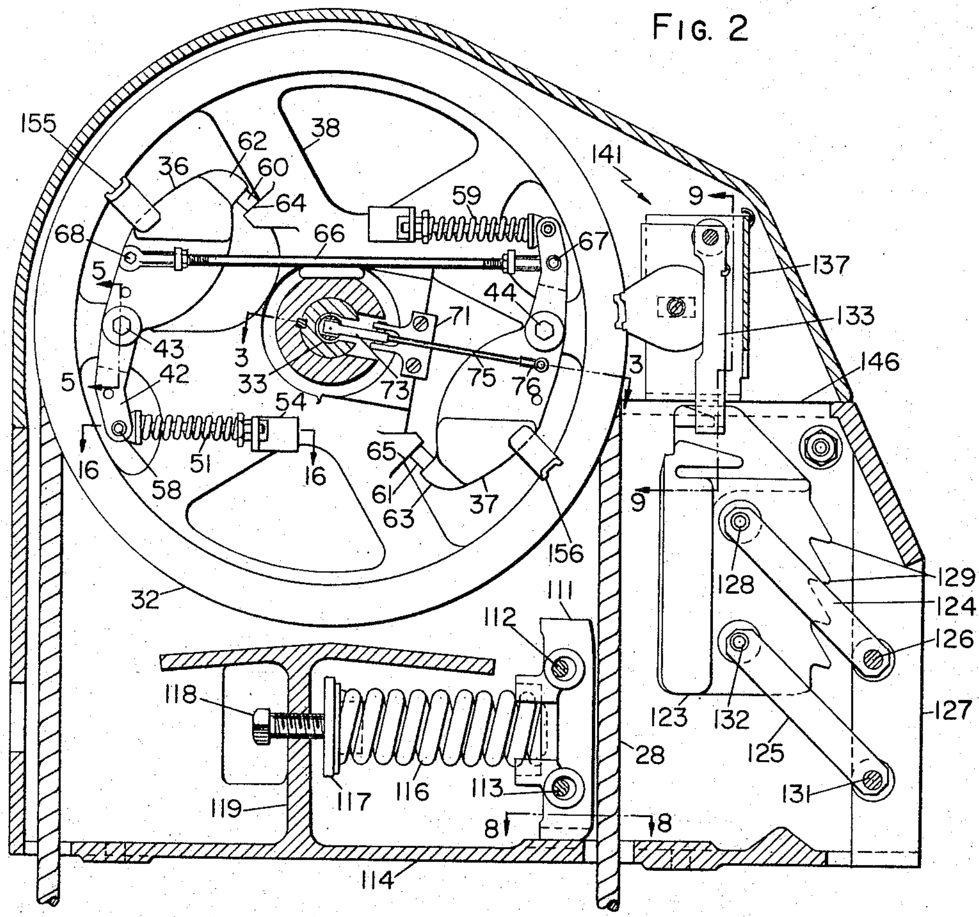
June 27, 1967 J. MASTROBERTE 3,327,811

GOVERNOR

Filed Oct. 28, 1966 5 Sheets-Sheet 1

FIG. 2



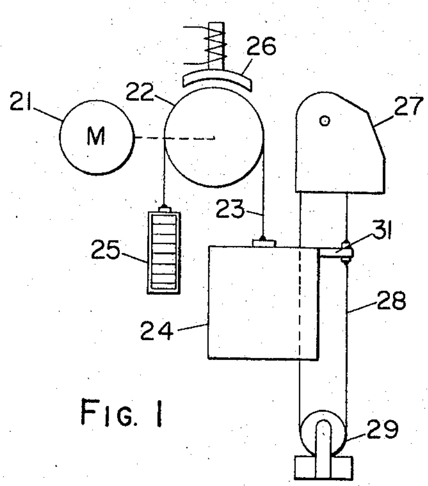


FIG. 1

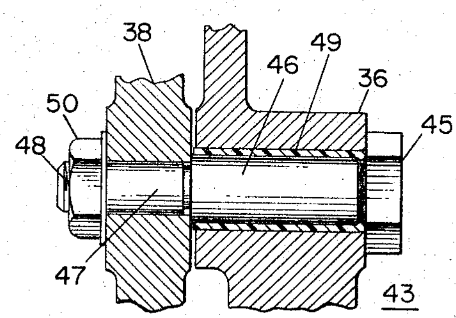


FIG. 5

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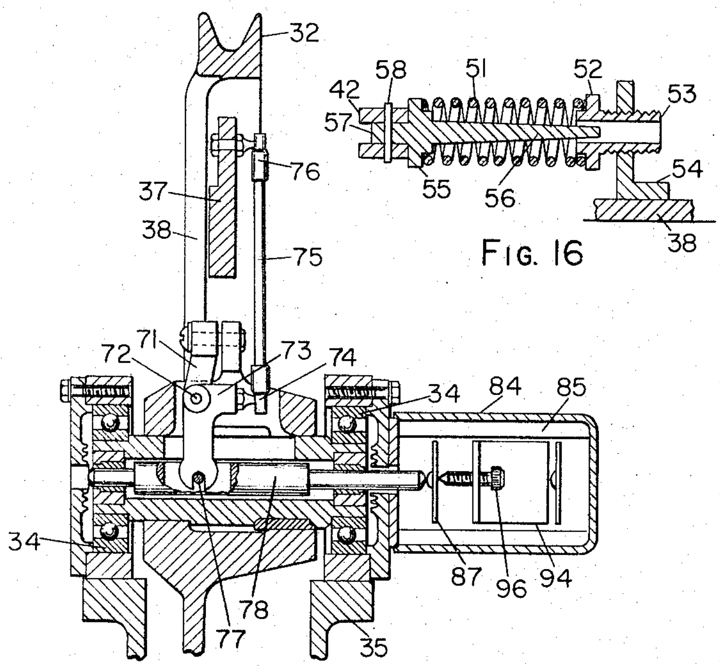

