Dec. 26, 1967 J. J. PHILLIPS 3,359,804

MECHANICAL ACTUATOR PACKAGE

Filed Oct. 11, 1965

Fig. 1.

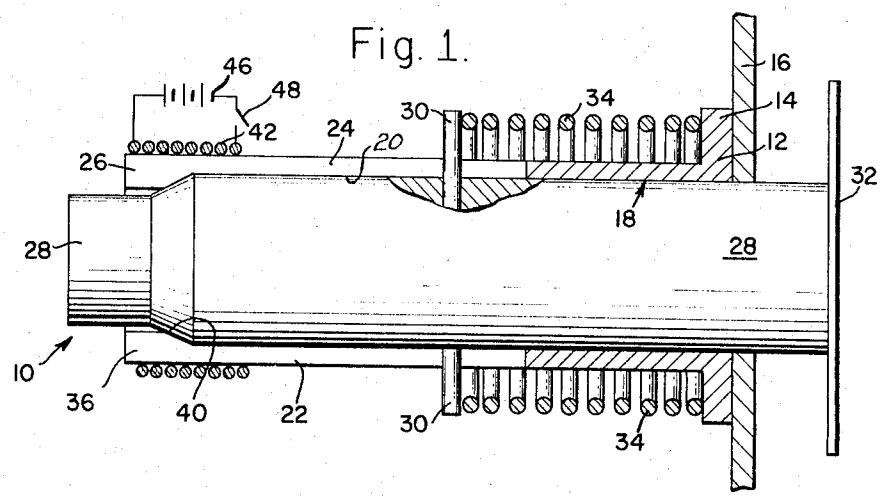


Fig. 2.

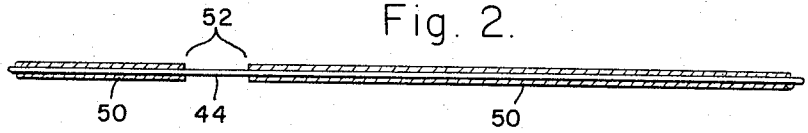


Fig. 4.

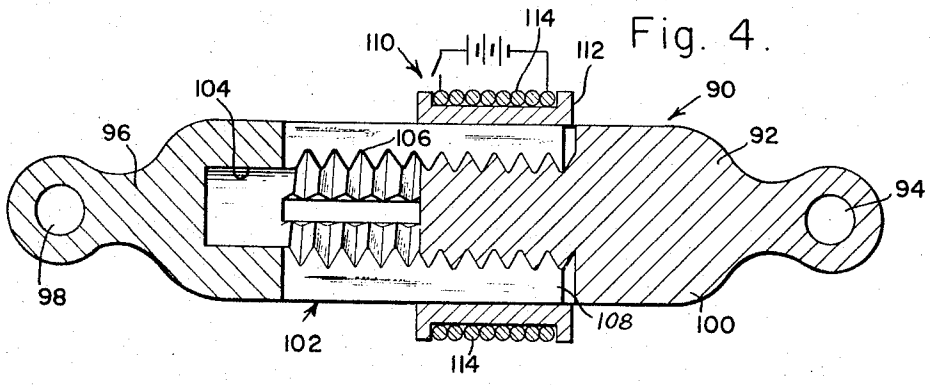
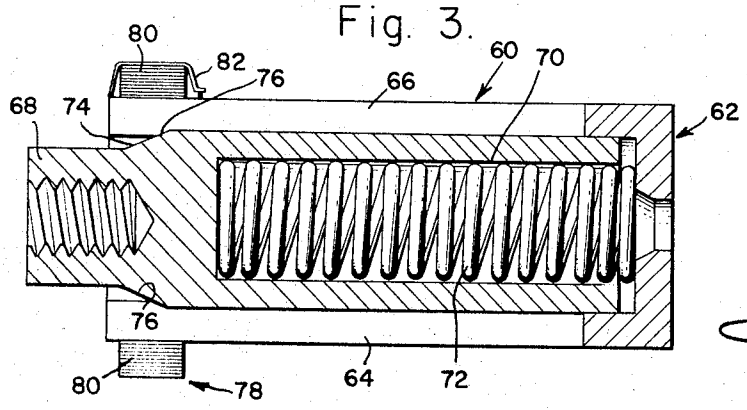


Fig. 3.



