June 13, 1950 W. C. CLIFT 2,511,697

ELEVATOR SAFETY APPARATUS

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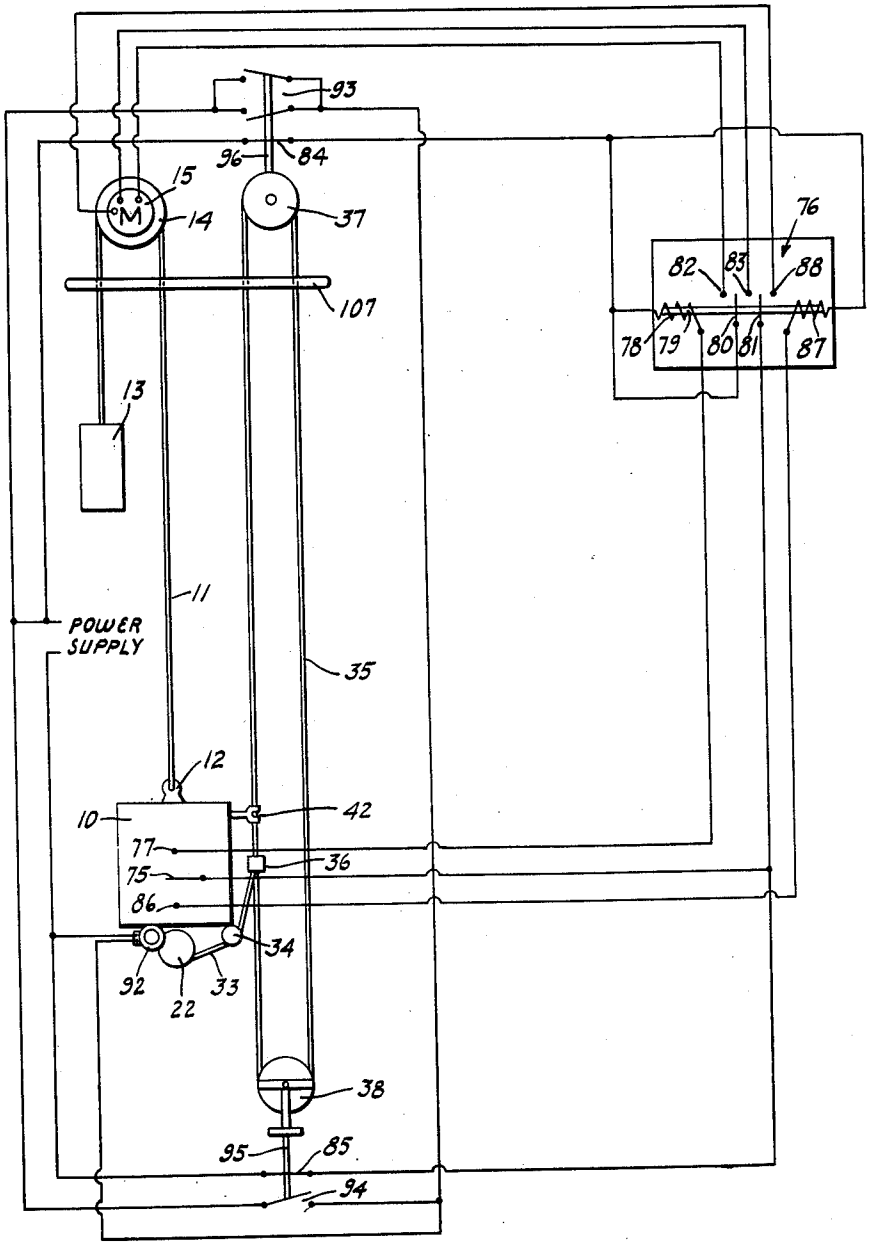


FIG. 1.