FIG. 3

FIG. 16

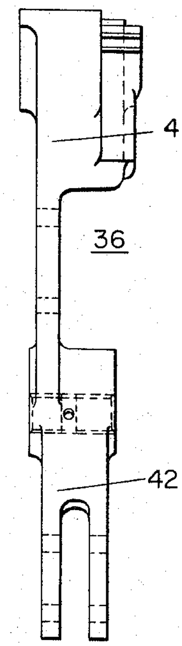

FIG. 4

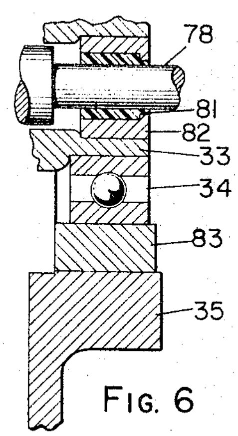

FIG. 6

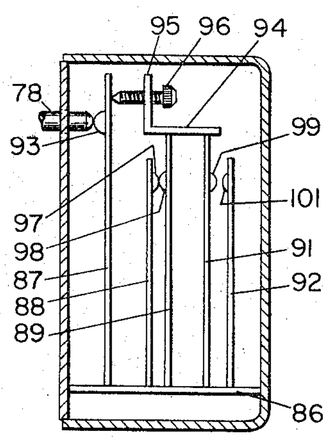

FIG. 7

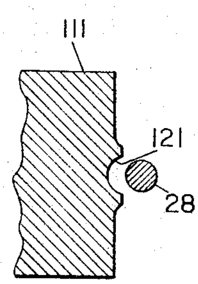

FIG. 8

JOSEPH MASTROBERTE
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GOVERNOR

Filed Oct. 28, 1966 5 Sheets-Sheet 3

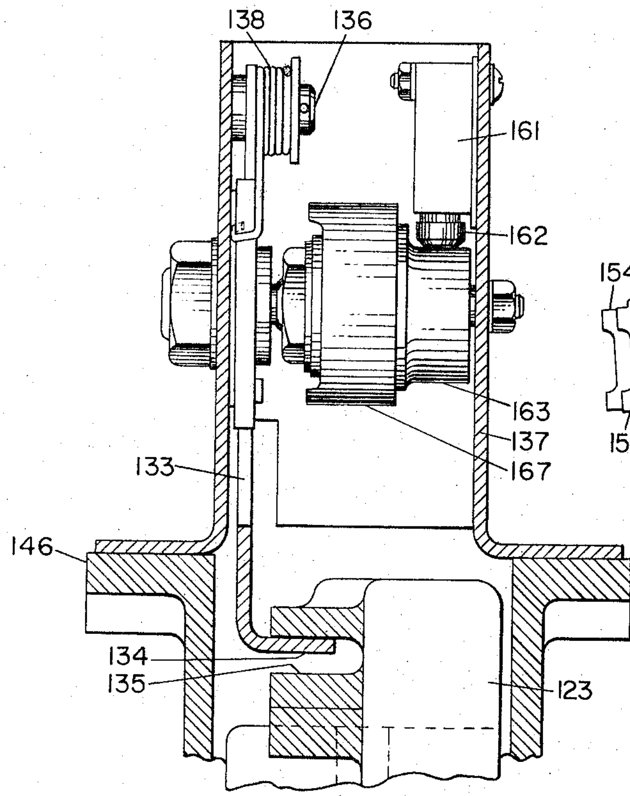

FIG. 9

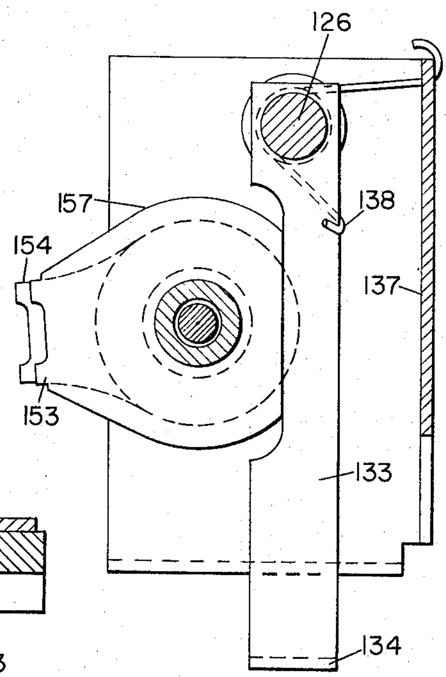

FIG. 12

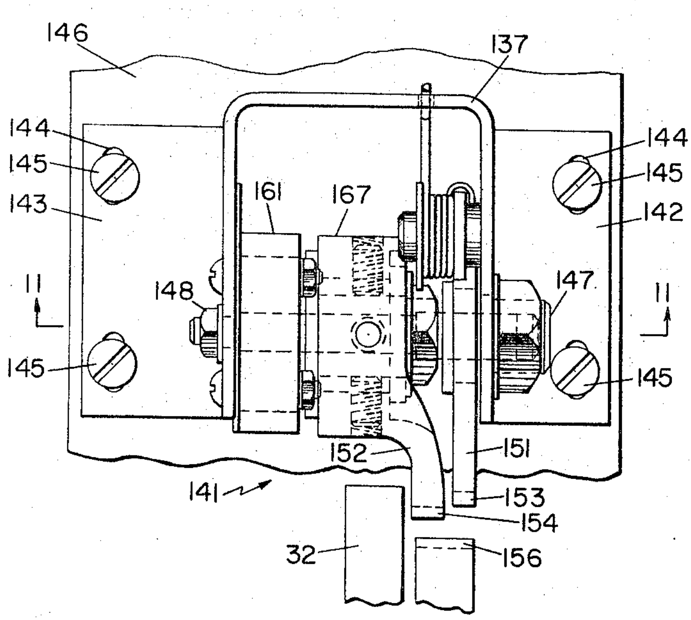

FIG. 10