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MECHANICAL ACTUATOR PACKAGE

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16 Claims. (Cl. 74—2)

ABSTRACT OF THE DISCLOSURE

The actuator includes a pair of members which may be forced apart, for example by means of a heavily loaded spring. These members are secured together by a latch means which includes a plurality of resilient spring fingers. Keeper means maintains the resilient fingers in the locked position whereby the actuator package is maintained in a fully loaded condition. The keeper means includes a multipiece spool and an electrically conductive wire around the spool. When an electric current circulates through the keeper wire the tensile strength of the wire very rapidly falls below the tension in the wire whereby the wire suddenly breaks as a result of a mechanical failure, the spool separates and frees the fingers whereby the actuator package is released.

The present invention relates to electromechanical actuators and more particularly to fast acting actuators capable of providing large forces.

It is frequently desirable to remotely or automatically actuate a device by physically moving a member. One means of accomplishing this is to employ a solenoid or servomechanism wherein an electric current is circulated through a coil coupled to a magnetic armature. Although such mechanisms are effective to provide the desired control, they are normally very expensive. Also when it is necessary to produce a large force the mechanism is not only very bulky and heavy, but also requires large amounts of power and/or are slow acting. As a consequence solenoids and servomechanisms are not entirely suitable for all types of applications wherein a remote control is required.

Another means of accomplishing a remote control is to employ a pyrotechnic device such as a squib. Such devices can be considerably smaller and lighter than a solenoid or servomechanism and produce larger forces. However, they are very susceptible to premature or accidental discharge whereby severe damage and possible personal injury or death may occur. It can thus be appreciated that pyrotechnic devices are extremely dangerous and require a considerable amount of special handling etc. Also, it is impossible to test a pyrotechnic device for reliability without destroying the device. As a result even in those instances where a high degree of reliability is necessary it is impossible to guarantee operation.

More recently the foregoing difficulties and disadvantages have been overcome by employing electromechanical devices such as disclosed and claimed in U.S. Patent #3,163,732 entitled Electrically Fused Spring Package filed in the names of John R. Abbott and John J. Phillips. In a device of this nature a spring is maintained in a loaded condition by an electrically responsive keeper wire. When an electrical current circulates through the wire it becomes hot and its tensile strength decreases below the tension produced therein by the loaded spring. The weakened keeper wire breaks from this tension and the spring is released to actuate any suitable device.

The foregoing type of actuator package is well suited for its intended use and is capable of providing a large working force from a very small package within an extremely short interval following the start of the current. However, the amount of tension in the keeper wire is a function of the amount of force produced by the spring. As a consequence when a very strong or heavily loaded spring has been employed it was necessary to employ a correspondingly strong keeper wire. This in turn requires a correspondingly larger current for heating the wire and/or a correspondingly longer period of time for the wire to separate.

The present invention provides means for overcoming the foregoing difficulties. More particularly the present invention provides an electromechanical device of the foregoing nature wherein the spring may be heavily loaded to provide an extremely strong force while at the same time employing a keeper wire that is very small and capable of separating in an extremely short time in response to a very small current.

In the limited number of embodiments of the invention disclosed herein this is accomplished by providing a member having a plurality of resilient fingers and a drive member that is moveably disposed inside of the fingers. The fingers and the drive member include coacting cam surfaces that prevent the drive member moving until the fingers are expanded radially outwardly. A heavily loaded spring reacts between the two members whereby to force them in opposite directions. The spring also applies a force on the cam surfaces that tends to force the fingers radially outwardly and release the members. However, a large number of turns of a keeper wire encompasses the fingers and prevents the fingers expanding whereby the spring cannot move the members. Since there are a large numbr of turns of keeper wire, a large mechanical advantage is provided whereby a small keeper wire can restrain an extremely large force produced by a very heavily loaded spring. As a consequence the keeper wire will separate in an extremely short interval in response to a small current. Means are also provided for insuring that the separated wire instantly disengages the fingers whereby the members are released.

These and other features and advantages of the present invention will become readily apparent from the following detailed description of a limited number of embodiments thereof, particularly when taken in connection therewith the accompanying drawings wherein like reference numerals refer to like parts and wherein

FIGURE 1 is a cross sectional view of an actuator package embodying one form of the present invention,

FIGURE 2 is a side view, on a greatly enlarged scale, of a keeper wire employed in the actuator package of FIGURE 1.

