pivoting it about its pivot mount at the base of the truck body 13.

In other applications, a coil torsion spring applies a torque or moment to the lower ends of the U-shaped bail member 22. One advantage of the coil torsion spring is that it can be mounted substantially under the truck body 13 so that the actuation mechanism is clear of the working area around the truck body. In some instances an under-body mount cannot be accomplished. In these
instances, a spiral torsion spring assembly can be used to apply torque at the pivot mount of the bail member 22.

Once such spiral torsion spring of the prior art as depicted in FIGS. 2 and 3. In particular, the actuation mechanism 25' is mounted to the vehicle bed by a mounting plate 27. The actuation mechanism 25' includes a post 29 that projects from the mounting plate 27. The post is configured to extend through openings at the pivot mount for the bail member 22'. A torsion spring pack 31 is disposed within the pivot end 23' of the bail member 22'.

As shown most clearly in FIG. 3, the spring pack 31 can include a number of individual springs, such as torsion spring 31a. Each spring includes an anchor end 33 that is configured to fit within an anchor groove 35 defined along the length of the post 29. The opposite end of the torsion spring constitutes a reaction end 37 that reacts against a post 39 extending through the interior of the bail member 22'.

With any of the various actuation mechanisms described above, the amount of force generated by the mechanism depends upon the nature of the tarp cover 16 and the length that it must reach in its deployed position. Obviously, the longer the open-topped body 13, the longer distance the tarp 16 must cover. This translates to longer arms for the bail member 22. The longer the arms, the stronger the force or torque needed to pivot the arms from the stowed to the deployed position.

In order to generate this increased force using a spiral torsion spring configuration, such as that shown in FIGS. 2 and 3, additional springs, such as spring 31a, must be added to the spring pack 31. In one typical prior art spiral spring system, between three and six such springs are utilized, depending upon the length of the bail member arms. In the configuration depicted in FIG. 2, four such springs are provided. Each of the springs is aligned axially along the length of the post 29. Obviously, additional springs added to the pack 31 will require a longer post 29.

It has been found in practice that any spring pack using more than three springs projects too far from the side of the vehicle body 13. This excessive projection presents two problems: (1) since the arms of the bail member 22
necessarily project farther from the side of the body 13, they are more easily struck or damaged; and (2) federal law prohibits tarping system hardware from exceeding three inches from the side of the truck body. Since each spiral torsion spring is typically about one inch in width, it can be easily be appreciated that no more than three such springs can fit within the federally mandated envelope.

Consequently, there remains a need for an actuation mechanism that can utilize spiral torsion springs for a wide range of bail member dimensions, while still avoid the problems of the prior art system shown in FIGS. 2 and 3.

**SUMMARY OF THE INVENTION**

In order to address this unresolved need, the present invention contemplates a spiral torsion spring configuration that incorporates two spring coils within the same envelope. In one feature of the invention, the spring is a double coil spring in which two concentrically wound coil portions are connected at a center anchor portion. An actuation mechanism according to a preferred embodiment of the invention includes a shaft defining an elongated slot that is configured to receive the center anchor portion of a number of such double coil springs.

The actuation mechanism can further include a housing that surrounds the double coil springs and mates with a pivot end of an arm of the bail member.

Each coil portion of each spring terminates in a reaction end that is configured to engage a post passing through the housing. In the preferred embodiment, two such posts are situated within the housing at diametrically opposite positions. Each spring element, then, includes a left coil portion and a right coil portion, each having a corresponding reaction end that contacts a respective one of the diametrically opposite posts. Thus, each coil portion can exert a torsional force against each post, which results in a pivoting moment being applied to the arms of the bail member through the housing.

In one aspect of the actuation mechanism, the housing can include a male and a female half that are connected together about the double coil springs. The two halves can be combined to define a pair of peg holes at diametrically opposite sides of the housing. The set of peg holes mate with similar pairs of pegs projecting from the pivot end of the arms of the bail member when the
housing halves are clamped about the pivot end. The pegs and peg holes hold the bail member arms to the housing.

Each housing half can also define a shaft bore through which the slotted shaft extends. Preferably, the shaft projects from a mounting plate that can be mounted to the open-topped container to support the actuation mechanism. A pair of bushings can be disposed between the shaft and the housing halves to reduce friction as the housing rotates about the shaft under the torsional force applied by the double coil springs. The free end of the shaft projects beyond the housing and can receive a retaining ring to hold the housing on the shaft.