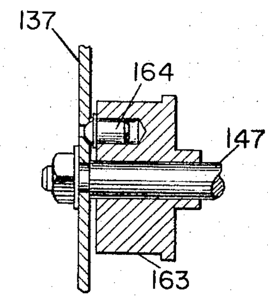

FIG. 15

JOSEPH MASTROBERTE
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BY W. L. Hunter ATTORNEY

June 27, 1967 J. MASTROBERTE 3,327,811

GOVERNOR

Filed Oct. 28, 1966 5 Sheets-Sheet 4

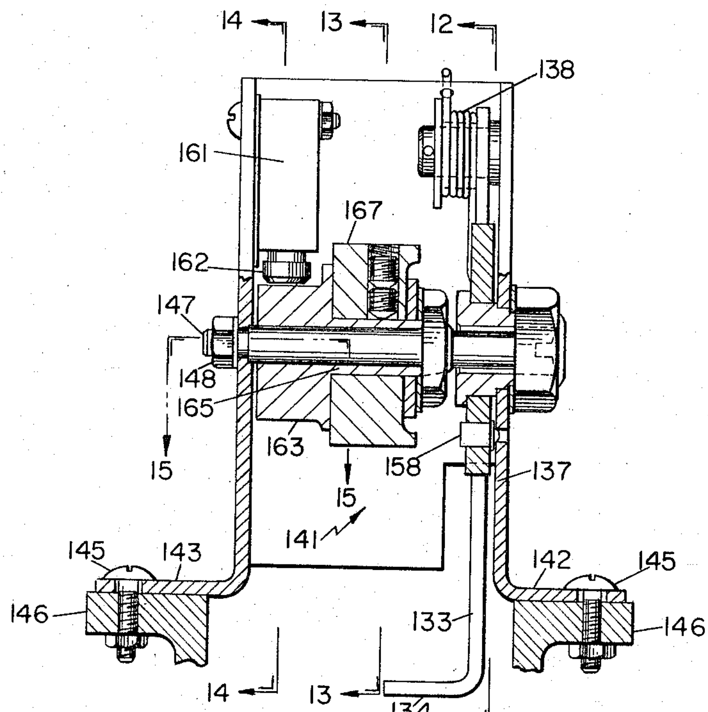

FIG. 11

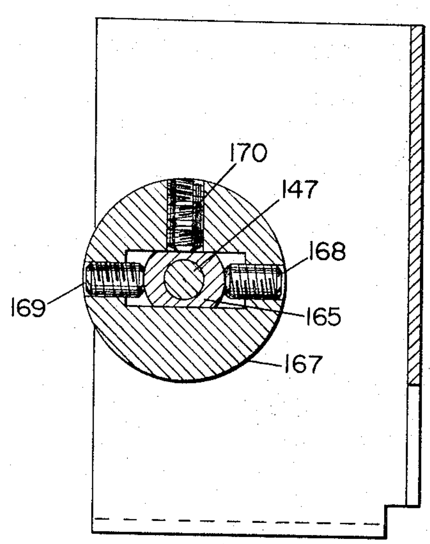

FIG. 13

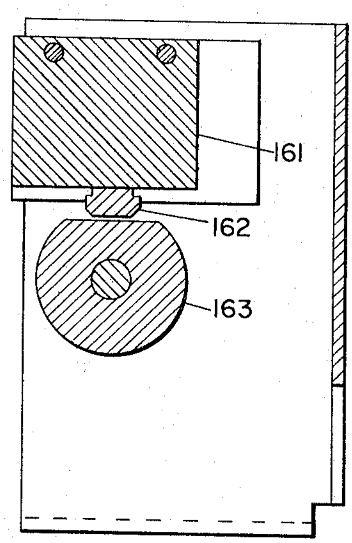

FIG. 14

JOSEPH MASTROBERTE
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BY W. L. Hunter ATTORNEY