FIGURE 3 is a cross sectional view of an actuator package embodying another form of the present invention.

FIGURE 4 is a cross sectional view of an actuator package embodying a still further form of the present invention.

Referring to the drawings in more detail and particularly to FIGURES 1 and 2, the present invention is particularly adapted to be embodied in a small electromechanical package **10** capable of producing an extremely large force within an extremely short interval following the circulation of an electrical current therethrough.

More particularly, the actuator package **10** includes a first or support member **12** having a mounting flange **14**. This flange **14** may be rigidly secured to a fixed reaction member such as a bulkhead **16** etc. As will become apparent subsequently the actuator package may be adapted to produce a very large force, for example several hundred pounds. Accordingly, the bulkhead **16** should be sufficiently strong to withstand such a force.

The support member **12** includes a barrel **18** that extends at right angles to the mounting flange **14**. A passage

20 having a generally cylindrical surface extends axially through the barrel 18. In addition the barrel 18 includes a plurality of cantilever fingers 22. The inner ends of the fingers 22 form an integral part of the flange 14 whereby they are rigidly held in place.

The fingers 22 may be formed by any suitable means such as by cutting the barrel 18 longitudinally at a plurality of equally spaced points. The resultant fingers 22 will thereby be separated from each other by a corresponding number of longitudinally extending slots 24. The fingers 22 will thus act as springs whereby the outer ends 26 thereof may be resiliently deflected between a radially inner position and a radially outer position. The fingers 22 may naturally remain in either position. However, in the present instance they remain in the inner position, i.e. the position of FIGURE 1.

The package 10 also includes a second or drive member 28 that is moveable relative to the support member 12. In the present embodiment the drive member 28 fits into the passage 20 extending through the center of the barrel 18. Preferably the exterior surface of the drive member 28 is effective to slide freely along the cylindrical surface inside of the barrel 18. A plurality of guide pins 30 or similar devices may project outwardly from the drive member 28 so as to extend into and through the slots 24. This will be effective to prevent the second member 28 rotating as it travels axially through the barrel 18.

A stop such as a pin or flange 32 may be provided on the inner end of the drive member 28. This stop 32 engages the end of the support member 12 or the bulkhead 16 upon which it is mounted. This is effective to limit the stroke of the drive member and prevent it from passing completely through the barrel 18.

A drive spring 34 is disposed concentrically about the exterior of the barrel 18 with one end engaging the flange 14 and the other end engaging the pins 30. This spring 34 will thus react between the support and drive members 12 and 28 and tends to bias the drive member 28 axially through the barrel 18 (to the left as seen in FIGURE 1). Normally it is desirable for the actuator package 10 to produce a large force, for example several hundred pounds. Under these circumstances the spring 34 is very stiff. Although the spring 34 may be of any desired form such as one or more helical springs, it has been found a stack of Belleville washers provides very large forces in a small space.

The stop 32 limits the amount of travel of the second member and prevents its being forced out of the barrel 18. In order to maintain the drive member 28 locked in a loaded or cocked position with the spring 34 fully loaded, a latch 36 may be provided. In the present instance this latch includes a tapered portion adjacent the outer end of the drive member 28. This tapered portion forms an annular ramp or cam surface 38. In addition the outer ends 26 of the fingers 24 include tapered portions that provide a set of ramps or cam shoulders 40 on the inner surfaces thereof.

When the resilient fingers 22 are in their radially inner position, the inside diameters of the shoulders 40 are less than the outside diameter of the drive member 28. As a consequence the cam surface 38 on the drive member 28 will engage the set of cam shoulders 40. As long as the fingers 22 remain in their inner position the drive member 28 will be unable to pass beyond the ends 26 of the fingers 22. However, when the fingers 22 are spread radially outwardly, the inside diameter of the cam shoulders 40 will be increased to or greater than the outside diameter of the drive member 28.