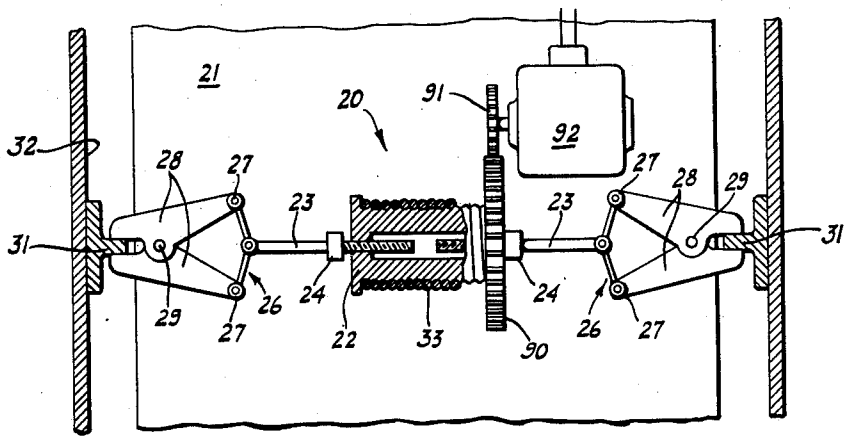
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FIG. 2.



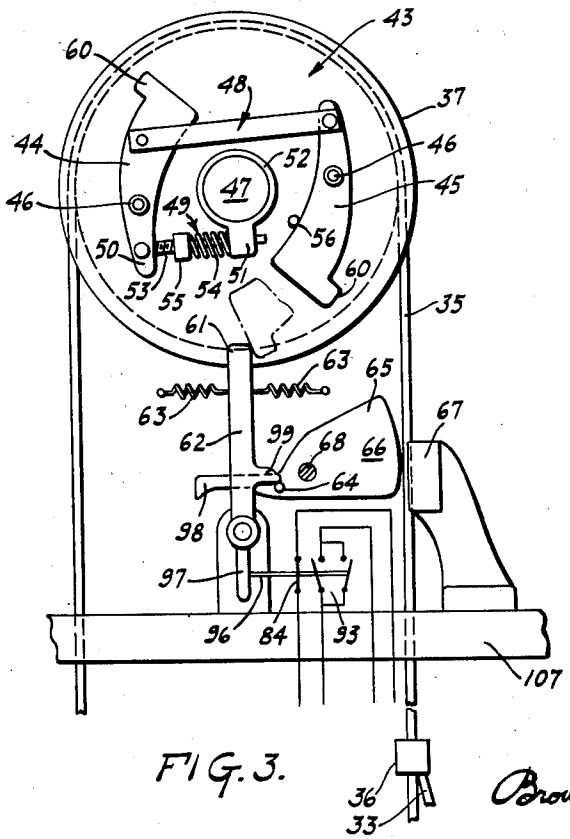


FIG. 3.

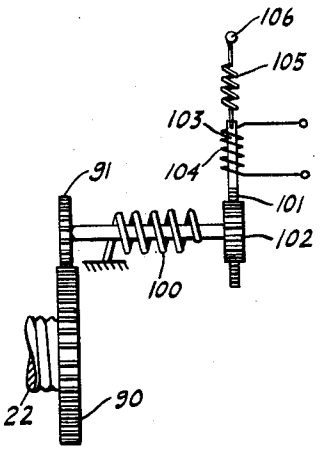


FIG. 4.

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ELEVATOR SAFETY APPARATUS

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13 Claims. (Cl. 187—90)

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This invention relates to improvements in safety apparatus for elevators and more particularly to means for actuating such apparatus automatically.

Most modern elevators are provided with a safety device carried by the car and operable automatically, in response to excessive speed of the car, to brake such movement or stop the car completely. In many cases, these devices are controlled by a governor mechanism operatively associated with the safety device and actuated by a cable releasably connected to the car.

In the operation of this type of safety apparatus, when the car reaches a predetermined excessive downward speed, the governor mechanism is actuated to grip and hold the governor cable and, because of the releasable connection, the car breaks loose from the cable and continues its downward movement relative thereto. This relative movement causes the safety device to move suitable clamping members into engagement with the elevator guide-rails and thereby to stop the movement of the car. Thus it is seen that successful operation of such elevator safety devices is dependent upon relative movement between the governor cable and the car, otherwise it fails.

Upon occasion, it has happened that the hoisting cable has been severed—or otherwise rendered inoperable—simultaneously with the governor cable, with the consequence that the safety device was rendered ineffective to stop the car which dropped to the bottom of the hatchway, with disastrous results to its occupants.

