SAFETY ATTACHMENT DEVICE FOR TWO ACTUATORS

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Abstract

Applicable in installations with two reaction bars attached to a first and a second piece, arranged above two actuators, also attached to the first and second piece for producing the relative displacement between both pieces. It comprises a support located between the reaction bars, fastened to them, covering at least their upper part; each reaction bar having at least one first cable, located above the surface of the support and whose ends are attached to the confronting side walls of an actuator; some vertical arms attached to the support and to two horizontal parallel bars, located between the confronting side faces of the actuators; at least one second cable located around each one of the horizontal parallel bars that are fastened to the side face of an actuator so that, when an actuator is disconnected from the first or second piece, it is kept retained by means of the device.
SAFETY ATTACHMENT DEVICE FOR TWO ACTUATORS

OBJECT OF THE INVENTION

[0001] The safety device of the invention is applicable to installations that are provided with actuators which are fixed to two pieces in order to produce the relative displacement between them and which require the incorporation of a standby or redundant actuator, in such a way that two actuators are provided arranged in parallel which can function simultaneously or with one of them as a standby element in the event of failure occurring in the other actuator. The safety device of the invention has the aim of permitting securing of one of the two actuators when its disconnection occurs with respect to the said pieces to which they are fixed. It is a further aim of the invention to provide a simplified, low weight, structure for the safety device.

[0002] As a consequence, the invention is applicable to any sector of industry in which it is sought to prevent the total or partial falling of either of the two actuators in the event of one of them being accidentally disconnected from any of its fastenings on the pieces to which they are attached, and more particularly it is applicable to those devices where the total or partial falling of the actuator can have an adverse impact on the safety of the element on which the installation is carried out.

[0003] The invention is especially applicable in the aeronautical industry in those actuators that are intended for tilting mobile elements with respect to fixed elements, such as the actuators for elevators, flaps, etc.

[0004] The invention can also be applicable in other industries such as for example shipbuilding, hydraulic systems, robotics and in cranes and elevation systems.

[0005] In the shipbuilding industry the invention is especially applicable to the manufacture of submarines where space is also limited, as occurs in the aeronautical industry.

[0006] With regard to hydraulic systems, it is applicable to those that include sluices moved by means of actuators, such as dams, thermal/nuclear power plants, etc., where the actuator could cause blockages that can lead to overpressures in the system with serious consequences for it.

[0007] In robotics it can be applied both to industrial production plants and to autonomous equipment, such as surveillance/exploration robots, etc.

[0008] In the cranes and elevation systems industry it is applicable mainly to those where there can exist an impact on human safety, such as for example operators or people not involved in the functioning of the machine.

BACKGROUND OF THE INVENTION

[0009] In the state of the art, patent document EP1677011 can be cited, which describes a safety attachment device for an actuator that is fixed to two pieces for producing the relative displacement between both pieces, to which a reaction bar is also attached in articulated fashion arranged above the actuator, in such a way that the safety device is provided with an upper part that is fixed above the reaction bar, and which also supports two side arms which clasps at least part of the sides of the actuator, said side arms including windows which are traversed by some safety bolts joined to the side walls of the actuator, in such a way that each window has dimensions larger than the transverse cross-section of the safety bolt passing through it and so that the safety bolt remains arranged without making contact with the edges of said window when the actuator is coupled to said pieces, and even during the movements of the actuator. The windows extend horizontally in such a way that their side edges do not make contact with the safety bolt when the actuator is disconnected from at least one of said pieces. Due to the dimensioning of the window, this configuration allows control over the movements of the actuator that are produced in the event of accidental disconnection of one or both of its coupling points.

[0010] Moreover, the safety bolts incorporate widenings at their free end in order to control the lateral movements of the actuator, this increases the weight and complexity of the safety bolts, apart from the fact that said safety bolts have to be capable of supporting the weight of the actuator in the event of disconnection.

[0011] One of the pieces to which the actuator is attached is a fixed piece, while the other one is mobile, in such a way that in the event of disconnection of the fixed piece occurring, when displacement of the mobile piece is effected, it pulls on the actuator, and with that the possible pulling movements of the actuator body are of considerable length, so large dimensioned windows need to be made through which the safety bolt can pass, which means that its weight is consequently large.

[0012] Another consequence of the long pulling movements is that the loads of the weight of the actuator applied at the ends of the window generate forces that are very centered with respect to the upper part of the safety device, and therefore means of reinforcement are included in the ensemble so that it can support said loads, and that implies an increase in weight.

[0013] On the other hand, it can be stated that in the event that vibrations are produced during the disconnection, the actuator safety bolts can produce a hammering effect on the window of the device, which is an unfavorable condition.