It is to be noted that the cam shoulders 40 on the fingers 22 and the drive member 28 are beveled at substantially the same angle. When the spring 34 is compressed it forces the drive member 28 axially of the barrel 18 with the cam surface 38 engaging the shoulders 40. Since the spring 34 has a very large force the cam surface 38 will tend to expand the various fingers 22 toward the radially outer position whereby the spring 34 may force the drive member 28 past the shoulders 40.

In order to prevent the fingers 22 spreading outwardly and releasing the drive member 28, a keeper 42 is provided for maintaining the fingers 22 compressed into the radially inner position. In the present instance this keeper 42 is in the form of an electrically conductive wire 44 wound around the exterior of the fingers 22. As long as the wire 44 is unbroken the fingers 22 will remain locked in the inner position. However, as soon as the wire 44 breaks the fingers 22 are released and the spring 34 will force the drive member 28 axially of the barrel 18.

In order to control breaking of the wire 44, the wire may be connected to a source 46 of electrical current. When the switch 48 is closed, the source 46 is effective to circulate enough current through the wire 44 to heat it enough to cause it to separate. The current may be large enough to melt the wire 44. However, as the temperature of the wire 44 increases beyond a predetermined level the tensile strength of the wire decreases. It is to be noted that a large amount of tension is produced in the wire 44 by the spring 34 and the coaction of the cam surface 38 and the shoulders 40 spreading the fingers 22. As a result, when the current heats the wire 44 above this critical level the tensile strength will fall below the tension and the wire 44 will break.

It is to be noted that the wire 44 must have a sufficient tensile strength when it is at normal temperatures to withstand the tension force resulting from the spreading of the fingers 22. However it is desirable to maintain the diameter of the wire 44 as small as possible. This will enable a small amount of current to be used and insure the wire 44 rapidly reaching the critical failure temperature. In order to permit a small diameter wire with a low tensile strength to be employed, the keeper wire 44 may be wound around the fingers 22 a large number of times. For example, the wire 44 may include as much as 50 turns or more.

By a proper choice of angles on the cam surface 38 and shoulders 40 and the proper number of turns a very large mechanical "advantage" may be obtained. By way of example, it has been found that a wire 44 with a tensile strength of about 4 pounds may restrain a spring 34 having a force of about 400 pounds. Thus a mechanical advantage of 100 to 1 is obtained. As a consequence of this large advantage the wire 44 may be small enough to be heated by a small current, for example 1 to 5 amperes. Moreover, because of its small size the wire 44 will heat up and separate in a very short interval, for example a few milliseconds or less.

As soon as the wire 44 separates it is possible for the fingers 22 to expand radially and allow the drive member 28 to perform the desired operation. However, it has been found that if the wire 44 should separate near one end a large amount of friction results from the large number of turns of the wire 44 sliding on the exterior of the barrel 18. This makes the unwinding of the keeper wire 44 from the fingers 28 and the release of the drive member 22 slow and unpredictable. Accordingly, if a large number of turns of small wire are to be employed, it is also desirable to provide means for insuring that the wire 44 rapidly unwinds as soon as it separates. Although this may be accomplished in a wide variety of ways in the present instance the keeper wire 44 is coupled to a resilient member that will unwind the wire 44 as soon as it is released. In the present embodiment the wire 44 is threaded through a hollow tubing 50 of the type commonly employed for making hypodermic needles. Such a tubing 50 is sufficiently flexible to permit it to be tightly wrapped around the exterior of the fingers 22. However, it is very resilient and straightens out rapidly when released.

Such a keeper 42 is shown in FIGURE 2. Normally the tubing is not continuous. Instead it has a short break which exposes a short segment 52 of the wire 44. In the encased portions the current flows through both the tubing

50 and the wire 44 whereas in the exposed segment 52 all of the current goes through the wire 44. As a consequence the exposed segment 52 of the wire 44 will heat up and weaken more rapidly than the rest of the wire. As a consequence the most probable point of separation is in the region of the exposed segment 52. It is to be noted that the tubing 50 will tend to reinforce the portions of the wire it surrounds and thereby further increase the probability of the separation occurring at the segment 52.

In order to employ this package 10 it is first loaded. This is accomplished by moving the drive member 28 inwardly to load the spring 34. The fingers 22 are then compressed inwardly so that the shoulders 40 will engage the surface 38 and lock the drive member 28 in position. Following this the encased keeper wire 44 is wrapped around the fingers 22 a sufficient number of times to withstand the expanding force produced by load spring 34. The package 10 is now fully loaded and the drive member 28 may be connected to a load to be actuated thereby.