June 27, 1967 J. MASTROBERTE 3,327,811

GOVERNOR

Filed Oct. 28, 1966 5 Sheets-Sheet 5

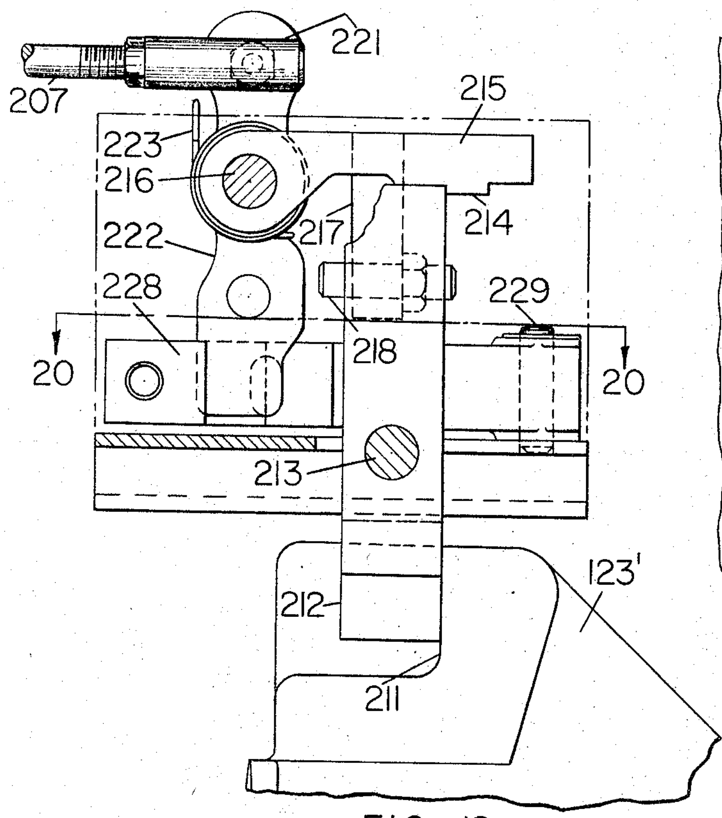

FIG. 19

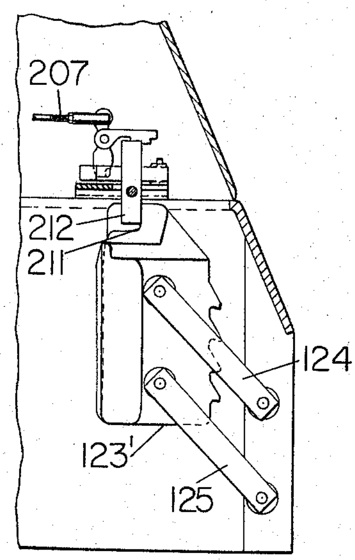

FIG. 18

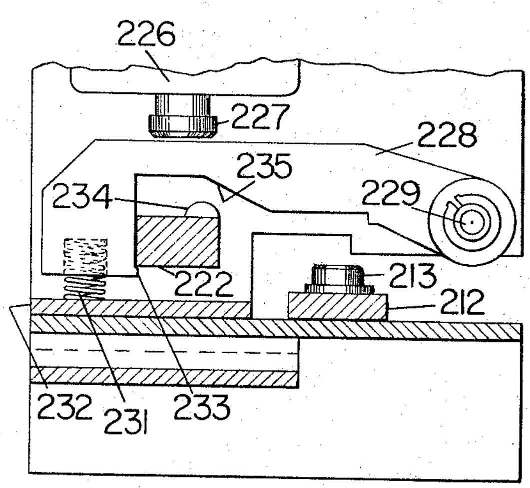

FIG. 20

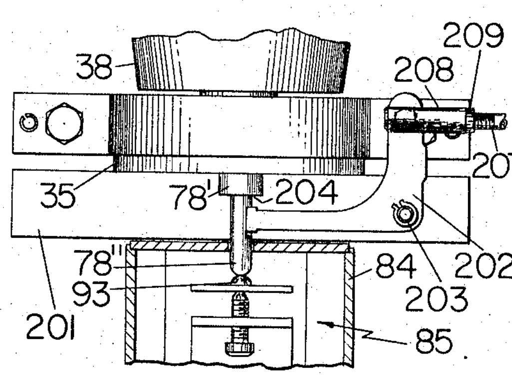

FIG. 17

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United States Patent Office

3,327,811

Patented June 27, 1967

1

3,327,811
GOVERNOR

Joseph Mastroberte, Hasbrouck Heights, N.J., assignor to Otis Elevator Company, New York, N.Y., a corporation of New Jersey

Filed Oct. 28, 1966, Ser. No. 595,294
11 Claims. (Cl. 187—38)

This application is a continuation-in-part of the copending application of Joseph Mastroberte, Ser. No. 453,153, filed May 4, 1965, for Governor, now abandoned.

This invention relates generally to elevator systems and particularly to overspeed governors which actuate switches and/or safety devices in response to excessive speeds of an elevator.

In a typical elevator installation, a governor is located in the machine room and includes a sheave driven by a rope attached to the car so that the sheave rotates at a speed directly proportional to car speed. The governor includes weights responsive to centrifugal force which, upon overspeed of the car, trip a device which grips the governor rope, thereby actuating the safeties on the car.

Various governors, using various arrangements of weights, tripping mechanisms, and rope clutching jaws have been used in the past but have had a number of disadvantages. Some have been suitable only for slow speed operation. Some have had a very limited range of adjustment of the tripping speed. Some have failed to stay in adjustment so that the tripping speed has not been accurately predictable.

It is a general object of the present invention to provide an improved governor for use in elevator systems.

Another object is to provide a governor suitable for use with high speed elevators.

Another object is to provide a governor which is readily adaptable to a wide range of speeds of operation.

Another object is to provide a governor which, after adjustment, will operate consistently at substantially the same speed.

Another object is to provide a governor which responds quickly to overspeeding.

Another object is to provide an improved governor which, at sucecssively higher speeds, provide three kinds of operations, namely, first, a simple switch actuation, second, a tripping switch actuation, and finally, a rope gripping operation.

Briefly stated, one specific embodiment of the invention includes a sheave mounted on a hollow shaft and driven by a rope attached to the car. A pair of weights pivotally mounted on the web of the sheave are held resiliently by springs but fly outward as the speed of the sheave increases. A mechanical linkage connects the weights with a plunger in the hollow shaft and converts the radial motion of the weights to axial motion of the plunger. The plunger actuates a bank of switches.

The governor also includes an overspeed switch provided with a tripping lever and further includes a pair of rope gripping jaws, one of the pair being a substantially stationary jaw and the other one a suspended swinging jaw. As the speed of the sheave increases, lugs on the weights first actuate the tripping lever of the overspeed switch and finally trip a latch which allows the swinging jaw to fall and grip the rope between it and the stationary jaw.

