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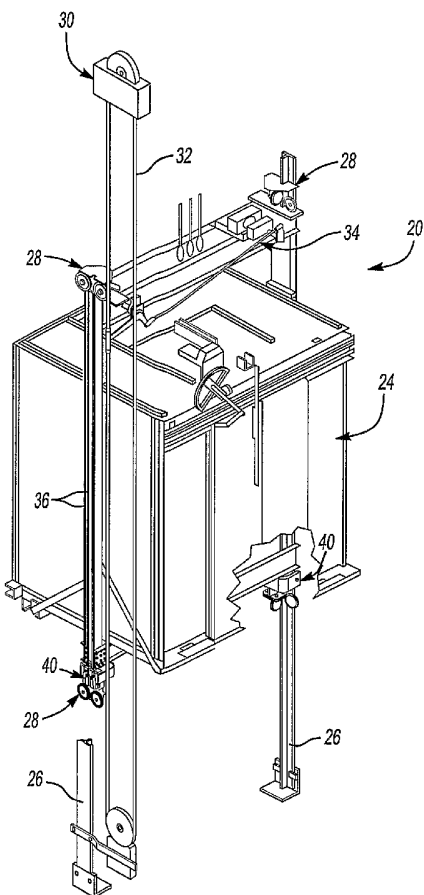
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(54) Title: ELEVATOR SAFETY DEVICE



(57) Abstract: The disclosed elevator safety devices provide better force management associated with stopping events. In one example, a linkage (44) provides a self-centering safety device (40) where lateral forces are accommodated within the safety device (40) and not transferred to other portions of a car assembly (24). In another example a resilient limiting member (100) automatically adjusts a braking force of the safety device to accommodate changes in a coefficient of friction during a stopping event.

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ELEVATOR SAFETY DEVICE

1. Field of the Invention

This invention generally relates to elevator safety devices. More particularly,
5 this invention relates to features of elevator safety devices including a self-centering
feature and a braking force adjustment feature.

2. Description of the Related Art

Elevator systems typically include guide rails positioned within a hoistway to
10 guide an elevator car as it travels between levels of a building, for example. Safety
devices provide an ability to stop the elevator car from moving (usually downward)
by applying a braking force against the guide rails. Various safety device
configurations are known, including wedge, roll and scissor types. There are several
shortcomings and drawbacks associated with known braking devices.

15 One drawback associated with many safety devices is that they transmit lateral
forces into the car frame if the safety device does not engage two sides of the guide
rail simultaneously. If the safety device is misaligned relative to the guide rail or one
of the wedges or friction pad holders actives quicker than the other, the contact
between the safety device and one side of the guide rail results in a lateral force
20 applied to the car frame or roller guides. Such forces can be great enough to damage
the roller guides or the car frame, which results in additional repair cost and
maintenance time. There is a need for an improved arrangement that provides
consistent engagement of the safety device with the guide rails to avoid such lateral
forces.

25 Various safety device configurations provide a constant normal force against
the guide rail once full engagement occurs. Another shortcoming of such braking
devices is that there is an increasing braking force applied as braking conditions
change during a stop procedure. For example, where the coefficient of friction
increases during a stopping event, the braking force increases and provides
30 inconsistent decelerations. Various substances on a guide rail or changes in the guide
rail surface from previous stopping events, for example, change the coefficient of

friction. In some instances, the variation in deceleration may exceed the amount allowed by current codes. It is desirable to provide a constant deceleration rate during a stopping event to satisfy current codes and provide greater comfort to passengers.

5 This invention provides improved elevator safeties that avoid the shortcomings and drawbacks discussed above.

SUMMARY OF THE INVENTION

One example safety device designed according to an embodiment of this invention has a plurality of braking members adapted to engage oppositely facing
10 surfaces on a guide rail. A linkage connects the braking members such that contact between one of the braking members and a guide rail surface causes movement of another one of the braking members toward contact with an oppositely facing guide rail surface. The linkage arrangement avoids transmission of lateral forces to the car frame or roller guides and provides a self-centering safety device.

15 Another example device designed according to an embodiment of this invention includes a plurality of braking members that are selectively moveable into engagement with a guide rail. A resilient limiting member automatically limits a braking force of the braking members such that the braking force does not exceed a selected threshold. The limiting member in one example selectively adjusts the
20 braking force of the braking members responsive to a change in a coefficient of friction associated with engagement between the braking members and the guide rail. The limiting member allows for having a consistent deceleration rate throughout an entire stopping event.

The various features and advantages of this invention will become apparent to
25 those skilled in the art from the following detailed description of the currently preferred embodiments. The drawings that accompany the detailed description can be briefly described as follows.

BRIEF DESCRIPTION OF THE DRAWINGS

30 Figure 1 schematically illustrates selected portions of an elevator system including a safety device designed according to this invention.

Figure 2 is a schematic illustration of an elevator safety device designed according to an embodiment of this invention as seen from the side facing a guide rail.

Figure 3 is a schematic illustration of the embodiment of Figure 2 seen from the opposite side.

5 Figure 4 schematically illustrates the embodiment of Figure 2 in a first operating condition.

Figure 5 schematically illustrates the embodiment of Figure 2 in another operating condition.

10 Figure 6A schematically illustrates an operating feature of a safety device designed according to this invention in a first operating condition.

Figure 6B illustrates the feature of Figure 6A in a second operating condition.

Figure 7 schematically illustrates the operation of a braking force limiting device designed according to an embodiment of this invention.

15 Figure 8 graphically illustrates selected performance features of elevator safety devices.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figure 1 schematically shows selected portions of an elevator system 20. An elevator car assembly 24 travels along guide rails 26 that are supported within a hoistway (not illustrated) for example. A plurality of guide roller assemblies 28 guide the car assembly 24 along the guide rails 26.

20 A governor device 30 includes a governor rope 32 that operates in a conventional manner. A linkage 34 is associated with the governor rope 32 in a conventional manner to trigger safety device actuators 36 that operate safety devices 40 under selected circumstances. For example, when the car assembly 24 is descending at a speed that exceeds that allowed by the governor device 30, the safety devices 40 operate to apply a braking force to the guide rails 26 to stop the car assembly 24 from further descent.