In order to actuate the package 10 after it has been loaded, a current is circulated through the keeper wire 44. This current will cause the temperature of the exposed segment 52 to rapidly rise above the critical temperature. The wire 44 will then separate. When this occurs the tubing 50 will immediately tend to unwrap itself from the fingers 22. The fingers 22 will thereby be instantly released and the drive member 28 freed to move axially through the barrel 18 with the full force of the spring 34.

As an alternative the embodiment of the actuator package 60 shown in FIGURE 3 may be employed. This package 60 is very similar to the preceding package 10 in that it includes a support member 62 having a barrel 64 with a plurality of resilient fingers 66. The support member 62 is adapted to be attached to any desired structure such as a bulkhead. A drive member 68 is slideably disposed inside of the barrel 64 for movement axially thereof.

A passage 70 extends axially of the drive member 68 for receiving a load spring 72. This spring 72 reacts between the support member 62 and the drive member 68 whereby the drive member 68 is biased axially of the passage 70. The outer end of the drive member 68 includes a ramp or cam surface 74 which is effective to engage similar cam shoulders 76 on the insides of the fingers 66. When the fingers 66 are in the radially inner position shown, the drive member 68 cannot move axially through the barrel 64. However the force from the loaded spring 72 tends to force the fingers 66 radially outwardly. When the fingers 66 do move to the radially outer position the drive member 68 is released. The spring 72 then forces the drive member 68 outwardly and produces the desired operation.

In order to prevent the drive member 68 moving through the fingers 66 a suitable keeper 78 is provided for maintaining the fingers 66 compressed into the radially inner position. Although the keeper 78 may be the same type employed in the first embodiment, in this embodiment the keeper 78 includes a spring ribbon 80 wrapped around the fingers 66. By employing a large number of turns, for example 5 or 10 turns or more, the spring ribbon 80 may be relatively light weight and very resilient, similar to the main spring in a watch. Such a spring 80 may be tightly wound around the fingers 66 for retaining them locked into position. However as soon as it is released, the spring 72 instantly unwinds and expands radially outwardly and frees the fingers 66.

To prevent the untimely unwinding of this spring 80, a current responsive keeper wire 82 is attached to this spring 80. When this wire 82 is at room temperature, the tensile strength is just adequate to retain the spring 80 in the tightly wound position. However when a current flows through this wire 82, the temperature rapidly rises into a critical range wherein the tensile strength decreases. As soon as the strength falls sufficiently, the wire 82 breaks and the spring 80 will immediately unwind from around the fingers 66. A portion of this unwinding will be attributable to the force resulting from the spring 80 forcing the drive member 68 against the cam shoulders 76 on the fingers 66. However, a large part of the unwinding force will result from the natural resiliency of the spring 80. It will thus be seen that even though a large number of turns are employed the spring 80 will rapidly release the fingers 66.

As a further alternative the package 90 of FIGURE 4 may be employed. This package 90 includes a support member 92 having a fastening means such as a clevis 94 for being attached to a load bearing member such as a bulkhead etc. A second, or drive member 96 is provided which also includes fastening means such as a clevis 98 for attaching the package 90 to a load to be supported but released.

The first member 92 includes a shank 100 on one end while the second member 96 includes a barrel 102 having a passage 104 into which the shank 100 may fit. Fastening means such as complementary threads 106 may be provided on the barrel 102 and the shank 100 for securing the two members 92 and 96 together.

The barrel 102 includes a plurality of fingers 108 which surround the passage 104 and are moveable between a radially inner position and radially outer position. Normally the fingers 108 move toward the outer position. When the fingers 108 are in the inner position, the threads 106 on the fingers 108 and the shank 100 will firmly lock the members 92 and 96 together. However when the fingers 108 are in the outer position, the threads 106 will separate and the two members 92 and 96 will be disconnected.