Likewise, the reaction posts can extend through reaction bores defined in the male and female housing halves. In one embodiment, the reaction posts include an enlarged head at one end and receive a retaining ring at the other end to hold the reaction posts within the housing.

In one aspect of the invention, the double coil springs reduce by half the number of spiral torsion springs required to achieve a desired deployment torque. Thus, when six prior art torsion springs are called for, only three double coil springs of the present invention are required. Each double coil spring can be formed of wound flat stock, with the number of windings of each coil portion being determined by the desired torsional force. Preferably, the flat stock has a width of about one inch or less, so a combination of three double coil springs easily falls within the federally mandated prominence guidelines.

It is one object of the present invention to provide an actuation mechanism for use in deploying a cover over an open-topped container. A more particular object is to provide such a mechanism for use with a flexible tarping system for vehicle, such as a dump truck.

One advantage achieved by the present invention over prior art devices is that a requisite amount of deployment torque can be generated by a spring pack that fits within an acceptable envelope. A further benefit is that the number of parts that must be assembled to form the actuation mechanism is reduced.

Other benefits and objects of the present invention can be readily discerned upon consideration of the following written description and accompanying figures.
DESCRIPTION OF THE FIGURES

FIG. 1 is a perspective view of a vehicle utilizing a tarping system to cover the open-topped body of the vehicle.

FIG. 2 is a side perspective view of an actuation mechanism of the prior art.

FIG. 3 is a partial cross-sectional view of the actuation mechanism shown in FIG. 2.

FIG. 4 is a top elevational view of a spiral torsion spring in accordance with one embodiment of the present invention.

FIG. 5 is a top perspective view of a shaft bracket for use with the spiral torsion spring shown in FIG. 4 to constitute an actuation mechanism in one embodiment of the invention.

FIG. 6 is a top exploded view of an actuation mechanism according to one embodiment of the present invention utilizing the spiral torsion spring of FIG. 4 and the shaft bracket of FIG. 5.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

For the purposes of promoting an understanding of the principles of the invention, reference will now be made to the embodiments illustrated in the drawings and specific language will be used to describe the same. It will nevertheless be understood that no limitation of the scope of the invention is thereby intended. The invention includes any alterations and further modifications in the illustrated devices and described methods and further applications of the principles of the invention which would normally occur to one skilled in the art to which the invention relates.

In accordance with certain aspects of the present invention, an actuation mechanism 25" is provided for use with the pivoting bail member 22 shown with the vehicle 10 in FIG. 1. The actuation mechanism utilizes a number of spiral torsion springs to apply a torque moment at the pivot end of each arm of the bail member 22. In one aspect of the invention, each spiral torsion spring includes double concentric coil portions connected by a center anchor section that is held fixed relative to the pivoting bail member arms. The novel spiral spring
incorporates two reaction ends that each provide a restoring or deployment torsional force to the bail member arms.

More specifically, one preferred embodiment of the invention utilizes a double concentric coil spiral spring 50 shown in FIG. 4. The spring 50 includes a left coil portion 52 and a right coil portion 54. The two portions 52 and 54 are connected at the center of the spiral by a center anchor portion 56 and are concentrically wound about this anchor portion. The two coil portions are disposed in a common plane passing through the anchor portion, so the entire spiral spring 50 presents the same envelope as a prior art spiral spring. The concentric winding of the two portions 52, 54 means that segments of the left and right portions alternate along a radial line emanating from the center anchor portion.

The free end of each coil portion 52 and 54 includes a corresponding reaction end 58, 60 that reacts against or provides a torsion force against an element connected to the arms of the bail member 22. Preferably, the two reaction ends 58, 60 are diametrically opposite, and in a most preferred embodiment are aligned with the center anchor portion 56, as depicted in FIG. 4.

Each of the coil portions 52, 54 are wound in the same direction, such as counter-clockwise in the illustrated embodiment. Of course, the coil portions can be wound in a clockwise sense; however, it is important that the portions be wound in the same direction so that they can provide a torsion force in the same direction, as represented by the arc arrow T. It is understood that when the spring 50 is installed within an actuation mechanism 25°, the spring is wound in a direction opposite the direction of the arrow T as the tarp is moved to its stowed position around the tarp roller 19. In this instance, the diameter of the two coil portions 52, 54 is reduced as the spring 50 is tightly wound. Of course, moving the bail arms to their stowed position, tightens the coil portion of the spring 50, thereby storing potential energy for future deployment.