30 Figure 2 shows one example safety device 40 designed according to this invention. Braking members 42 are adapted to engage the guide rail 26 during a stopping event. In this example, the braking members 42 comprise friction pads of known materials. A linkage 44 supports the braking members 42 in a manner that

renders the safety device 40 self-centering. The linkage 44 includes braking member support links 46 to which the braking members 42 are secured. A plurality of swing arm links 48 are associated with each of the braking member support links 46. The swing arm links 48 are pivotally moveable relative to the braking member support links 46 at the pivot axes 50. Opposite ends of the swing arm links 48 are pivotable about an axis 52.

The outward (according to the drawing) ends of the swing arm links 48 are coupled with connecting rod links 54 that extend into the page according to the drawing. The connecting rod links 54 are pivotally mounted at 56 on a block link 58. The block link 58 is adapted to be secured to the car frame of the car assembly 24 in a known manner.

The braking member support links 46 and the swing arm links 48 are movable at least within a first plane that is parallel to the plane of the page. The connecting arm links 54 extend generally perpendicular to the first plane. One end of the connecting arm links 54 is visible in the illustration of Figure 2. An opposite end of the connecting arm links 54 is visible in Figure 3, which illustrates an opposite side of the safety device 40 compared to the view of Figure 2.

Referring to Figure 3, a connecting link 60 is pivotally connected with the connecting rod links 54 such that back link members 62 are pivotally moveable relative to the connecting rod links 54. The connecting link 60 includes yoke portions 66 between sets of the back link members 64. The yoke members 66 provide reaction surfaces for a biasing portion 70 that biases the back link members 64 for movement with each other prior to full engagement of the braking members 42 during a stopping event. The biasing portion 70 in this example includes a rod 72 supporting a plurality of springs and in this case Belleville washers 74 that are compressed between the yoke portions 66 and securing members 76, which are threaded nuts and washers in this example.

The entire linkage is moveable in a manner that provides a self-centering function for the braking device 40. This prevents any undesirable forces acting on the car frame or the roller guides 28.

Referring to Figure 4, the braking device 40 is shown in a condition where the safety device is triggered to stop movement of the car assembly 24. The situation in

Figure 4 includes one of the braking members 42 engaging one surface 80 on the guide rail 26 prior to the other braking member 42 engaging the surface 82 on the guide rail 26. This may occur when the safety device is not centered about the guide rail, for example. This may also occur if the safety device actuators 36 do not operate consistently or have slightly varied tension or lengths, for example. When this occurs, there is a reactive force shown schematically by the arrow 84 because of the contact between the braking member 42 and the guide rail surface. Prior to this invention, such a reactive force would be transmitted to the roller guide assembly 28, the car frame or both. With the inventive arrangement, however, the linkage 44 allows for the reactive force 84 to operate in a manner that centers the safety device about the guide rail 26 without transmitting any such force to the roller guide assembly 28 or the car frame.

As one of the braking members 42 contacts one of the surfaces on the guide rail 26, the reactive force operates on the linkage 44 to draw the other braking member 42 into engagement with the oppositely facing surface on the guide rail. In the illustration of Figure 4, as the braking member 42 contacts the surface 80, the swing arm links 48 are moving in an upward direction (somewhat clockwise according to the drawing). The force 84 causes the connecting rod links 54 on the right hand side of the drawing to move outward in the direction of the arrow 84. Such movement draws the back link 60 to the right according to Figure 4 or the left according to Figure 3. This movement draws the connecting rod links 54 and the associated swing arm links 48 on the opposite side of the device 40 toward the guide rail surface 82, which brings the other braking member 42 into engagement with the surface 82. Accordingly, the linkage 44 is essentially free floating and provides for alignment of the braking members 42 so that both surfaces of the guide rail 26 are engaged and no intermediate lateral forces are transmitted to other portions of the car assembly 24.

As can be appreciated from Figure 5, when both braking members 42 engage the surfaces 80 and 82, the swing arm links 46 continue moving upward until a top dead center position of the braking member support links 44 is achieved. In such a position, a maximum braking force is applied. The biasing portion 70 under such circumstances experiences compression of the springs 74 such that the yoke portions

66 separate slightly and there is relative movement between corresponding sets of the back link members 64. Because both braking members 42 are engaging the surfaces 80 and 82 simultaneously, there is an equal amount of braking force applied on both sides of the guide rail 26 as schematically shown by the arrows 86 and 88 in Figure 5.

5 The example arrangement provides a self-centering safety device that can be considered a six bar linkage arrangement. In the example of Figures 2-5, the six links include the braking member support link 46, the swing arm links 48, the connecting rod links 54 and the block link 58. In this example, the top and bottom (according to the drawing) block portions 58 are considered one link. The six bar linkage arrangement of this invention provides a significant enhancement to elevator safety
10 devices.

Another feature of the example embodiment is that the lower portion (according to the drawing) of the block link 58 includes a cradle 90 that supports the braking member supporting link 46 in a rest position. One feature of the cradle 90 is
15 that if the safety device becomes misaligned and a braking member 42 contacts the guide rail under conditions where the safety should not be activated, the cradle 90 provides a ground point that prevents a false trip of the safety device as the cradle 90 prevents movement of the linkage. Because the braking member 42 moves upward and away (according to the drawing) from the cradle 90 during a stopping event, the
20 cradle 90 does not impact the ability of the linkage to move and the device to utilize the self-centering features described above.

Referring again to Figure 2, resilient limiting members 100 are supported on the block link 58 for selectively limiting upward (according to the drawing) movement of the braking members 42 and the associated supporting links 46. It is
25 known that link-supported braking members like the braking members 42 reach a maximum braking force application position, which is often referred to as a top dead center position. Conventional arrangements include stopping blocks to keep the braking members from moving beyond the top dead center position. One drawback associated with the conventional arrangements is that any changes in a coefficient of
30 friction during a stopping event resulted in changing decelerations of the car assembly. The example resilient limiting members 100 avoid that problem by effectively sensing changing braking conditions and automatically adjusting a braking

force applied by the braking members 42 responsive to changes in the coefficient of friction during a stopping event.

Although the example limiting member is shown and described in connection with the six bar linkage safety device of Figures 2-5, it is not limited to application with such an arrangement. The friction sensing, resilient limiting member is useful with any linkage type safety device where a braking member moves into a top dead center position to apply a maximum braking force. Further, the example six bar linkage arrangement of Figures 2-5, is useful to provide a self-centering safety without a resilient limiting member 100.