In order to maintain the fingers 108 in the inner position and secure the members 92 and 96 together a suitable keeper 110 is provided. The keeper 110 fits around the fingers 108 and maintains them compressed inwardly into the inner position. Although the keeper 110 may be identical to either of the preceding embodiments, in this embodiment the keeper 110 includes a bobbin or spool 112 that fits over the exterior of the fingers 108. This spool 112 includes several pieces such as three or four that may be placed together to form a cylinder. However, the pieces may rapidly separate and release the fingers 108.

A thermal wire 114 is wrapped around the pieces a large number of times so as to form a single structure that is capable of retaining the fingers 108 locked in position. This wire 114 may be of any desired variety. However it includes a small wire and a surrounding tubing similar to that in FIGURE 2.

In order to utilize this package 90, the pieces of the bobbin or spool 112 are placed together and the keeper wire 114 wound there around until a strong self-supporting keeper unit 110 is formed. This keeper 110 may then be slipped onto the exterior of the fingers 108 and moved to their outer ends 116, this will compress the fingers 108 inwardly and retain them in the inner position. Following this the two members 92 and 96 are threaded together until the overall length of the package 90 is suitable for securing the load to the support.

After the assembled package 90 is secured in position it may be actuated by circulating a current through the keeper wire 114. When the wire 114 separates, the resiliency of the fingers 108 will separate the pieces of the spool 112 and move into the outer position. When this occurs the two members 92 and 96 will be released.

It may be appreciated that the spool 112 and wire 114 wrapped therearound forms an easily handled preassembled keeper unit 110. This keeper 110 may be easily slipped over the fingers of any of the actuator packages 10, 60 or 90 and as a consequence is suitable for installation where the device is to be repeatedly employed.

Although only a limited number of embodiments of the present invention are disclosed herein, it will be readily apparent to persons experienced in the art that numerous changes may be made without departing from

the invention. For example, the arrangement and configuration of the various support and the drive members may be varied. Also the form of the keeper may be varied. Accordingly, the foregoing disclosures and descriptions are for illustrative purposes only and do not in any way limit the present invention which is defined only by the claims which follow.

I claim:

1. An electromechanical actuator package including the combination of

an outer member,

an inner member moveably disposed inside of said outer member,

a plurality of resilient fingers on the outer member surrounding said inner member and being moveable between a radially inner position and the radially outer position,

a cam surface on the inner member,

cam shoulders on said fingers positioned to engage said cam surface when the fingers are in the inner position and prevent the members moving relatively to each other, the cam shoulders being effective to disengage the cam surface and release said members for relative movement when the fingers are in the radially outer position,

spring means connected to said members and forcing the inner member through said fingers, said spring forcing the cam surface against said shoulders whereby the fingers are forced radially outwardly towards the second portion,

a keeper wrapped around said fingers and keeping them in the inner position,

said keeper including a wire having a tensile strength at ambient temperatures that is greater than tension produced in said wire by the expanding fingers, said keeper including a resilient sleeve around said wire to unwind the keeper when the wire separates.

2. An electromechanical actuator package including the combination of

a pair of members moveable relative to each other,

a cam surface on one of said members,

a plurality of resilient fingers on the other of said members, said fingers being movable between a radially inner position and a radially outer position,

cam shoulders on said fingers positioned to engage the cam surface when the fingers are in the inner position and prevent the members moving relatively to each other, the cam shoulder being effective to disengage the cam surface and release said members for relative movement when the fingers are in the radially outer position,

an expandable keeper spool encompassing the fingers and retaining them in the inner position,

a keeper wire wrapped around the keeper spool, said wire having a tensile strength at ambient temperature greater than the tension in said wire, said wire having a tensile strength at an elevated temperature that is less than said tension.

3. An electromechanical actuator package including the combination of

a plurality of resilient fingers, said fingers being moveable between a radially inner position and a radially outer position,

a member moveable relative to the fingers,

cam means on said fingers and the member, said cam means being positioned to engage each other and lock the member in a fixed position when the fingers are in the inner position, said cam means being effective to separate and release said member when the fingers are in the radially outer position,

means exerting a force on said member tending to move said member relative to the fingers, said cam means being effective to spread said fingers into the radially outer position, and

a keeper including a center wire and a surrounding resilient sleeve, said center wire having a high tensile strength at ambient temperature and a low tensile strength above a predetermined elevated temperature, said sleeve being effective to unwind said keeper from said fingers when said wire separates.