Another element of the actuation mechanism is the shaft bracket 65, depicted in FIG. 5. The shaft bracket includes a mounting plate 71 configured to be mounted to the side of the vehicle body 10. A shaft 67 projects perpendicularly outward from the mounting plate 71. The shaft 67 defines an
anchor slot 69 that extends along a substantial portion of the length of the shaft. This anchor slot 69 has a width sufficient to accommodate the center anchor portion 56 of each of the double coil spiral springs 50 included with the actuation mechanism. This arrangement of the center portion 56 relative to the shaft 67 is depicted in dash lines in FIG. 4.

In accordance with the preferred embodiment, the double coil spiral spring 50 and shaft bracket 65 form part of an actuation mechanism 25" as shown in FIG. 6. In order to integrate the springs with the bail member, the actuation mechanism 25" includes a housing 80 formed by a male housing half 82 and a female housing half 83 that can be connected together about a number of spiral springs 50. The two housing halves can be at least initially snap-fit together, and ultimately held together by some type of fastener, such as a bolt and nut.

The two housing halves 82 and 83 combine to define a leg engaging portion 84. The leg engaging portion 84 is elongated and hollow to receive the pivot end 23" of a leg of the bail member 22". The two halves 82, 83 also combine at the shaft engagement portion 84 to define a pair of peg holes 85 on opposite sides of the portion. These peg holes are configured to clamp about a pair of pegs 86 projecting from opposite sides of the pivot end 23" of the bail member 22". Thus, when the two housing halves 82, 83 are combined about the end portion 23" of the bail member 22", the pegs 86 are solidly retained within the peg holes 85, to prevent translation and rotation of the bail member leg relative to the leg engagement portion 84.

Each of the housing halves 82, 83 defines a shaft bore 88 projecting therethrough. This shaft bore 88 is configured to pivotally receive the shaft 67 of the shaft bracket 65. Preferably, a pair of shaft bushings 89 are provided at each of the housing halves 82, 83. These bushings can reduce the amount of friction between the shaft 67 and the housing 80 of the actuation mechanism as the housing, (together with the bail member 22") pivots relative to the shaft 67.

It is understood that the shaft bore 88 is arranged so that the anchor slot 69 of the shaft 67 can engage the center anchor portions 56 of each spiral spring 50 contained within the housing 80. In the illustrated embodiment, three
such springs are provided, although one or two springs may be contained within
the housing depending upon the amount of pivoting torque required for the
particular bail member 22" and tarp system.

The reaction ends 58 and 60 of each of the coil portions 52 and 54 react
against corresponding posts 92. Each post 92 passes through combined post
bores 93 defined in each of the housing halves 82, 83. Preferably, the reaction
ends 58, 60 are configured to bend around a corresponding post, in the manner
depicted in FIG. 4. Since the reaction post 92 does not pivot, no bushing is
required between the post and the housing halves.

In order to retain the combined housing 80 on the shaft 67, the shaft
defines a retaining ring groove 75 at its free end. This groove 75 projects just
outside the male housing half 82, as shown in FIG. 6. A retaining ring 90 is
provided that can be engaged within the groove 75. The retaining ring 90 can be
in the form of a snap ring or other mechanism sufficient to hold the housing 80 on
the shaft 67. For instance, instead of a retaining ring 90, a cotter pin
arrangement can be implemented.

A similar arrangement is applied to each reaction post 92. Specifically,
each post can include a groove 94 at its free end that can be engaged by a
retaining ring 95. Preferably, the reaction post 92 can have an enlarged head 96
at the end opposite the retaining ring. This enlarged head 96 can fit within an
undercut portion of the post bores 93 in the female housing half 83. It is
understood, of course, that other means for mounting the reaction post 92 to the
housing halves 82, 83 are contemplated. For instance, the free end of each of
the reaction post 92 can be threaded to engage corresponding threads in the
post bores 93 within the male housing half 82.

The present invention provides an actuation mechanism 25" that can be
easily assembled. Specifically, each of the housing halves can be readily
engaged about the pivot end 23" of the bail member 22". The springs 50 forming
a spring pack can be contained within the housing 80 in their free state as the
shaft 67 is passed through the shaft bores 88 and the anchor slot 69 engaged
about the center anchor portion 56 of each of the springs 50. Attachment of the
reaction posts 93 to the housing halves 82, 83 can require some torquing or
winding of the spiral springs 50. It is preferable that the spring pack have some
residual torque when the bail member 22" is in its deployed position.