In another embodiment of the invention the plunger actuates not only the bank of switches but also actuates the overspeed switch and the tripping mechanism of the latch holding the rope gripping jaw.

For a clearer understanding of the invention, reference may be made to the following detailed description and the accompanying drawing, in which:

2

FIGURE 1 is a schematic diagram of an elevator system;

FIGURE 2 is an elevation view, with some parts in section, of a governor in accordance with the invention;

FIGURE 3 is a cross section view taken on the line 3—3 of FIGURE 2;

FIGURE 4 is a side view of one of the weights;

FIGURE 5 is a cross section view of a detail, taken on the line 5—5 of FIGURE 2;

FIGURE 6 is an enlarged view of a portion of FIGURE 3;

FIGURE 7 is an elevation view of the bank of switches;

FIGURE 8 is a cross section view taken on the line 8—8 of FIGURE 2;

FIGURE 9 is a cross section view taken on the line 9—9 of FIGURE 2;

FIGURE 10 is a plan view of the tripper assembly;

FIGURE 11 is a cross section view taken on the line 11—11 of FIGURE 10;

FIGURE 12 is a cross section view taken on the line 12—12 of FIGURE 11;

FIGURE 13 is a cross section view taken on the line 13—13 of FIGURE 11;

FIGURE 14 is a cross section view taken on the line 14—14 of FIGURE 11;

FIGURE 15 is a cross section view taken on the line 15—15 of FIGURE 11;

FIGURE 16 is a cross section view taken on the line 16—16 of FIGURE 2;

FIGURES 17–20 illustrate a modified form of the invention. More specifically;

FIGURE 17 is a fragmentary plan view, with portions cut away, showing the mechanism actuated by the plunger;

FIGURE 18 is an elevation view, with some parts in section, of the rope gripping jaw and its mounting;

FIGURE 19 is an elevation view, with some parts in section and with a supporting bracket removed, of the switch and jaw tripping mechanism; and

FIGURE 20 is a cross section view taken on the line 20—20 of FIGURE 19.

Referring first to FIGURE 1, there is shown an electric motor **21** which drives a traction sheave **22** over which pass hoisting ropes **23**, opposite ends of which are fastened to an elevator car **24** and a counterweight **25**. A friction brake **26** is preferably spring applied and electromagnetically released. Adjacent to the motor **21** and sheave **22** is a governor **27** including a sheave or wheel (not shown in FIGURE 1) over which passes a governor rope **28**. The rope **28** passes over a tensioning sheave **29** in the pit and has both of its end fastened to an operating member **31** mounted on the car **24**. The rope **28** and the governor pulley are driven at a speed proportioned to that of the car **24** and play no part during normal operation of the elevator. However, upon overspeed of the car **24** for any reason, the governor **27** operates one or more switches and, upon still further overspeed, clamps the rope **28** between a pair of rope gripping jaws. The resulting tension in the rope **28** moves the operating member **31** with respect to the car thereby actuating safety devices (not shown) which grip the supporting rails thereby stopping the car. Such general mode of operation is well known and, it is believed, need not be further described. The present invention is directed principally to the details of the governor **27**.

Referring now to FIGURES 2 and 3, the governor sheave or wheel **32** is fastened to a hollow shaft **33** rotatably supported by bearings **34** which in turn are mounted on a suitable frame member **35**. A pair of identical weights **36** and **37** are pivotally moutned at diametrically opposite points on the web **38** of the sheave

32. As best shown in FIGURE 4, each weight includes a massive portion 41 and an extending arm portion 42, the end of which is bifurcated. The weight 36 is pivotally mounted to the sheave by a pin 43, preferably a hardened pin, which passes through an aperture in the arm portion 42 near its junction with the massive portion 41. The weight 37 is pivotally mounted by a similar pin 44. As best shown in FIGURE 5, the pin 43 includes hexagonal head portion 45 which bears against the weight 36, an enlarged diameter portion 46 formed with a smooth surface which passes through the aperture in the weight, a smaller diameter portion 47 which passes through an aperture in the web 38 of the sheave 32, and a threaded end portion 48. A sleeve 49 made of a low friction plastic bearing material surrounds the enlarged portion 46. The enlarged diameter portion 46 is slightly longer than the thickness of the weight and, at its transition to the smaller diameter portion 47, forms a shoulder which bears against the web 38 of the sheave 32. A nut 50 holds the pin 43 in place.

A spring 51 urges the weight 36 to rotate radially inwardly, or clockwise as viewed in FIGURE 2, about its pivot 43. As best shown in FIGURE 16, one end of the spring 51 bears against a shoulder 52 formed in a hollow bolt 53 threaded into a bracket 54 which in turn is fastened to the web 38 of the sheave 32. The outer surface of the shoulder 52 is preferably square or hexagonal so that it may be engaged by a wrench so as to adjust the force exerted by the spring 51. The other end of the spring 51 bears against a shoulder 55 formed integrally with a rod 56. The rod 56 also serves as a guide for the spring 51. The end of the rod 56 beyond the shoulder 55 is formed with a flattened portion 57 containing an aperture, which portion is positioned between the forks of the arm portion 42 of the weight 36 where it is held by a pin 58. The entire rod 56, including the shoulder portion 55 and the flattened portion 57, is made of a low friction material such as a plastic containing molybdenum disulphide.

A spring 59 is mounted in a like fashion and similarly urges the weight 37 to rotate radially inwardly, or clockwise as viewed in FIGURE 2, about its pivot 44. Such inward rotation of the weights 36 and 37 is limited by bumpers 60 and 61, which are fastened to shoulder portions 62 and 63 of the weights 36 and 37, and which engage abutments 64 and 65 formed in the web 38 of the sheave 32.