4. An electromechanical actuator package including the combination of

a plurality of resilient fingers, said fingers being moveable between a radially inner position and a radially outer position,

a member moveable relative to the fingers,

cam means on said fingers and the member, said cam means being effective to engage each other and lock the fingers and member together when the fingers are in the inner position, said cam means being effective to separate and release said member when the fingers are in the radially outer position,

means exerting a force on said member tending to move said member relative to the fingers, said cam means being effective to spread said fingers into the radially outer position,

a keeper spool encompassing the fingers and maintaining them in the radially inner position, said keeper spool being expandable to free said fingers for movement into the radially outer position, and

a keeper wire encompassing said spool and having a high tensile strength at ambient temperatures and a low tensile strength at a predetermined elevated temperature.

5. An electromechanical actuator package including the combination of

a plurality of resilient fingers, said fingers being moveable between a radially inner position and a radially outer position,

a member moveable relative to the fingers,

cam means on said fingers and member, said cam means being effective to engage each other and lock the fingers and member together when the fingers are in the inner position, said cam means being effective to separate and release said member when the fingers are in the radially outer position,

means exerting a force on said member tending to move said member relative to the fingers, said cam means being effective to spread said fingers into the radially outer position,

a keeper wire wrapped around said fingers and having a high tensile strength at ambient temperature and a low tensile strength above a predetermined elevated temperature, the number of turns of said wire being large enough to reduce the tension in the wire produced by the cam means to less than the tensile strength of the wire at ambient temperature but few enough to maintain the tension in said keeper wire greater than the low tensile strength whereby said wire will break, and

means to unwind said keeper wire from said fingers when said wire breaks.

6. An electromechanical actuator package including the combination of

a plurality of resilient fingers moveable between a radially inner position and a radially outer position,

a member moveable relative to said fingers,

means on said fingers positioned to engage the member when the fingers are in the inner position and prevent movement of the member, said means being effective to disengage said member when the fingers are in the radially outer position and release the member for movement,

means exerting a force on said member tending to move said body member relative to the fingers and biasing the fingers radially outwardly, and

a keeper wrapped around the fingers and effective to maintain the fingers in the inner position, said keeper including means effective to separate in response to

a current therethrough, said keeper including means effective to unwrap said keeper upon said separation.

7. An electromechanical actuator package including the combination of

a plurality of resilient fingers moveable between a radially inner position and radially outer position,

a member moveable relative to said fingers,

said fingers when in the inner position engaging said member and preventing movement thereof, said fingers when in the outer position releasing the member for movement,

a plurality of turns of a keeper wire wrapped around the fingers to maintain the fingers in the inner position, said wire being breakable to release the fingers for movement to the outer position, and

resilient means coupled to said keeper wire to unwind the keeper wire from the fingers when said wire breaks.

8. An electromechanical actuator package including the combination of

a plurality of resilient fingers moveable between a radially inner position and a radially outer position,

a member moveable relative to the fingers,

means on said fingers positioned to engage the member when the fingers are in the inner position and prevent movement of the member, said means being effective to disengage said member when the fingers are in the radially outer position and release the member for movement,

means exerting a force on said member tending to move said body member relative to the fingers and biasing the fingers toward the radially outer position,

a keeper wire having a high tensile strength at ambient temperature and a low tensile strength above a predetermined elevated temperature, a plurality of turns of said wire wrapped around the fingers until the tension produced in the wire by the spreading of the fingers is less than the tensile strength of the wire at ambient temperature but is greater than the tensile strength of the wire at the elevated temperature whereby said keeper wire separates at the elevated temperature, and

mean effective to unwind said keeper wire when it separates.

9. An electromechanical actuator package including the combination of

an outer member having a passage extending axially therethrough,

an inner member disposed in said passage moveable relative to the outer member,

a plurality of resilient fingers on the outer member surrounding the inner member, said fingers being moveable between a radially inner position and the radially outer position,

a cam surface on the inner member,

cam shoulders on said fingers positioned to engage the cam surface when the fingers are in the inner position and retain the inner member in position, the cam shoulders being effective to disengage the cam surface and release said inner member for movement when the fingers are in the radially outer position,

spring means connected to said members and forcing the cam surface against said shoulders whereby the fingers are forced radially outwardly towards the second portion, and

a plurality of turns of a keeper wrapped around the fingers, said keeper having a tensile strength at ambient temperature greater than tension produced in said keeper by the spring means, said keeper having a tensile strength at an elevated temperature that is less than said tension whereby the keeper breaks at said elevated temperature, said keeper being resilient and effective to rapidly unwind when it breaks.