Figure 8 graphically illustrates the changes in a coefficient of friction over time during an example stopping event. Such changes occur because of inconsistencies in the guide rail surfaces, various substances on the guide rail surfaces, pressure, velocity, humidity, or other known factors. The plot represents the coefficient of friction, which corresponds with the accelerations during a stopping event because of the relationship between coefficient of friction and acceleration. It is known that the braking force $F_B = \mu N$, which equals mass times acceleration. Accordingly, the acceleration, $a = \mu N/m$.

Figure 8 also includes a graphical representation 104 of an ideal deceleration curve during a stopping event. The curve 104 shows that there preferably are constant decelerations along much of the braking event, to ensure a smoother stop and keep to forces within safety code limits, for example. The example resilient limiting members 100 accommodate variations in the coefficient of friction so that a stopping event may have an acceleration curve 104.

Figures 6A and 6B schematically show two different positions of an example braking member 42 during the stopping event. Figure 6A shows the braking member 42 near a resting position before engagement with the guide rail 26. Figure 6B shows the braking member 42 in engagement with the guide rail 26 where a maximum braking force F_B is applied. The change in distance Δ shown in Figure 6B corresponds to the amount of compression of the springs 74 during the stopping event. This maximum amount of compression provides the maximum braking force applied by the braking members 42 against the guide rail 26.

The resilient limiting member 100 maintains the braking members 42 in the position illustrated in Figure 6B under most braking conditions. There are situations, however, where the coefficient of friction changes significantly enough that the braking force would increase, causing larger deceleration. The example arrangement
5 accommodates such situations because the limiting member 100 resiliently maintains a position of the braking members 42 that allows for the braking members 42, the braking member support links 46 and the swing arm links 48 to move further upward (according to the drawings) from the position shown in Figure 6B. Those portions move upward from the position illustrated in Figure 6A to the position illustrated in
10 Figure 6B when the device 40 is activated. The resilient limiting member 100 accommodates further upward movement (i.e., beyond the top dead center position) to lessen the normal spring force and the braking force responsive to an increase in the coefficient of friction, for example. As the braking member 42 moves further upward from the position shown in Figure 6B, the amount of compression of the springs 74
15 decreases, which decreases the spring normal force and, therefore, the braking force applied by the braking members 42.

Figure 7 schematically illustrates one example limiting member 100 which comprises a preloaded spring. Assuming a deceleration range is selected corresponding to 0.2 to 1.0 g's, the spring 100 and the normal force springs 74 are
20 selected according to known spring characteristics to activate the appropriate braking force. As the braking member 42 contacts the spring 100, the preload force of the spring 100 resists motion of the braking member 42 with a force equivalent to a 0.2 g braking force. At top dead center, the normal force provided by the spring 74 is equivalent to the normal force for a 1.0 g braking force.

25 If the braking force is .6 g's for example, the friction pad 42 continues to move upward until the resistive spring force of the limiting member 100 is equal to a 0.6 g braking force and, in turn, reduces the normal force of the braking member 42 and the spring 74 to the normal force of a 0.6 g braking force. This is possible because the braking member 42 travels beyond top dead center and the spring 74
30 deflection is reduced, which lessens the spring 74 force and normal force. If the deceleration rate approaches 1.0 g, the resistive spring 100 bottoms out and the normal force is reduced to a 0.2 g braking force.

Consider the following example. The car assembly 24 has a 5,000 kg load on safety (LOS) at 3.5 m/s contract velocity (V_c) and the average coefficient of friction (μ_{avg}) is 0.15 for cast iron grade 30 friction material on the braking members 42. Assume that at a position θ , the resistive spring 100 is at maximum compression and maximum force for a given set up.

The force of the resistive spring 100, F_{rs} at top dead center, which is the spring preload in this example, equals $m(1+a_{0.2}) g/n = m(1.2) g/n = LOS (1.2) g/n = 5,000 \text{ kg} (1.2) 9.81/4 = 14,715 \text{ N}$. The force of the resistive spring 100 F_{rs} at $\theta = m(1+a_{1.0}) g/n = 24,525 \text{ N}$, which is the maximum value.

The spring force F_s of the springs 74 is set as follows. F_s at top dead center = $N/n_s = 2.0 \text{ mg}/n_s \mu_{avg} n = 5,000 \text{ kg} (2.0) 9.81 \text{ m/s}^2/8 (0.15) = 81,750 \text{ N}$. F_s at $\theta = 1.2 \text{ mg}/n_s \mu_{avg} n = 49,050 \text{ N}$. Based upon the above equations and referring to Figure 7, at 0.2 g's the braking force $F_b = 5,000 \text{ kg} (1.2) 9.81 \text{ m/s}^2 = 58,860 \text{ N}$. At this braking force, the coefficient of friction $\mu = F_b/nN$, where N is set for a 0.6 g stop as with a traditional set up. Accordingly, $\mu = 58,860 \text{ N}/4 (130,800 \text{ N}) = 0.1125$. The normal force set to the previous maximum value at top dead center for 2.0 g's compensates for a coefficient of friction of 0.1125. It follows that $F_b = \mu F_s n_s n = 0.1125 (81,750 \text{ N}) 8 = 73,575 \text{ N}$. Acceleration $a = 1 - (F_b/mg) = 1 - (73,575 \text{ N}/(5,000 \text{ kg})(9.81 \text{ m/s}^2)) = 0.5 \text{ g's}$. This is within code allowable limits.

At 0.6 g's, the braking member 42 travels up until the resistive force $F_{rs} = 0.6 \text{ g's}$ at which point the spring force of the springs 74 is also equal to the spring force for a 0.6 g stop. At 1.0 g's, the braking force equals: $F_b = 5,000 \text{ kg} (2.0) 9.81 \text{ m/s}^2 = 98,100 \text{ N}$. At this braking force, the coefficient of friction $\mu = F_b/nN = 0.1125$. The normal force set to the minimum value at θ for .2 g's compensates for a coefficient of friction of 0.1875. It follows that $F_b = \mu F_s N_s n = 73,575 \text{ N}$ and the acceleration $A = 1 - (F_b/mg) = 0.5 \text{ g's}$.