[0014] Furthermore, in order to allow maintenance or dismantle of an actuator, provision has been made for the lower part of the windows to include an articulated section so that the window can be opened in order to allow the safety bolts to pass and so the actuator can be extracted. This configuration represents a design that requires additional reinforcements in the articulated section and the window, which implies an increase in weight.

[0015] The situation occurs, above all in aeronautical installations, where safety is an important requisite, that instead of installing a single actuator two adjacent actuators are installed, in such a way that in normal mode one is active and the other one is on standby in case of failure, or both are functioning together but if one of them fails the other one can increase its load in order to guarantee the proper functioning of the system.

[0016] These drawbacks are resolved in the Spanish patent with application number 200802765, which describes a safety device comprising two supports which are fixed to the reaction bar and which, by means of some vertical arms, support two horizontal bars that remain located confronting and parallel to the side faces of the actuator, in such a way that a cable is provided located around each one of the horizontal parallel bars and whose ends are fixed to the side walls of the actuator so that, when disconnection of the actuator takes place, it is kept retained by means of the cables. This configuration determines a less weight and it simplifies the configuration of the safety device, but in cases in which it is desired...
to provide installations with two actuators, a safety device has to be fitted for each one of the actuators.

[0017] It does not exist a safety device that permit attachment of at least one of the two actuators installed in parallel when it becomes disconnected, and which moreover would not represent an excessive increase in weight.

[0018] The invention relates to a safety device capable of providing safety attachment for both actuators, with a criterion of minimum weight for which it uses common elements that permit the retention of either of the actuators to be carried out, but with the restriction that the loads of both actuators would not need to be supported simultaneously since the possibility of accidental disconnection taking place simultaneously in the two actuators is very low, therefore the possibility is not considered of having to effect protection against the simultaneous disconnection of both actuators, unlike what happens in the case in which independent devices are installed for each of the actuators since, being independent devices, they both have to be capable of supporting the loads of the actuator on which they are installed.

DESCRIPTION OF THE INVENTION

[0019] In order to achieve the objectives and solve the drawbacks stated above, the invention is applied in conventional installations comprising two parallel reaction bars that are attached to a first and a second piece, and which are arranged above two actuators located in parallel, which are also attached to the first and second piece so that, when at least one of the actuators is actuated, the relative displacement between the first and second piece is produced.

[0020] The main novelty of the safety device of the invention lies in the fact that it comprises a support running between the reaction bars and attached to them in such a way that covers at least the upper part of said reaction bars; in order to allow the location of at least one first cable for each reaction bar and above the surface of the support covering the reaction bars, in such a way that the ends of said cables are attached to the parallel confronting side walls of the actuator above which they are located, with which, when disconnection of one of the actuators takes place, it is left hanging by means of the first cable and on the corresponding reaction bar. Moreover, the section of the support that runs between the reaction bars comprises vertical arms that are attached to two horizontal parallel bars which are located between confronting side faces of the actuators, in order to permit the provision of at least a second cable around each one of the horizontal parallel bars, in such a way that the ends of said second cables are fixed to the side face of the actuator which closes to said horizontal parallel bars such that when disconnection of one of the actuators takes place and when it remains suspended by the first cable, the actuator is further retained by means of the second cable via the horizontal parallel bar, in order to limit the lateral movements of the actuator that could occur.

[0021] The preferred embodiment of the invention provides that the support consists of a frame comprising first parallel sides and second parallel sides, in such a way that its first parallel sides are fixed on each of the reaction bars covering at least the upper part of them, and in such a way that the second parallel sides are transverse to the first ones and connect the ends of said first parallel sides. In this configuration the vertical arms are connected to the second parallel sides so that the horizontal parallel bars remain located between the confronting parallel side faces of the actuators, as it was previously mentioned.

[0022] The frame consists of a metal sheet in such a way that the first parallel sides of the frame present a semicircular cross-section which is fixed on the reaction bars by means of clamps that close the lower part of said reaction bars, such that the first cables are permitted to slide on the surface of their respective first parallel sides when disconnection of the actuator to which they are attached takes place.

[0023] In order to provide the support with greater consistency, provision is made for the second parallel sides to comprise means of reinforcement consisting of folds made in said second parallel sides, in such a way that they define a “U” configuration.

[0024] Furthermore, in the preferred embodiment of the invention the vertical arms are made from folded sheet metal and likewise comprise means of reinforcement consisting of ribs.

[0025] In order to achieve a reduction in weight of the safety device, provision is made for the horizontal parallel bars to be hollow.

[0026] In order to facilitate the securing of the actuator that has become disconnected, the ends of the first cables are to be attached to the upper part of the side faces of the actuator and the vertical of its center of gravity.

[0027] Moreover, in order to permit maintenance and/or detachment of an actuator to be carried out, provision is made for one of the ends of the first and second cables to be attached to the side walls of the actuator in such a way that is permanent, while the other end is fixed in such a way that is detachable.