10. An electromechanical actuator package including the combination of

a pair of members moveable relative to each other,

latch means on one of said members moveable between a locked position wherein said members are secured together and an unlocked position wherein said members are released and free to move,

means exerting a force on said members tending to move them in opposite directions and biasing the latch means into the unlocked position,

a keeper retaining the latch means in the locked position against the biasing force, said keeper being effective to separate and release the latch means when the temperature of the keeper exceeds a predetermined level, and

spring means in said keeper to release said latch means when the keeper separates.

11. An electromechanical actuator package including the combination of

a pair of members moveable relative to each other,

latch means on one of said members moveable between a locked position wherein said members are secured together and an unlocked position wherein said members are free to move,

means exerting a force on said members tending to move them in opposite directions and biasing the latch means into the unlocked position,

a keeper wire encompassing the latch means and retaining the latch means in the locked position against the biasing force, said wire being effective to separate and release the latch means when the temperature exceeds a predetermined temperature, and

a resilient sleeve encompassing the keeper wire, said sleeve being effective to remove the keeper wire from the latch means when the wire separates.

12. An electromechanical actuator package including the combination of

first and second members moveable relative to each other,

latch means on the first member moveable between a locked position and an unlocked position, said latch means when in the locked position engaging the second member and securing said members together,

means exerting a force on said members biasing them in opposite directions and biasing the latch means into the unlocked position,

a multipiece keeper on the latch means for retaining the latch means in the locked position against the biasing force, and

a temperature responsive member maintaining the pieces of the keeper together, said temperature responsive member being effective to separate at an elevated temperature and allow the pieces of the keeper to separate and release the latch means.

13. An electromechanical actuator package including the combination of

a pair of members moveable relative to each other,

a plurality of fingers on the first member engaging the second member and retaining them locked together,

means tending to move said members in opposite directions and spread said fingers radially outwardly to release the bodies for relative movement,

a keeper spool surrounding the fingers and retaining them locked in position, and

a keeper wire wrapped around the spool, said wire being effective to separate at an elevated temperature and release the spool from the fingers.

14. An electromechanical actuator package including the combination of

a pair of members moveable relative to each other,

a plurality of fingers on the first member engaging the second member and retaining them locked together,

means tending to move said members in opposite directions and spread said fingers radially outwardly to release the bodies for relative movement, and

a keeper wrapped around the fingers, said keeper including a center wire that weakens and separates at an elevated temperature and a resilient sleeve around the wire that unwraps the keeper from the fingers when the wire separates.

15. An electromechanical actuator package including the combination of

a pair of members moveable relative to each other,

a plurality of fingers on the first member engaging the second member and retaining the members locked together,

means tending to move said members in opposite directions and spread said fingers radially outwardly to release the members for relative movement, and

a keeper encompassing said fingers and maintaining them in engagement with the first member, said keeper including a plurality of separable pieces on said fingers and a wire wrapped around said pieces, said wire having a large tensile strength at ambient temperature and a low tensile strength above a predetermined temperature, said wire encompassing the pieces a sufficient number of times to reduce the tension produced therein from the spreading of the fingers to less than said large tensile strength.

16. An electromechanical actuator package including the combination of

a pair of separate load bearing members moveable relative to each other in response to a force applied to said members,

a keeper for maintaining said members secured together, said keeper including a plurality of separable pieces biased radially outwardly when said members are secured together,

an electrically conductive temperature responsive member encompassing said keeper, said temperature responsive member having a tension therein and being effective to maintain said pieces biased radially inwardly toward each other whereby said load bearing members are secured together by said keeper,

said temperature responsive member when at ambient temperatures having a tensile strength greater than said tension, said temperature responsive member when at an elevated temperature having a tensile strength less than said tension, and

means coupled to said temperature responsive member whereby an electric current may be circulated through said temperature responsive member until said member is heated above elevated temperature and separates whereby the pieces of said keeper separate and said load bearing members are released.

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