Assuming the coefficient of friction increased to 0.2, the deceleration rate using the example resistive spring 100 set up would be: $F_b = \mu F_s n_s n = 0.2 (49,050 \text{ N}) 8 = 78,480 \text{ N}$. The deceleration rate for this braking force is: $A = 1 - (F_b/mg) = 0.6 \text{ g's}$. This is within acceptable code limits. A traditional arrangement having a solid stopping block preventing the braking member from moving beyond top dead center does not meet code limits under these circumstances.

Accordingly, the example arrangement varies the normal force (i.e., braking force) to compensate for variations in the coefficient of friction during a stopping event, which provides a smoother deceleration within acceptable code limits.

5 One benefit of the example sensing, resilient limiting 100 when utilized on a lever type elevator safety device is the ability to turn over the elevator after only one test in areas governed by certain codes. The ability to turn over the elevator after only one test saves field time and money by reducing the amount of time needed to turn over the safety. With conventional arrangements, an elevator cannot be turned over because of long or short slides during testing. This requires additional field time to
10 reset the safeties and test to ensure compliance. Then another date has to be set to recertify in front of a licensed inspector. With traditional safeties, this is a common occurrence. With the example arrangement, this is avoided, which provides considerable savings.

The preceding description is exemplary rather than limiting in nature.
15 Variations and modifications to the disclosed examples may become apparent to those skilled in the art that do not necessarily depart from the essence of this invention. The scope of legal protection given to this invention can only be determined by studying the following claims.

20

CLAIMS

We claim:

1. An elevator safety device, comprising:
a plurality of braking members adapted to engage oppositely facing surfaces
5 on a guide rail; and
a linkage connecting the braking members such that contact between one of the braking members and a guide rail surface causes movement of another one of the braking members toward contact with an oppositely facing guide rail surface.
- 10 2. The device of claim 1, including
a first braking member that is adapted to engage a first guide rail surface;
a second braking member that is adapted to engage a second, oppositely facing
guide rail surface; and wherein
the linkage includes
15 first links moveable with the braking members, respectively, in a first
plane;
second links extending in a direction generally perpendicular to the
first plane and moveable with the first links, respectively; and
a third link extending between the second links and moveable with the
20 second links, the third link moving in a second plane that is generally parallel
to the first plane.
3. The device of claim 2, wherein each first link comprises a braking member
support link that moves with the corresponding braking member and a plurality of
25 swing arm links that extend between the corresponding braking member support link
and the corresponding second link, the swing arm links being moveable relative to the
braking member support links and moveable relative to the second links.
4. The device of claim 3, wherein the swing arm links have a first end that is
30 pivotally moveable relative to the corresponding braking member support link and a
second end that is pivotally moveable relative to the corresponding second link.

5. The device of claim 3, wherein the second links each comprise two connecting links extending between corresponding ones of the swing arm links and the third link.
6. The device of claim 5, wherein the connecting links having a first end that is pivotally moveable relative to the corresponding swing arm link and a second end that is pivotally moveable relative to the third link.
7. The device of claim 5, including a block link that supports the second links such that the second links are pivotally moveable relative to the block link along an axis that is generally perpendicular to the first and second planes.
8. The device of claim 2, wherein the third link comprises a plurality of back link members coupled to a yoke and a biasing portion associated with the yoke such that the back link members are biased to move in unison as the contact between one of the braking members and the guide rail surface causes movement of the other one of the braking members toward contact with the oppositely facing guide rail surface.
9. The device of claim 8, wherein at least a first back link member is associated with the first braking member and at least a second back link member is associated with the second braking member and wherein the first and second back link members move relative to each other against the bias of the biasing portion responsive to equal braking engagement between the braking members and the guide rail surfaces.
10. The device of claim 1, including a block link supporting the linkage for movement relative to the block link, the block link being adapted to be supported on an elevator car assembly, the block link including a cradle portion that supports the braking members in a rest position where the braking members do not normally engage the guide rail surfaces.
11. The device of claim 1, including a resilient limiting member that limits movement of the braking members, the limiting member automatically adjusting a braking force of the braking members.

12. An elevator safety device, comprising:

a plurality of braking members that are selectively moveable into engagement with a guide rail; and

5 a resilient limiting member that automatically limits a braking force of the braking members such that the braking force does not exceed a selected threshold.

13. The device of claim 12, wherein the limiting member comprises a spring.

10 14. The device of claim 12, wherein the limiting member selectively adjusts the braking force of the braking members responsive to a change in a coefficient of friction associated with engagement between the braking members and the guide rail.

15 15. The device of claim 12, wherein the braking members apply a braking force in a first direction and the limiting member provides a variable limiting force in a second direction that is generally perpendicular to the first direction.

16. The device of claim 12, wherein the braking members are supported by movable link members that move in a first direction toward a maximum braking engagement position and further in the first direction toward an increasingly reduced braking engagement position and wherein the limiting member permits selected movement of the braking members and the link members toward the increasingly reduced braking engagement position to thereby selectively reduce the braking force.

25 17. The device of claim 16, wherein the limiting member comprises a spring that biases the braking members in a second direction opposite the first direction and wherein an increase in the braking force beyond a desired threshold when the braking members are in the maximum braking engagement position operates against the bias of the spring to allow the braking members to move toward the increasingly reduced braking engagement position.

30

18. The device of claim 12, including a block supporting the braking members and wherein the limiting member is supported on the block.

19. The device of claim 12 including a linkage connecting the braking members
5 such that contact between one of the braking members and a guide rail surface causes movement of another one of the braking members toward contact with an oppositely facing guide rail surface.

20. An elevator safety device, comprising:
a plurality of braking members adapted to engage guide rail; and
a linkage supporting the braking members, the linkage having a free-floating
5 portion that automatically centers the braking members relative to the guide rail.