[0028] Below, in order to facilitate a better understanding of this descriptive specification and forming an integral part thereof, a series of figures is attached in which the object of the invention has been represented by way of illustration and non-limiting.

BRIEF DESCRIPTION OF THE FIGURES

[0029] FIG. 1.—Shows a plan view of an example of embodiment of the upper frame of the safety device of the invention.

[0030] FIG. 2.—Shows a view according to cross-section A-A of FIG. 1.

[0031] FIG. 3.—Shows a view according to cross-section B-B of FIG. 1.

[0032] FIG. 4.—Shows a view according to cross-section C-C of FIG. 4.

[0033] FIG. 5.—Shows a side view of the safety device of the invention assembled on the reaction bars and on the actuators.

[0034] FIG. 6.—Shows a transverse cross-section of the assembly of previous figure.

DESCRIPTION OF THE PREFERRED FORM OF EMBODIMENT

[0035] A description of the invention is made below based on the figures mentioned above.

[0036] As already mentioned, the safety device of the invention is applicable in installations comprising two adjacent and parallel actuators 1 whose ends are fixed to a first piece 2 and to a second piece 3, in such a way that the first piece 2 is fixed and the second piece 3 is mobile.

[0037] Comprised above the actuators there is a reaction bar 4, whose ends are fixed to the first piece 2 and second piece 3.
Provision is made for both actuators 1 to be able to function together or that one of them is kept in standby mode in case of failure. In the event of both of them jointly functioning, if a failure occurs in one of them the other may increase its load in order to guarantee proper functioning.

The safety device of the invention comprises a support 5 consisting of a frame 13 which includes some first parallel sides 6 and some second parallel sides 7, in such a way that the first parallel sides 6 present a semicircular configuration that is arranged enveloping the upper part of the reaction bars 4.

The frame 13 is fixed on the reaction bars by means of some clamps 8 closing the lower part of the reaction bars 4. The clamps are fixed to the frame 13 by conventional fastening means, such as for example screws and nuts.

The second parallel sides 7 comprise means of reinforcement, preferably by means of folding its edges forming flanges that define a transverse cross-section in the shape of a “L”.

On the surface of each of the first parallel sides 6 a steel cable 9 is provided whose ends are attached to the confronting parallel side faces of each of the actuators 1, in such a way that if disconnection of one of the actuators 1 takes place it remains suspended from the corresponding first cable 9 which in turn remains supported by one of the first parallel sides 6 and by means of the reaction bar 4.

Fixed in the midpoint of the second parallel sides 7 are some vertical arms 10, preferably made of folded sheet metal, which incorporate means of reinforcement, for example ribs, such that the vertical arms 10 are prevented from being able to oscillate when they are subjected to loads. The vertical arms 10 are fixed by conventional means of fastening, such as screws and nuts, rivets or by welding.

In the lower part of the vertical arms 10, two hollow horizontal parallel bars 11 are supported which remain located confronting the side faces of each one of the actuators 1.

It also comprises a second steel cable 12 located around each one of the horizontal parallel bars 11, in such a way that the ends of each of the second cables 12 are fixed to the side wall of the actuator 1 to which it is confronted, forming a loop that is traversed by the corresponding horizontal parallel bar 11.

The joint of one of the ends of the first cables 9 and of the second cables 12 is done in a permanent manner, while that of their other end is done in a detachable way, for example by means of screws, in order to allow the actuators 1 to be detached in the event that this becomes necessary.

In case disconnection of the actuator 1 from the second mobile piece 3 takes place, the first cable 9 makes contact with the surface of its corresponding first parallel side 6 and the actuator 1 remains hanging by means of the first cable 9, reaction bar 4 and first parallel side 6. Moreover, the lateral movements of the body of the actuator are limited by means of the second cables 12, due to being traversed by the horizontal parallel bars 11.

In the case in which the actuator 1 comes loose from the fixed first piece 2, it continues to be connected to the mobile second piece 3, with which the displacement of the mobile second piece 3 produced by the other actuator 1 could provoke a pulling movement on the actuator, which means that the dimensioning of the device has to be adequate for permitting said pulling movement to be performed, during which the steel cables 9 run along the surface of the first parallel sides 6, and so that the length of these has to be such that the pulling movement of the actuator 1 is not limited, said actuator 1 sliding along the surface of the first parallel side 6, thereby avoiding the actuator 1 from becoming blocked in a fixed position, and with this way also avoiding damages or friction of the reaction bar 4, since it remains protected by the first parallel sides 6.

Moreover, in the event of the pulling movement occurring, the lateral movements of the body of the actuator are limited by means of the second cables 12 along the horizontal parallel bars 11.

The dimensioning of the safety device also has to be adequate for permitting the normal functioning of the actuator.