The present invention has for its primary object to provide improved elevator safety apparatus operative, in response to dangerous operational conditions, positively to stop the car.

Still another object of the invention is the provision of elevator safety apparatus operable automatically in response to failure either of the elevator hoisting apparatus, the governor mechanism, or both simultaneously.

A further and more specific object of the invention is to provide elevator safety apparatus which is effective automatically to operate in response to predetermined excessive speed of the car, either in ascent or descent, to stop the movement thereof in a predetermined safe interval of time or distance.

The manner in which the aforesaid, and other objects, are attained will become apparent from the following specification and the accompanying drawings illustrating a preferred embodiment of the invention, and in which:

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Figure 1 is a diagrammatic view of an elevator system embodying the present invention;

Figure 2 is a fragmentary bottom plan view of an elevator car showing safety apparatus mounted thereon;

Figure 3 is an elevational view on an enlarged scale of the governor mechanism, as viewed from the side opposite to that shown in Figure 1; and

Figure 4 is a diagrammatic view of a modified form of the invention.

With reference to Figure 1 of the drawings, the numeral 10 identifies the elevator car which is raised and lowered by means of the hoisting cable 11 having one end attached to the car, as at 12, and its other end connected to a suitable counterweight 13. The cable 11 extends over a traction sheave 14, which is driven by a motor 15 of suitable capacity.

As shown in Figure 2, safety apparatus, indicated generally by the numeral 20, is mounted on the bottom 21 of car 10. This apparatus may be of any suitable type, but, for the purpose of simplification, the present embodiment has been illustrated as comprising the following described mechanism. A safety drum 22 is mounted for rotation upon a pair of shafts 23 which are oppositely threaded into the ends of the drum. Shafts 23 are journaled in supports 24 secured to the bottom of the car in any convenient manner, and have their outer ends pivotally connected to the knuckles of toggles 26. The ends 27 of the toggle links are pivotally connected to the clamping jaws 28 which, in turn, are pivotally secured to the bottom of the car, as at 29. The outer ends of these jaws normally move freely over stationary guide rails 31 positioned at each side of the elevator shaft on hatchway 32, but are adapted to be actuated, by rotation of the drum, into clamping engagement with the rails.

As illustrated, and in one mode of operation, drum 22 is rotated by means of a safety rope or cable 33 which has one of its ends wrapped around and fixed to the drum, and its other end extending over an idler pulley 34 and fixed to a governor cable 35, as at 36 (Figure 1). Governor cable 35 extends in a continuous path around upper and lower governor sheaves 37 and 38, respectively, and, as clearly seen in Figure 1, is releasably connected to the car by a suitable yieldable connection 42. This connection is sufficiently secure to move the cable freely around sheaves 37 and 38 during normal operation of the car, but, under an extraordinary relative pull between cable 35 and the car, the cable will

break loose from the car and permit free relative movement therebetween.

With reference to Figure 3 is can be seen that upper governor sheave 37 carries a centrifugal governor mechanism, indicated generally by the numeral 43, which may be of any well known type, but which, in the present embodiment, is illustrated as comprising a pair of oppositely facing weights or dogs 44 and 45, pivotally mounted as at 46 to the side of sheave 37. These dogs are oppositely positioned and have equal radial displacement from shaft 47, in order to balance the sheave 37 which is rotatably mounted on a shaft 47, the latter being supported in any suitable manner, not shown. A rigid link 48 connects adjacent ends of the dogs so that their radial displacement remains equal. Dogs 44 and 45 may be set to move outwardly at a rotational speed of sheave 37, which may be adjustably predetermined, as desired, by tension means 49 positioned between one end 50 of weight 44 and an ear 51 on hub 52 of the sheave. This tension means may best comprise a threaded rod 53, about which a spring 54 is positioned. One end of the rod is pivotally secured to end 50 of dog 44 while its other end is slidably received in an aperture (not shown) in hub 51. The tension of spring 54 is adjusted by rotating nut 55 in either direction on rod 53. The normal, at rest position of weights 44 and 45, is determined by the stop pin 56, positioned adjacent the weighted end of dog 45.