AMENDED CLAIMS

[received by the International Bureau on 16 August 2004 (16.08.2004);
original claims 1-20 replaced by new claims 1-17 (5 pages)]

CLAIMS

We claim:

1. An elevator safety device (40), comprising:
 - a plurality of braking members (42) adapted to engage oppositely facing surfaces on a guide rail (26) including a first braking member (42) that is adapted to engage a first guide rail (26) surface and a second braking member (42) that is adapted to engage a second, oppositely facing guide rail (26) surface; and
 - a linkage (44) connecting the braking members (42) such that contact between one of the braking members and a guide rail surface causes movement of another one of the braking members toward contact with an oppositely facing guide rail surface, wherein the linkage (44) includes
 - first links (48) moveable with the braking members (42), respectively, in a first plane;
 - second links (54) extending in a direction generally perpendicular to the first plane and moveable with the first links (48), respectively; and
 - a third link (60) extending between the second links and moveable with the second links, the third link (60) moving in a second plane that is generally parallel to the first plane.
2. The device of claim 1, wherein each first link (48) comprises a braking member support link (46) that moves with the corresponding braking member (42) and a plurality of swing arm links (48) that extend between the corresponding braking member support link (46) and the corresponding second link (54), the swing arm links (48) being moveable relative to the braking member support links (46) and moveable relative to the second links (54).
3. The device of claim 2, wherein the swing arm links (48) have a first end that is pivotally moveable relative to the corresponding braking member support link (46) and a second end that is pivotally moveable relative to the corresponding second link (54).
4. The device of claim 2, wherein the second links (54) each comprise a connecting link (54) extending between corresponding ones of the swing arm links (48) and the third link (60).

5. The device of claim 4, wherein the connecting links (54) have a first end that is pivotally moveable relative to the corresponding swing arm link (48) and a second end that is pivotally moveable relative to the third link (60).

6. The device of claim 4, including a block link (58) that supports the second links (54) such that the second links (54) are pivotally moveable relative to the block link (58) along an axis that is generally perpendicular to the first and second planes.

7. The device of claim 1, wherein the third link (60) comprises a plurality of back link members (64) coupled to a yoke (66) and a biasing portion (70) associated with the yoke (66) such that the back link members (64) are biased to move in unison as the contact between one of the braking members (42) and the guide rail (26) surface causes movement of the other one of the braking members (42) toward contact with the oppositely facing guide rail surface.

8. The device of claim 7, wherein at least a first back link member (64) is associated with the first braking member (42) and at least a second back link member (64) is associated with the second braking member (42) and wherein the first and second back link members (64) move relative to each other against the bias of the biasing portion (70) responsive to equal braking engagement between the braking members and the guide rail surfaces.

9. An elevator safety device (40), comprising:
a plurality of braking members (42) adapted to engage oppositely facing surfaces on a guide rail (26); and
a linkage (44) connecting the braking members (42) such that contact between one of the braking members and a guide rail surface causes movement of another one of the braking members toward contact with an oppositely facing guide rail surface;
and
a block link (58) supporting the linkage (44) for movement relative to the block link, the block link (58) being adapted to be supported on an elevator car assembly, the block link (58) including a cradle portion (90) that supports the braking members (42) in a rest position where the braking members do not normally engage the guide rail (26) surfaces.
10. An elevator safety device (40), comprising:
a plurality of braking members (42) adapted to engage oppositely facing surfaces on a guide rail (26); and
a linkage (44) connecting the braking members (42) such that contact between one of the braking members and a guide rail surface causes movement of another one of the braking members toward contact with an oppositely facing guide rail surface;
and
a resilient limiting member (100) that limits movement of the braking members (42), the limiting member (100) automatically adjusting a braking force of the braking members (42).
11. An elevator safety device (40), comprising:
a plurality of braking members (42) that are selectively moveable into engagement with a guide rail (26); and
a resilient limiting member (100) that automatically limits a braking force of the braking members (42) such that the braking force does not exceed a selected threshold, the limiting member (100) selectively adjusts the braking force of the braking members (42) responsive to a change in a coefficient of friction associated with engagement between the braking members (42) and the guide rail (26).

12. An elevator safety device (40), comprising:
a plurality of braking members (42) that are selectively moveable into engagement with a guide rail (26); and
a resilient limiting member (100) that automatically limits a braking force of the braking members (42) such that the braking force does not exceed a selected threshold, wherein the braking members (42) apply a braking force in a first direction and the limiting member (100) provides a variable limiting force in a second direction that is generally perpendicular to the first direction.
13. The device of claim 12, wherein the limiting member (100) comprises a spring.
14. The device of claim 12, including a block (58) supporting the braking members and wherein the limiting member (100) is supported on the block (58).
15. The device of claim 12 including a linkage (46) connecting the braking members (42) such that contact between one of the braking members (42) and a guide rail (26) surface causes movement of another one of the braking members (42) toward contact with an oppositely facing guide rail (26) surface.
16. An elevator safety device (40), comprising:
a plurality of braking members (42) that are selectively moveable into engagement with a guide rail (26); and
a resilient limiting member (100) that automatically limits a braking force of the braking members (42) such that the braking force does not exceed a selected threshold, wherein the braking members (42) are supported by movable link members (46, 48) that move in a first direction toward a maximum braking engagement position and further in the first direction toward an increasingly reduced braking engagement position and wherein the limiting member (100) permits selected movement of the braking members (42) and the link members (46, 48) toward the increasingly reduced braking engagement position to thereby selectively reduce the braking force.

17. The device of claim 16, wherein the limiting member (100) comprises a spring that biases the braking members (42) in a second direction opposite the first direction and wherein an increase in the braking force beyond a desired threshold when the braking members (42) are in the maximum braking engagement position operates against the bias of the spring to allow the braking members (42) to move toward the increasingly reduced braking engagement position.