As the circumstance of the disconnection of the two actuators occurring simultaneously is minimal, the invention does not consider the possibility of having to support the loads of both actuators simultaneously due to the disconnection of both actuators taking place. This means that both the second parallel sides 7 and the vertical arms 10 can be lighter since they do not require any additional means of reinforcement for bearing the load of the two actuators 1 simultaneously.

1. SAFETY ATTACHMENT DEVICE FOR TWO ACTUATORS, applicable in installations comprising two parallel reaction bars 4 that are attached to a first piece 2 and to a second piece 3, and which are also arranged above two parallel actuators 1, also attached to the first piece 2 and second piece 3, so that, when at least one actuator 1 is actuated, the relative displacement between the first piece 2 and second piece 3 is produced; wherein the device comprises:

- a support 5 running between the reaction bars 4 and attached above them, in such a way that covers at least their upper part;
- at least one first cable 9 for each one of the reaction bars 4 arranged above the surface of the support 5 and whose ends are attached to the confronting side walls of an actuator 1;
- vertical arms 10 attached to the support 5 and to two horizontal parallel bars 11 which are located between confronting side faces of the actuators 1;
- at least one second cable 12 located around each one of the horizontal parallel bars 11 and whose ends are fastened to the side face of the actuator to which it is confronting, so that, when one of the actuators 1 is disconnected from the first piece 2 or the second piece 3 it is kept retained by means of the device.

2. SAFETY ATTACHMENT DEVICE FOR TWO ACTUATORS, according to claim 1, wherein the support 5 consists of a frame 13 comprising first parallel sides 6 and second parallel sides 7, whose first parallel sides 6 are fixed above each one of the reaction bars 4.

3. SAFETY ATTACHMENT DEVICE FOR TWO ACTUATORS, according to claim 2, wherein the frame 13 is made of a metal sheet.

4. SAFETY ATTACHMENT DEVICE FOR TWO ACTUATORS, according to claim 2, wherein the parallel sides 6 of the frame 13 present a semicircular cross-section which is fixed above the reaction bars 4 by means of clamps 8 closing the lower part of said reaction bars 4, so as to permit the first cables 9 to slide on their respective first parallel sides 6 when the actuator to which they are attached is disconnected.
5. SAFETY ATTACHMENT DEVICE FOR TWO ACTUATORS, according to claim 4, wherein the vertical arms (10) are attached to the middle part of the second parallel sides (7).

6. SAFETY ATTACHMENT DEVICE FOR TWO ACTUATORS, according to claim 2, wherein the second parallel sides (7) comprise means of reinforcement.

7. SAFETY ATTACHMENT DEVICE FOR TWO ACTUATORS, according to claim 6, wherein the means of reinforcement of the second parallel sides (7) consist of folds made in said second parallel sides (7).

8. SAFETY ATTACHMENT DEVICE FOR TWO ACTUATORS, according to claim 7, wherein folds for reinforcement of the second parallel sides (7) define a “U” shaped configuration.

9. SAFETY ATTACHMENT DEVICE FOR TWO ACTUATORS, according to claim 1, wherein the vertical arms (10) consist of folded metal sheet and include means of reinforcement.

10. SAFETY ATTACHMENT DEVICE FOR TWO ACTUATORS, according to claim 9, wherein the means of reinforcement of the vertical arms (10) consist of ribs.

11. SAFETY ATTACHMENT DEVICE FOR TWO ACTUATORS, according to claim 1, wherein the horizontal parallel bars (11) are hollow.

12. SAFETY ATTACHMENT DEVICE FOR TWO ACTUATORS, according to claim 1, wherein the ends of the first cables (9) are attached to the upper part of the confronting side faces of the actuator (1) and in the vertical of its center of gravity.

13. SAFETY ATTACHMENT DEVICE FOR TWO ACTUATORS, according to claim 12, wherein one of the ends of the first cables (9) and of the second cables (12) are attached to the side walls of the actuators (1) in a way that is permanent, while the other end is fixed in a way that is detachable.

14. SAFETY ATTACHMENT DEVICE FOR TWO ACTUATORS, according to claim 1, wherein the first cables (9) or the second cables (12), or both, are steel cables.

15. SAFETY ATTACHMENT DEVICE FOR TWO ACTUATORS, according to claim 2, wherein the first cables (9) or the second cables (12), or both, are steel cables.

16. SAFETY ATTACHMENT DEVICE FOR TWO ACTUATORS, according to claim 9, wherein the first cables (9) or the second cables (12), or both, are steel cables.

17. SAFETY ATTACHMENT DEVICE FOR TWO ACTUATORS, according to claim 11, wherein the first cables (9) or the second cables (12), or both, are steel cables.

18. SAFETY ATTACHMENT DEVICE FOR TWO ACTUATORS, according to claim 12, wherein the first cables (9) or the second cables (12), or both, are steel cables.

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