Each of the dogs 45 and 46 is provided on its outer end with a radial extension 60, which, when the dogs swing outwardly in response to excessive speed of the sheave, strike the upper end 61 of lever 62, which latter is normally biased toward the vertical position, illustrated, by springs 63. When struck from the right side as shown in broken lines in Figure 3—the sheave rotating in a clockwise direction—lever 62 moves to the left, out of the path of a cocking pin shown at 64, to permit the weighted end 65 of movable gripping jaw 66 to drop and wedge the governor rope against the cooperating stationary jaw 67 and thus to lock the cable against further movement. The movable jaw 66 is pivotally mounted upon stationary structure (not shown), as at 68.

When the governor cable is so locked, continued movement of the car creates the necessary relative movement to break the aforesaid releasable connection 42 and cause safety rope 33 to unwind from and rotate drum 22. This rotation serves—through shafts 23 and toggles 26—to bring the clamping jaws into engagement with rails 31 and thus to stop the downward movement of the car.

Thus it is seen that the safety apparatus, as set forth above, will stop the car in response to excessive downward speed thereof when the apparatus is functioning in its intended manner. However, as thus far described, the apparatus would not function if the governor cable broke, or for some other reason was rendered incapable of rotating drum 22. Therefore, in addition to the above described mechanism, and in particular accordance with the present invention, means is provided for stopping the car in response to the existence of any one of several such dangerous conditions, to be described hereinafter.

Normal operation of the elevator, to raise or lower car 10, is controlled from within the car through suitable means, such as the electrical circuits diagrammatically illustrated in Figure 1. As shown in this figure, there is provided a manual control lever 75 positioned in the car and adapted selectively to close suitable circuits for operating a double pole magnetic switch 76 to energize hoist motor 15, and thus to raise or lower the car. With the control lever moved against stationary contact 77, solenoid 78 is energized to draw armature 79 of the switch to the left, as illustrated, and move switch arms 80 and 81 against stationary contacts 82 and 83, thereby closing the power circuit through normally closed switches 84 and 85 and thus energizing the hoist motor to raise the car.

Movement of the control switch or lever 75 against stationary contact 86, energizes solenoid 87 to draw armature 79 to the right, as illustrated, moving the switch arms 80 and 81 against stationary contacts 83 and 88, respectively, thus closing the power circuit through switches 84 and 85 and energizing the hoist motor to lower the car.

In further accordance with the present invention, the safety apparatus 20, as illustrated in Figure 2, is provided with additional means responsive to emergency conditions, described hereinafter, for rotating drum 22 to move clamping jaws 28 into gripping engagement with rails 31, as described above. This means includes a large gear 90 secured to the right end of the drum and in mesh with a driving pinion 91, which is adapted to be rotated by a motor 92 secured by suitable means (not shown) to the bottom of car 21. Motor 92 is normally inoperative but may be placed in circuit with the power supply, by closure of the normally open switches shown at 93 and 94.

Switch 94, as illustrated in Figure 1, is positioned below switch 85, and both are adapted to be actuated by a switch actuating arm, shown diagrammatically at 95, in response to excessive lowering of sheave 38 as would occur in the event cable 35 was severed and collapsed into the hatchway. It should be understood, however, that actuation of these switches is not effected by normal stretching of governor rope 35. These switches 93 and 94 provide means for breaking the power supply to the hoisting motor and, at the same time, energizing safety motor 92 whereby to rotate drum 22 and stop the car, as described above, in the event governor cable 35 is severed.

As best seen in Figure 3, switch 84 of the hoist motor power supply circuit, and switch 93 of the safety motor power supply circuit, are adapted to be actuated by governor 43, in response to excessive rotational speed thereof in either direction, and thereby to break the hoist motor circuit and close the safety motor circuit. The mechanism for so actuating these switches comprises a common actuating arm, diagrammatically represented at 96, and an extension or finger 97 depending from lever 62.

The various conditions under which the safety mechanism is particularly effective and the manner in which the apparatus of the invention operates, under such conditions, will now be described.