The orientation of the shaft 67 relative to the bail member 22" can be
adjusted by positioning the mounting bracket 71 on the vehicle body 13. To
accomplish this adjustment, the mounting plate 71 defines an array of mounting
holes 73. The array of mounting holes allows the shaft bracket 65 to be affixed
to the truck body 13 with the anchor slot 69 at different angular orientation
relative to the truck body. These different angular orientations impact the
residual torque exerted on the bail member 22" when the tarp cover 16 is fully
deployed. In addition, this angular orientation of the shaft 67 and anchor slot 69
also determines the amount of initial torque applied to the tarp cover when it is
released from the tarp roller 19.

The actuation mechanism 25" can be assembled by first extending the
reaction posts 92 through the post bores 93 in the female housing half 83. The
requisite number of springs 50 can be placed within the housing half 83 with the
reaction ends 58, 60 engaged about a corresponding one of the posts. The pivot
end 23" of the bail member 22" can be situated within the shaft engaging
portion 84 of the female housing, with the pegs 86 extending into the female
housing portion of the peg holes 85.

At this point, the male housing half 82 can be combined with the female
housing half 83 to form the complete housing 80. Of course, the posts 92 extend
through the male housing post bores 93 and the pegs 86 extend into the male
housing peg holes. The housing assembly can be completed by bolting the two
halves together. The retaining rings 95 can be engaged within the grooves 94 at
the exposed end of each post 92.

The shaft bracket 65 can be fastened to the truck body 13 at a suitable
pivot location for the bail member 22". The assembled housing can mounted on
the shaft 67 with the slot 69 sliding around the center anchor portion 56 of each
spring in the spring pack. When the shaft extends beyond the male housing
half 82, the retaining ring 90 can be engaged within the groove 75 of the shaft to
hold the housing on the shaft.
In one specific embodiment of the invention, each of the double coil spiral springs 50 can be formed from flat steel wire having a thickness of 0.187 in. and a width of 0.625 in. A spring sized in this manner is capable of generating 900 in.lbs. of torque at 120° of deflection.

Preferably the shaft 67 has a diameter of about 1.25 in. Thus, the working length of the center anchor portion 56 must be at least 1.25 in. to accommodate the shaft.

Preferably the shaft 67 and the reaction post 92 are formed from steel bar stock. The male and female housing halves 82, 83 can be die cast in steel or other suitable material. The shaft bushings 89 can be formed of bronze or other similar low friction material.

While the invention has been illustrated and described in detail in the drawings and foregoing description, the same is to be considered as illustrative and not restrictive in character. It should be understood that only the preferred embodiments have been shown and described and that all changes and modifications that come within the spirit of the invention are desired to be protected.

For instance, the reaction posts 92 can be integrally formed within one or both of the housing halves 82, 83. The reaction posts themselves can also provide a means for fastening the male and female halves together, such as by externally threading a free end of the posts for engagement by a machine nut, or internally threading the posts to receive a bolt.
What is claimed is:

1. An actuation mechanism for a cover system on an open-topped container, the cover system including a cover extendable from a stowed position to a deployed position covering the container and a bail member attached to the cover and pivotable relative to the container to move the cover between its two positions, said mechanism comprising:
   at least one double coil spring having two coil portions concentrically wound around and disposed in a common plane with an integral center portion, each of said coil portions including a free reaction end;
   a pivot shaft mounted on the container, said shaft defining an elongated slot for receiving said center portion therein;
   a housing connected to the bail member and defining a bore to receive said pivot shaft therethrough, said housing configured to receive said at least one spring therein with said center portion disposed within said slot of said shaft; and
   a pair of reaction posts disposed within said housing, each of said posts configured to contact a reaction end of a corresponding one of said two coil portions, whereby said at least one double coil spring applies a torsional force to the bail member through said pair of reaction posts and said housing.
A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B60J/08

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)
IPC 7 B60J E05F E05D F16F

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 practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
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<th>Relevant to claim No.</th>
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<td>Y</td>
<td>US 5 887 937 A (SEARFOSS TIMOTHY KEITH) 30 March 1999 (1999-03-30) column 2, line 6 -column 2, line 41 abstract; claims 1,2,16; figures 1,2,4</td>
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<tr>
<td>A</td>
<td>US 5 944 374 A (SEARFOSS TIMOTHY KEITH) 31 August 1999 (1999-08-31) column 2, line 10 -column 2, line 39 abstract; claims 1-4,8,13-16,18; figures 1,3,4</td>
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Further documents are listed in the continuation of box C. Patent family members are listed in annex.

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Name and mailing address of the ISA
European Patent Office, P.B. 5818 Patentazzi 2 NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Facs (+31-70) 340-2016

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