Rotation of the sheave 32 causes the weights 36 and 37 to be urged by centrifugal force to fly radially outwardly, that is, to rotate counterclockwise about their respective pivots against the urging of the springs 51 and 59. A tie rod 66 interconnects the weights 36 and 37 so that they act in unison, that is, so that they fly radially outwardly by equal distances. One end of the tie rod 66 is pivotally connected to the arm portion of the weight 37 by a low friction joint 67 while the other end is connected to the massive portion of the weight 36 by a similar joint 68. The distance from the pin 44 to the joint 67 is made equal to the distance from the pin 43 to the joint 68. The tie rod 66 is preferably of adjustable length.

As best shown in FIGURE 3, a bracket 71 fastened to the web 38 supports a pin 72 the axis of which is approximately perpendicular to but does not intersect the axis of the shaft 33. The pin 72 serves as the pivot for a two armed bell crank lever 73, made of a low friction plastic material such as a material containing molybdenum disulphide. The first arm of the lever 73 is connected by a low friction joint such as a plastic ball and socket joint 74 to one end of a link 75, the opposite end of which is connected by a similar joint 76 to the weight 37. The shaft 33 and the hub of the sheave 32 are each formed with a slot or opening, which openings are aligned to provide access to the interior of the shaft, and through which extends the second arm of the lever 73. The forked end of this arm embraces a pin 77 which extends through a slot in a plunger 78 positioned on the axis of the hollow shaft 33. The plunger 78 is preferably made of a material which will take and retain a smooth finish, stainless steel having been found satisfactory. The plunger 78 is supported at each end for longitudinal movement. The right hand end, as viewed in FIGURE 3 is supported, as best shown in FIGURE 6, by a sleeve 81 made of a low friction plastic material, within which the plunger 78 is freely slidable. The sleeve 81 is supported by a steel bushing 82 which engages the interior surface of the hollow shaft 33. The shaft 33 is supported by the bearing 34 the outer race of which is supported by the ring 83 which in turn is supported by the frame 35. The left hand end of the plunger is similarly supported.

The portion of the apparatus immediately above described operates as follows. As the sheave 32 rotates, the weights 36 and 37 fly radially outward. The link 75 rotates the bell crank lever 73 which in turn imparts axial movement to the plunger 78. Stated briefly, radial motion of the weights is converted to axial motion of the plunger.

The right hand end of the plunger 78 extends through a cover 84 and operates a bank of switches, denoted generally by the reference character 85. As best shown in FIGURE 7, a base 86 of insulating material supports five upstanding resilient strips 87, 88, 89, 91 and 92. The strip 87 carries a button 93 of a low friction bearing material which is urged by the resilience of the strip 87 into engagement with the end of the plunger 78. The two strips 89 and 91 are joined to but insulated from a bracket 94 an upstanding tab 95 of which is threaded to receive a machine screw 96 which bears against the top of the strip 87. The screw 96 is used to adjust the position of the strips 89 and 91. The strip 88 carries a contact 97 which, with the parts in the position shown, engages a contact 98 carried by the strip 89. The strip 91 carries a contact 99 which, in the position of the parts shown, is spaced from a contact 101 carried by the strip 92.

In operation, as the speed of rotation of the sheave increases, the plunger 78 moves to the right, eventually separating the contacts 97 and 98 and engaging the contacts 99 and 101. As the speed of the sheave decreases, the plunger 78 recedes to the left, causing the disengagement of contacts 99 and 101 and the reengagement of contacts 97 and 98. There is no "tripping" action and no manual resetting of the switches is required after they operate. In other words, as the speed increases, the switches are actuated and as soon as the speed decreases sufficiently, the switches are returned to their former condition.

It will be understood that the two switches shown are merely illustrative and that additional switches, either normally open or normally closed, may be provided and that they may be adjusted to operate at various predetermined speeds of rotation of the sheave 32. The manner in which the switches may be connected to control the motor 21 is well known to those skilled in the art and is not a part of the present invention.

Referring again to FIGURE 2, a stationary rope gripping jaw 111 is supported by two pins 112 and 113 which are fastened to a suitable portion of the frame 114 and which pass through oversized holes in the jaw 111. The jaw 111 is urged toward the rope 28 by a compression spring 116 one end of which bears against a suitable seat formed in the jaw 111 and the other end of which bears against a cap 117. The cap 117 is held by a bolt 118 which is threaded through a portion 119 of the frame so that the force exerted by the spring 116 against the jaw 111 can be adjusted. As best shown in FIGURE 8, the jaw 111 is formed with an arcuate groove 121. FIGURE 2 illustrates the positions of the parts during normal operation of the elevator. The spring 116 urges the jaw 111 into engagement with the pins 112 and 113, as shown, with the face of the jaw 111 close to but not engaging the rope 28. Under overspeed conditions, as will be more fully explained, the rope 28 is displaced to the left, as viewed in FIGURE 2, and engages the jaw 111.