Firstly, if the car reaches an excessive upward speed, the governor mechanism will operate to throw out the weighted ends of dogs 44 and 45, which strike lever 62 on the left side, as seen in Figure 3, thus pivoting finger 97 in a clockwise direction to open the power circuit to the hoist motor (through switch 84) and closing the safety motor circuit, simultaneously. In this manner safety motor 92 is energized, which motor, in

turn, moves clamping jaws 28 into gripping engagement with rails 31, and thereby prevents the car crashing into the floor 107 of the control room at the top of the hatchway. It is to be noted that, when the car is moving upwardly at such an excessive speed, movable gripping jaws 66 are not released to grip cable 35, but only that lever 62 is moved to the right to actuate switches 84 and 93 which, respectively, open the hoist motor circuit and close the safety motor circuit thus stopping the car as described.

On the other hand, if the car reaches an excessive downward speed, the governor mechanism will operate to advance the movable gripping jaw to grip and hold governor cable 35, as described heretofore, and thus to cause the safety device to operate. Concurrently, the power circuit to hoist motor 15 is opened and the circuit to safety motor 92 is closed, thus assuring positive operation of the safety apparatus, both through safety rope 33 and motor 92.

Other emergency conditions in which the apparatus is particularly effective arise when either the governor cable or the hoist cable become severed, in which event the safety apparatus will operate in the manner described hereinafter.

If, for example, the hoist cable breaks, the car falls freely and almost immediately reaches the speed necessary to actuate the governor mechanism to grip the associated cable and break the yieldable connection between the car and cable thus causing the relative movement between the car and cable necessary to actuate the safety mechanism and stop the fall of the car. Simultaneously with the foregoing, and as above described, the governor mechanism opens switch 84 breaking the circuit to the hoist motor 15 and closes switch 93, to energize safety motor 92 and actuate the safety apparatus as described above. By providing two actuating means, capable of acting either simultaneously or individually, the safety apparatus, of the invention completely eliminates the possibility of the car falling because of failure of the safety rope 33.

If the governor cable alone is severed or broken, lower governor sheave 38 drops or collapses into the hatchway opening the power circuit to the hoist motor, as a result of arm 95 bearing against switch 84, and simultaneously closing the circuit to the safety motor through the agency of switch 94, and thus actuating the safety apparatus. Thus, it may be seen that, even though both the hoist cable and the governor cable be severed, the safety apparatus will operate to stop the car safely and maintain it stationary.

After such actuation of the governor mechanism as serves to release the movable gripping jaw 66, the mechanism may easily be reset by pressing downwardly on the lateral extension 98 of jaw 66 until pin 64 is reengaged under the finger 99 of lever 62.

From the foregoing description, it will be evident that the present invention provides a safety apparatus operable under virtually every dangerous operating condition which might be encountered. However, in some installations where the danger of power shut-off is present, it is additionally proposed to replace the power actuated motor 92 with a spring actuated device, as shown in the modified form of the invention illustrated in Figure 4.

As shown in this figure, the apparatus includes drum 22, gear 90 and pinion 91, as heretofore described. In this form, however, the pinion is adapted to be driven by a spring motor device

comprising a coil spring 100, which is preloaded by means of a rack and pinion 101 and 102, respectively. The rack is directly connected to the armature 103 of a solenoid 104, which, when energized, urges the rack to an advanced position in which the pinion 102 has been rotated to load the spring and hold the safety apparatus in its inoperative position, that is, in such position that clamping jaws 28 are free to slide over guide rails 31. A spring 105, having one end reacting against fixed structure 106, may be provided to assist the solenoid 105 in preloading spring 100. If for any reason the power should fail, solenoid 104 is deenergized releasing the spring 100, which then serves to rotate the pinion and gear, and thereby to actuate the safety mechanism in the manner described heretofore with relation to the preferred form.

It will be seen, therefore, that my invention provides improved safety apparatus for elevator cars, which is highly effective and, further, positively protects against mechanical failures not hitherto provided for.

I claim:

1. In safety apparatus for elevator cars operable upwardly and downwardly within a hatchway, a safety device carried by the car, said device including a rotatable drum and means actuated by rotation of said drum for gripping fixed hatchway structure thus to stop the car, governor means including a governor cable releasably connected to said car and having means adapted when said cable is released from said car to rotate said drum so to actuate said gripping means, and electro-mechanical means cooperable with said governor means to rotate said drum to stop the car.