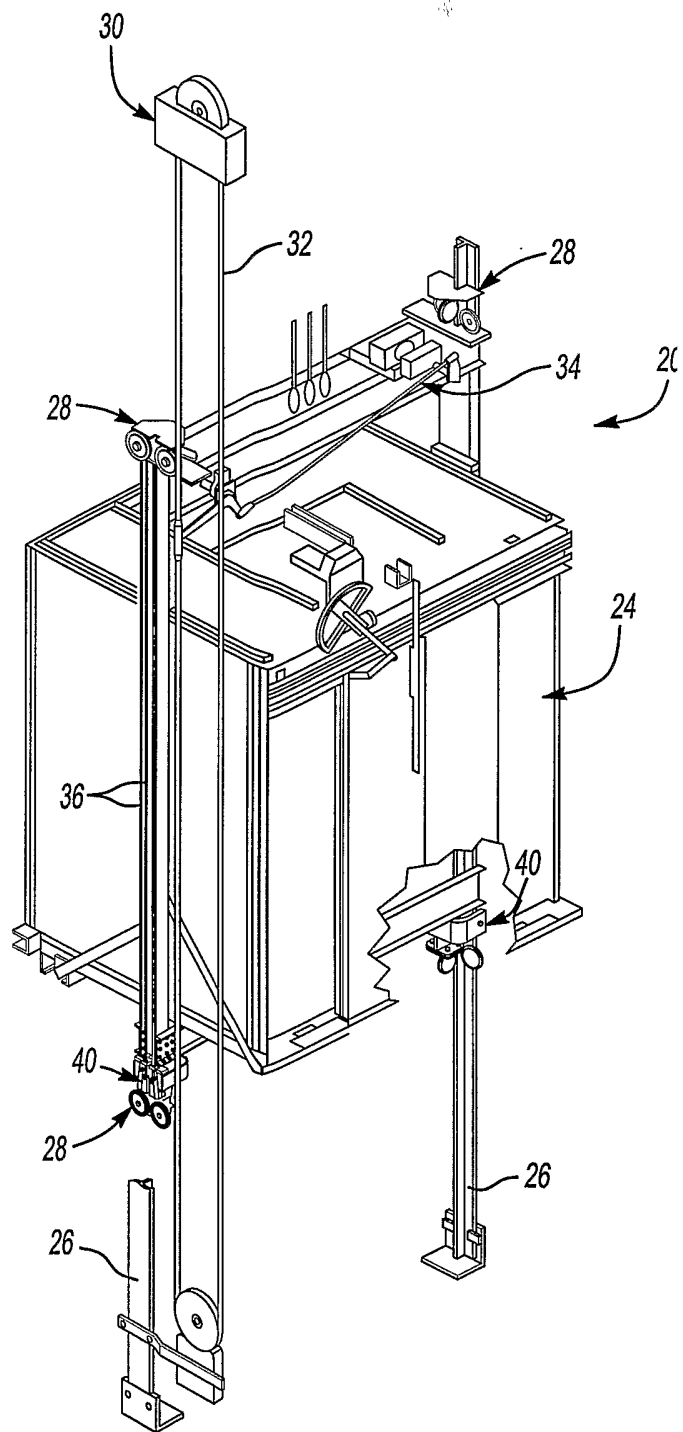


Fig-1

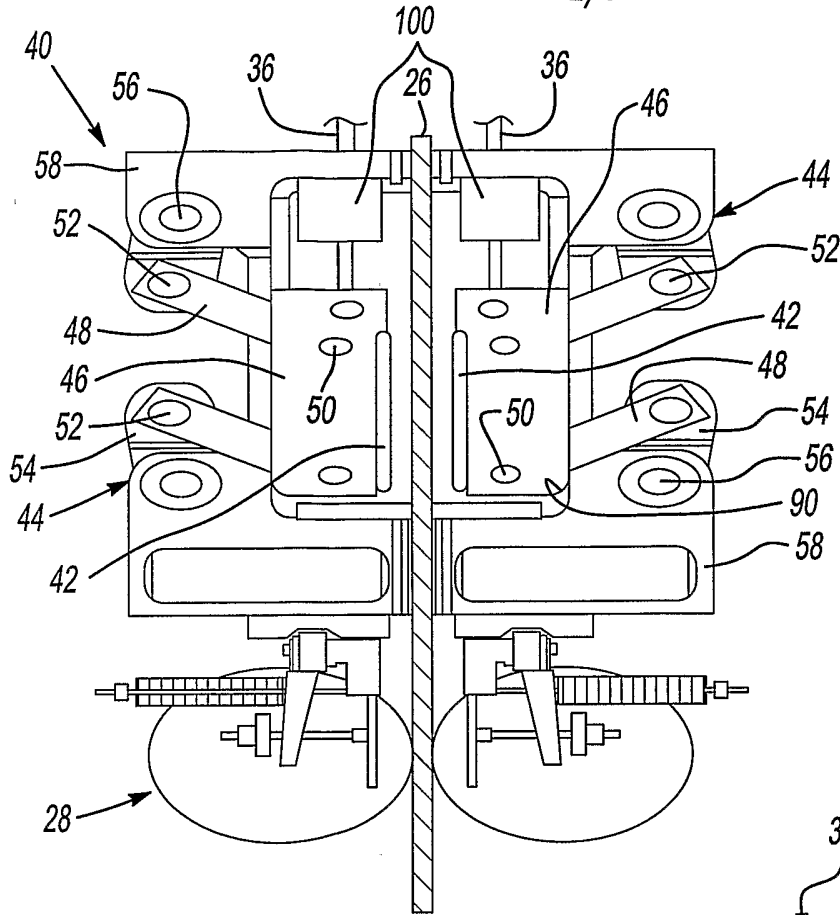


Fig-2

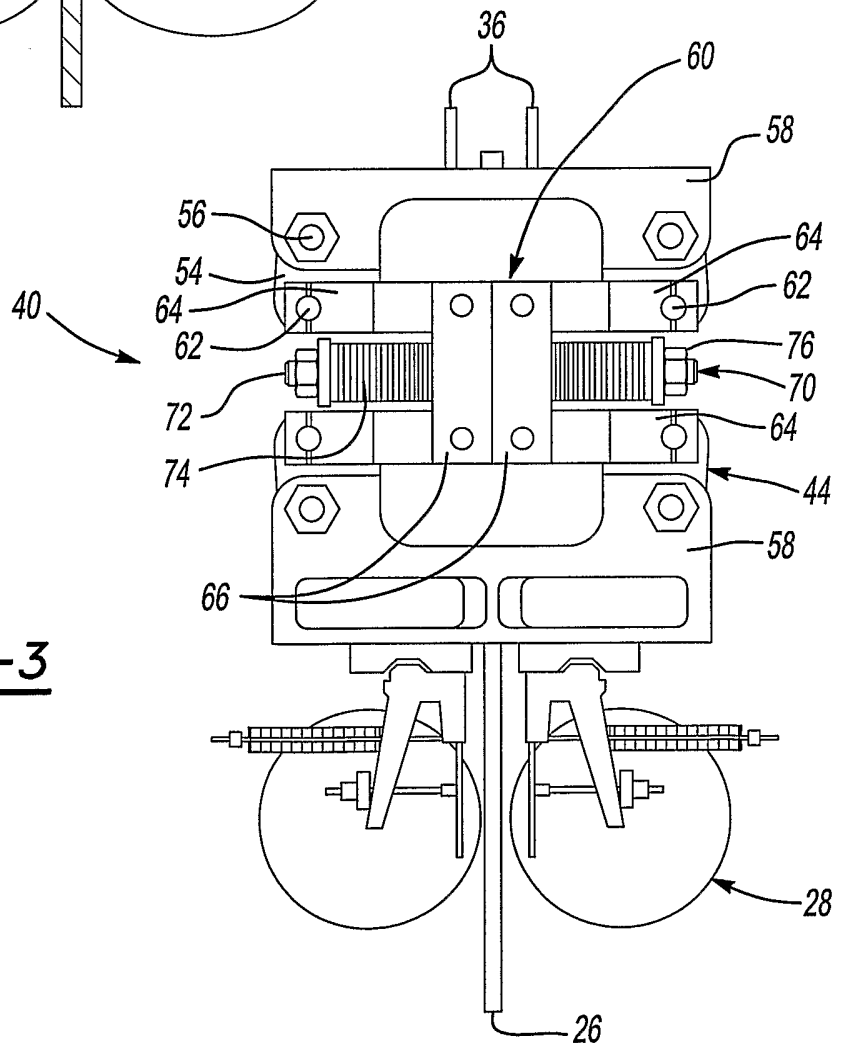


Fig-3

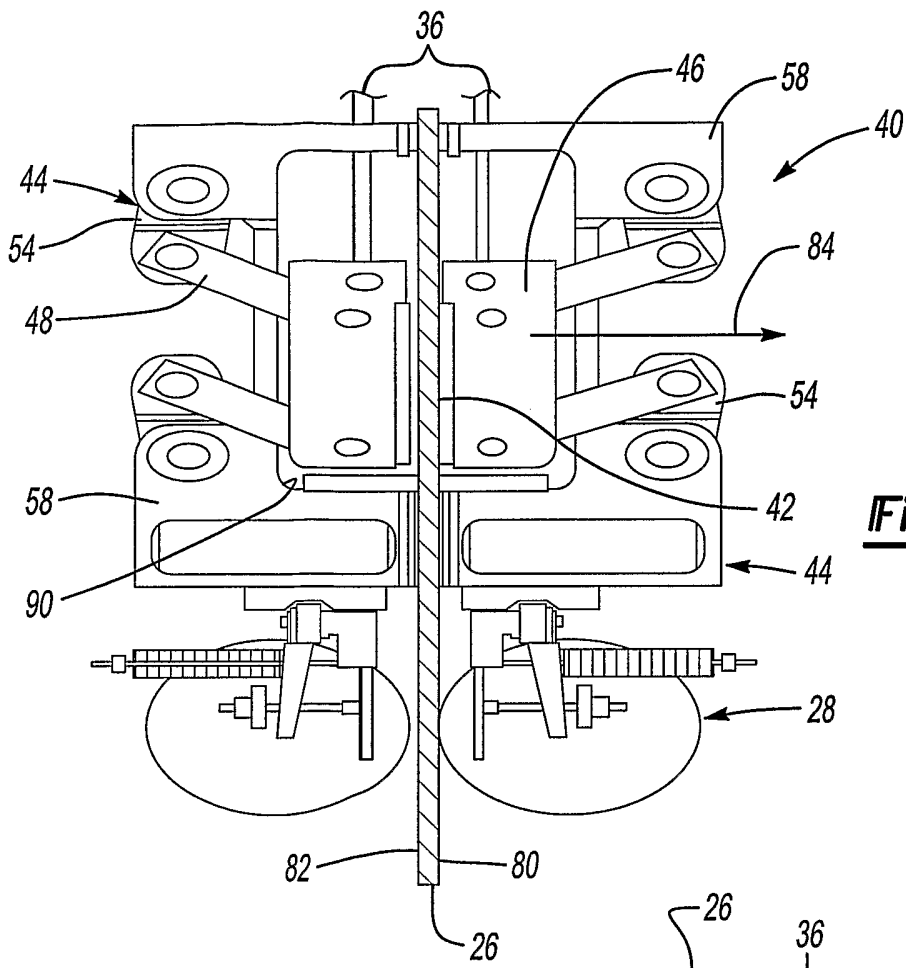


Fig-4

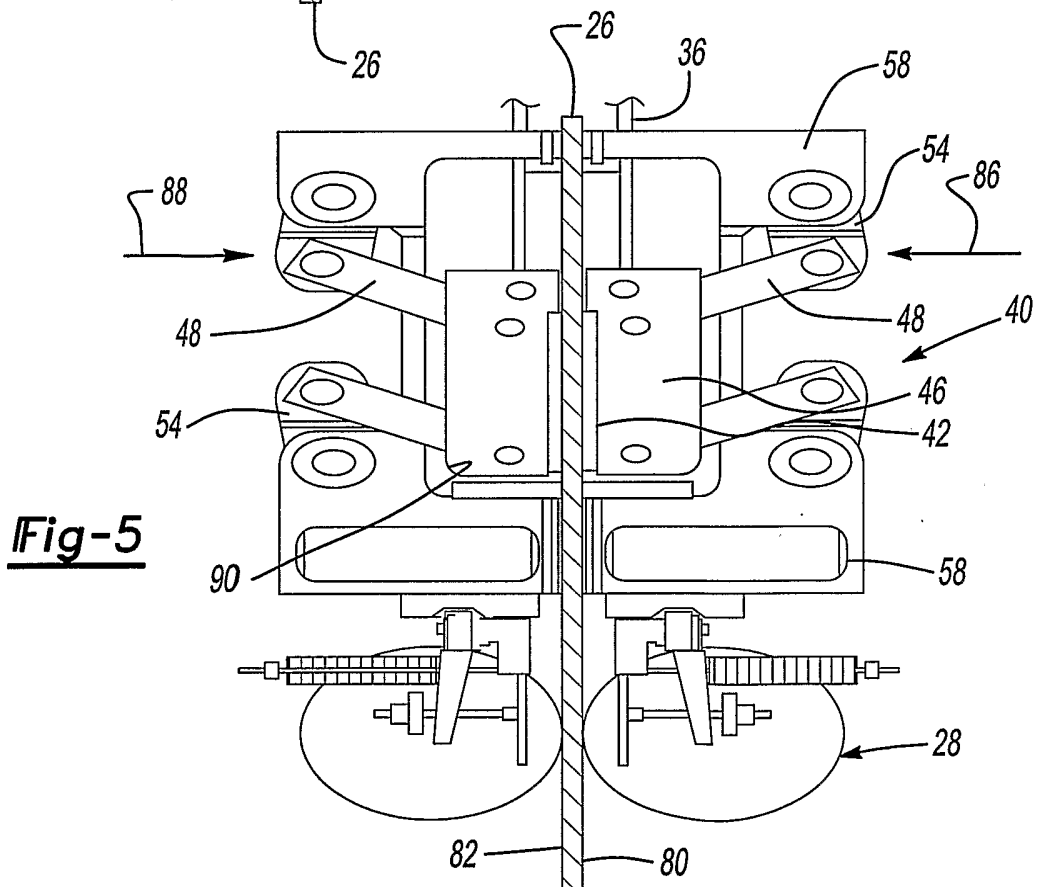


Fig-5

Fig-6A

Fig-6B

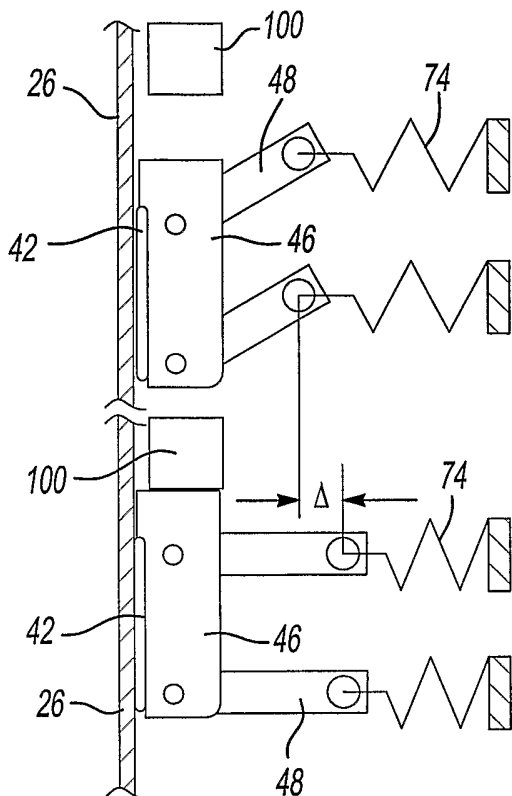
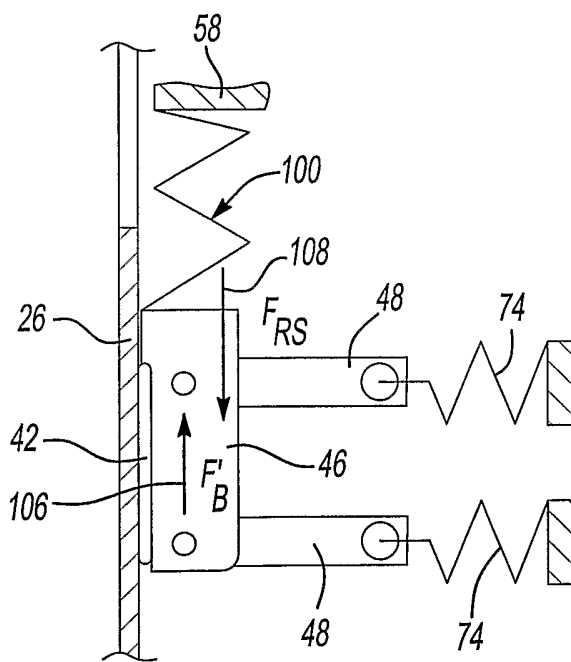


Fig-7



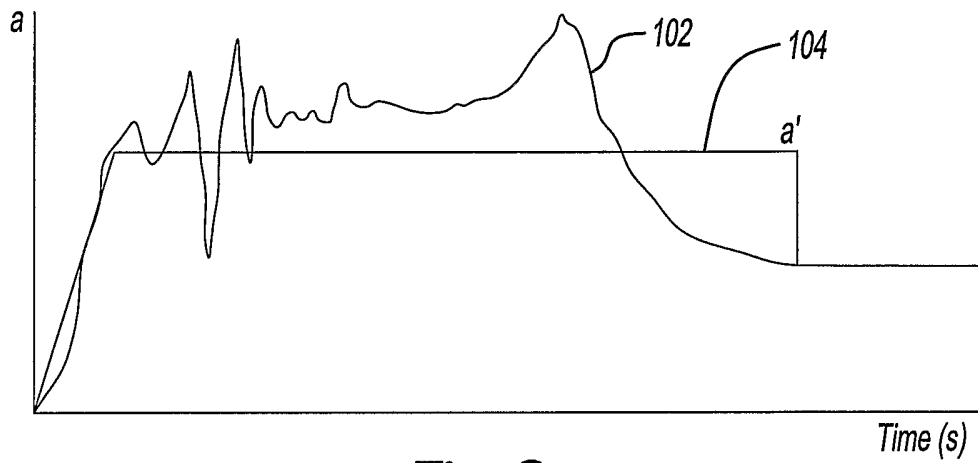


Fig-8

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US03/41692

A. CLASSIFICATION OF SUBJECT MATTER		
IPC(7) : B66B 5/18 US CL : 187/370, 371		
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) U.S. : 187/370, 371, 375, 376, 366		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3,215,231 A (LODIGE) 02 November 1965, Figures 1-4, columns 1-2.	1, 12, 13 and 20
X	US 6,176,350 B1 (SCHLOSSER) 23 January 2001, Figures 1-11, columns 3-6.	1, 12, 13 and 20
X	US 6,053,287 A (WEIBERGER ET AL.) 25 April 2000, Figures 1-5, columns 2-3.	1, 12, 13 and 20
X	US 3,250,402 A (DE LIGT) 10 May 1966, Figures 3, 6.	1, 12, 13 and 20
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.		
* Special categories of cited documents:		
"A"	document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E"	earlier application or patent published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O"	document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P"	document published prior to the international filing date but later than the priority date claimed	
Date of the actual completion of the international search 03 May 2004 (03.05.2004)		Date of mailing of the international search report 16 JUN 2004
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450 Facsimile No. (703) 305-3230		Authorized officer: Eileen D. Lillis <i>[Signature]</i> Telephone No. 703-308-1113