Also shown in FIGURE 2 is a swinging rope gripping jaw **123** which is formed with a groove in its face similar to the groove **121** in the jaw **111**. The jaw **123** is mounted on four links, two of which, the links **124** and **125** are shown in FIGURE 2. The link **124** (and another one directly behind it) has one end pivoted at **126** to a portion **127** of the frame and the other end pivoted at **128** to the jaw **123**. Similarly, the link **125** (and another one directly behind it) has one pivoted at **131** to the frame **127** and the other end pivoted at **132** to the jaw **123**, the pivot points being positioned so that all four links are parallel to each other. The jaw **123** is normally held in the raised position shown by a latch **133** which, as best shown in FIGURE 9, is formed with a horizontal portion **134** which lies in a slot **135** in the jaw **123**. The latch **133** is pivotally mounted on a stud **136** which in turn is fastened to an upstanding U-shaped bracket **137**, forming part of the tripper assembly, as shown in FIGURES 2 and 10. A torsion spring **138** around the stud **136** has one end fastened to the bracket **137** while the other end bears against the edge of the latch **133**, thereby urging the latch to the left, as viewed in FIGURES 2 and 12, and into the paper, as viewed in FIGURE 9. It is apparent that if the latch be displaced against the urging of the spring **138**, it will become disengaged from the jaw **123**, allowing gravity to swing the jaw **123** into engagement with the rope **28**. If the portion of the rope **28** engaging the jaw is moving downwardly, as it would be if the elevator car **24** were overspeeding downwardly, friction between the rope **28** and the jaw **123** assists gravity in the downward movement of the jaw **123**. The jaw **123** comes to rest with the links **124** and **125** substantially horizontal, thereby clamping the rope **28** between the jaws **111** and **123** with a force dependent upon the strength of the spring **116**. Subsequently, the rope **28** can be released by manually raising the jaw **123**. The rear portion of the jaw is formed with teeth **129** which may be engaged by a bar or other tool to assist the raising operation.

A tripper assembly, designated generally by the reference character **141**, is shown in FIGURES 2, 10 and 11. The assembly includes the previously mentioned upstanding generally U-shaped bracket **137** formed with bent out horizontal portions **142** and **143** at the bottom. The portions **142** and **143** are formed with slots **144** for machine screws **145** by which the bracket is fastened to a portion **146** of the frame of the governor. A bolt **147** passes through apertures in opposite leg portions of the bracket **137** and is fastened by a nut **148**. The bolt **147** is formed with a smooth surface in the region between the legs of the bracket **137** and rotatably supports two tripping mechanisms **151** and **152**, for the rope gripping jaw **123** and an overspeed switch respectively, as will be more fully explained. The tripping mechanisms **151** and **152** terminate in lugs **153** and **154**, located adjacent to the periphery of the sheave **32**, to cooperate with the weights **36** and **37**. As shown in FIGURE 2, the weights **36** and **37** are formed with projections **155** and **156** so positioned as to constitute that portion of each weight farthest from the axis of the sheave **32** and the shaft **33**. The projections **155** and **156** are wide enough, and are relatively axially positioned with respect to the lugs **153** and **154**, as shown in FIGURE 10 so that when the weights **36** and **37** fly outward sufficiently, the projections **155** and **156** strike and deflect the lugs **154** and **153**.

The tripping mechanism **151** is rotatably mounted on the bolt **147** and includes, in addition to the lug portion **153**, a cam portion **157**. As best shown in FIGURE 12, the cam portion **157** has a smooth, curved surface except in the region opposite the lug **153** where it is formed with a flat surface which cooperates with a corresponding flat surface of the latch **133**. As shown in FIGURE 11, the cam portion includes a spring loaded plunger **158** which cooperates with an aperture in the bracket **137** to constitute a detent which lightly holds the parts in the position shown in the drawing. In this position the

spring **138** holds the latch **133** against the flat portion of the cam **157**, in which position it engages and holds the jaw **123** against falling. It is apparent that rotation of the tripping mechanism **151**, such as is caused by one of the projections **155** or **156** striking the lug **153**, deflects the latch **133** to the right as viewed in FIGURES 2 and 12, thereby releasing the jaw **123**.

As shown in FIGURES 9, 10, 11 and 14, a switch **161** is fastened to the bracket **137** and includes an operating plunger **162** spring biased to the position shown. Movement of the plunger **162** upward, as viewed in FIGURES 9, 11, and 14, actuates the switch. A cam **163** is rotatably mounted on the bolt **147** and cooperates with the switch **161** and the tripping mechanism **152**. In the region adjacent to the switch **161**, as best shown in FIGURE 14, the cam **163** is formed with a circular cross section except near the top, adjacent to the plunger **162**, where it is flattened as shown. The cam **163** is formed with an aperture on the end containing a spring loaded plunger **164** which, as shown in FIGURE 15, cooperates with a small aperture in the bracket **137** to hold the cam lightly in the position shown. The cam **163** also includes a portion **165** of reduced size extending to the right, as viewed in FIGURE 11. As best shown in FIGURE 13, this portion is of generally rectangular cross section with slightly rounded end portions.

The tripping mechanism **152** includes, in addition to the previously mentioned lug **154**, a body portion **167** which surrounds the portion **165** of the cam **163**. The body portion **167** is of approximately circular cross section and is formed with an axially extending aperture of approximately rectangular cross section, the height of which is approximately equal to the height of the portion **165** to form a freely sliding fit therewith but the width of which is significantly greater than the width of the portion **165**. Set screws **168** and **169** threaded into the body portion **167** extend into the rectangular aperture and bear against the portion **165** of the cam **163** to provide adjustment of the radial position of the body portion **167** with respect to the portion **165**. A double set screw **170** locks the parts in their adjusted position. It is apparent that rotation of the tripper mechanism **152**, such as is caused by one of the projections **155** or **156** striking and deflecting the lug **154**, causes a corresponding rotation of the cam **163** and actuation of the switch **161**.

The tripper mechanism **141** is initially adjusted by first, loosening the screws **145** and moving the entire assembly in the slots **144** to adjust the radial distance of the lug **153** from the axis of the shaft **33** and the sheave **32**, whereupon the screws are tightened. This adjustment selects the speed at which one of the projections **155** or **156** on the weights **36** and **37** will strike the lug **153** and trip the rope gripping jaw **123**. Next, the tripping mechanism **152** is adjusted with the screws **168**, **169** and **170** to set the radial distance of the lug **154** with respect to the lug **153**. This adjustment selects the speed at which one of the projections **155** or **156** will strike the lug **154** and actuate the switch **161**. It is preferred that the lug **154** be closer to the projections **155** and **156** so that the switch **161** is actuated at a lower speed than the jaw **123**.