2. Safety apparatus for elevator cars comprising a safety mechanism for stopping the car, governor means responsive to a predetermined downward speed of said car and including a cable effective to actuate said safety mechanism, and electro-mechanical means effective to actuate said safety apparatus in response to failure of said cable.

3. Apparatus in accordance with claim 2, and further characterized in that said cable is arranged parallel to the path of car travel and operatively associated with said safety mechanism, and in which said electro-mechanical means is responsive to severing and consequent collapse of said cable.

4. The combination with an elevator system comprising an elevator car, a safety device including a drum and operable by rotation of said drum, a safety cable reeled upon said drum, and governor means responsive to predetermined speeds of the elevator car to cause said safety cable to unreel from said drum to actuate said safety device and thereby to stop the car; of electro-mechanical means associated with said governor means and operable conjointly with or independently of said safety cable and in response to a predetermined speed of said car to rotate said drum and thus operate said safety device.

5. A construction in accordance with claim 4 and including means responsive to collapse of said safety cable to energize said electro-mechanical means and thus to actuate the safety device.

6. The combination with an elevator system comprising an elevator car, a safety device including a drum and operable by rotation of said drum, a safety cable reeled upon said drum, and governor means responsive to predetermined speeds of the elevator car to cause said safety

cable to unreel from said drum to actuate said safety device and thereby to stop the car; of electro-mechanical means associated with said governor means and operable conjointly with or independently of said safety cable and in response to a predetermined speed of said car to effect operation of said safety device, and means for energizing said electro-mechanical means in response to excessive upward speed of said car to actuate the safety device independently of said safety cable.

7. Safety apparatus for elevator cars comprising a safety device for stopping the car, governor means, means connecting said governor means with said safety device, said governor means being responsive to a predetermined downward speed of said car to cause said connecting means to actuate said safety mechanism, electro-mechanical means responsive to a predetermined downward speed to operate conjointly with said connecting means and said safety mechanism to stop the car, said governor means being operable in response to a predetermined upward speed of said car to actuate said electro-mechanical means to stop the car, and means responsive to severing of said connecting means to effect operation of said electro-mechanical means and thus to actuate said safety apparatus.

8. In combination with an elevator car, hoisting means for moving said car up and down a hatchway, a safety mechanism carried by the car, said safety mechanism including a drum rotatable to actuate clamping means against fixed hatchway structure, a safety cable wound on said drum, speed responsive governor mechanism, a governor cable releasably secured to said car and so attached to said safety cable as to operate said speed responsive mechanism at speeds corresponding to the speed of the car, means responsive to a predetermined speed of said car to grip and hold said governor cable whereby continued movement of the car is effective to cause rotation of said safety drum to stop the car, electro mechanical means for rotating said drum, normally open switch means adapted, when closed, to energize said electro-mechanical means, and means responsive to collapse of said governor cable to close said switch means.

9. A construction in accordance with claim 8, and wherein said switch means is also adapted to render said hoisting means inoperative.

10. In safety apparatus for elevator cars, a rotatable member carried by the car, means actuated by rotation of said member to grip fixed structure and thereby to stop the car, and electro-mechanical means responsive to power cut-off to rotate said member.

11. In an elevator system of the type having a car, a safety mechanism for stopping the car and a governor cable, and in which relative movement between said car and cable is effective to operate said safety mechanism, the improvement which comprises: means for effecting operation of said safety mechanism, said means being responsive to severing and consequent collapse of said governor cable.

12. In an elevator system of the type having a car, a safety mechanism for stopping the car and a governor cable, and in which relative movement between said car and cable is effective to operate said safety mechanism, the improvement which comprises: means for effecting operation of said safety mechanism, said means comprising an electro-mechanical actuator responsive to severing and consequent collapse of said governor cable.

13. In an elevator system of the type having a car, a safety mechanism for stopping the car and a governor cable, and in which relative movement between said car and cable is effective to operate said safety mechanism, the improvement which comprises: means for effecting operation of said safety mechanism, said means comprising an electrical device adapted to actuate said safety mechanism, and switch means adapted to energize said electrical device and so positioned with respect to said governor cable as to be responsive to severing and consequent collapse of the latter.

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