In operation of the elevator system, the sheave **32** rotates at an angular speed proportional to the linear speed of the car **24**. The weights **36** and **37** tend to fly outwardly under the influence of centrifugal force, against the urging of the springs **51** and **59**.

As the car **24** reaches a first predetermined speed, the weights **36** and **37** fly outwardly sufficiently to cause the link **75**, the bell crank lever **73** and the plunger **78** to actuate one or more of the switches in the bank of switches **85**. These switches may be connected in the motor control circuit in any well known manner, for example, so as to exercise a corrective action on the speed control circuits of the motor **21** so as to tend to reduce its speed. If this corrective action is sufficient, the speed of the motor **21**, car **24** and sheave **32** will decrease, the weights **36** and **37** will move inwardly, and the switches in the bank **85** will be returned automatically to their former condition. In other words, these switches are not "tripped" and no manual resetting is required.

If the car **24** should overspeed, then, as the car **24** and the sheave **32** reach a second predetermined speed, the weights **36** and **37** fly outwardly sufficiently so that one of the projections **155** or **156** strikes the lug **154** thereby rotating the cam **163** thereby forcing the plunger **162** upward and actuating the switch **161**. This action is a tripping action because, if the speed now decreases, there is virtually no force tending to restore the cam **163** and the plunger **162** to their former positions. The initial conditions can be restored only by manually rotating the tripping mechanism to its former position, as illustrated in the drawing, at which position it is held lightly by the spring loaded plunger **164**. The switch **161** may be connected in the elevator control system in any well known manner, preferably so as to remove the driving power from the motor **21** and so as to remove the energization from the electromagnet on the brake **26** thereby allowing the usual spring to apply the brake. If the car **24** should overspeed still further, then, as the car **24** and the sheave **32** reach a third predetermined speed, the weights **36** and **37** fly outwardly sufficiently so that one of the projections **155** or **156** strike the lug **153** thereby rotating the cam portion **157** and displacing the latch **133** whereupon the jaw **123** swings down, gripping the rope **28** between it and the jaw **111**, and causing application of the safety devices on the car **24**. This action is also a tripping action because if the speed now decreases, there is no force tending to raise the jaw **123** out of contact with the rope **28**. To reset the apparatus to its former condition it is necessary to manually raise the jaw **123**, rotate the tripping mechanism **151** to its normal position where it is held lightly by the pring loaded plunger **158**, and reinsert the horizontal latch portion **134** into the slot **135**.

It is apparent that a governor in accordance with the present invention is suitable for use over a wide range of car speeds. Coarse adjustment of the speed at which operation occurs can be made by selecting weights **36** and **37** of various masses and by selecting the strength of the springs **51** and **59**. For example, it has been found that a selection between two sets of weights **36** and **37** and among eleven sets of springs **51** and **59** can accommodate a range of speeds from 150 to 1200 feet per minute of elevator car speed. Fine adjustment in each case is made by adjusting the force exerted by the springs **51** and **59** by rotating the shoulder **52**, by adjusting the machine screw **96** on the switch bank **85**, by adjusting the position of the entire tripper assembly **141** by means of the slots **144**, and by adjusting the tripping mechanism **152** by the set screws **168**, **169** and **170**.

It has also been found that, after initial adjustment, the various operations occur at substantially the same speeds time after time. This is due at least in part to the use of joints and parts which minimize friction and backlash at critical points as previously specified.

Referring now to FIGURE 17, a modification of the invention is shown in which the cover **84** and the bank of switches **85** have been displaced axially outward a short distance and are supported by a block **201** fastened to the frame **35**. The plunger **78** is modified in that the enlarged diameter portion **78'** extends through the bearing and cover plates as shown in FIGURE 17. The reduced diameter portion **78''** operates the bank of switches **85** as formerly.

A bell crank lever **202** is pivotally mounted on a substantially vertical pin **203** supported by the block **201**. One arm of the lever **202** is positioned near the shoulder **204** formed by the junction of the portions **78'** and **78''** of the plunger so that an axial movement of the plunger somewhat in excess of that required to actuate the bank of switches **85** will cause the shoulder **204** to engage the lever **202** and rotate it counterclockwise, as viewed in FIGURE 17. Such rotation causes the other arm of the lever **202** to move to the left, thereby also moving a rod **207** which is pivotally fastened thereto by a low friction fitting **208**. The rod **207** and the fitting **208** are interconnected by threads, as shown, so that the effective length of the rod may be adjusted. The adjustment is maintained by a lock nut **209**. The rod **207** extends beyond the rim of the sheave **38** where it actuates a modified switch and jaw tripping mechanism.

As shown in FIGURE 18, the swinging jaw **123'** may be mounted as before by the links **124** and **125** but is modified slightly in that it is formed with an approximately vertical surface or abutment **211** which, when the jaw is in the raised position shown in FIGURE 18, bears against the lower end of a latch **212** and urges it to the left. As long as the latch **212** is held stationary, the jaw **123'** will be held in its raised position.

As best shown in FIGURE 19, the latch **212** is pivotally mounted by an approximately horizontal pin **213** which in turn is supported by a bracket (not shown). The upper end of the latch **212** is restrained from moving to the right by its engagement with a downwardly extending projection **214** formed on a generally horizontal arm **215** mounted for rotation about a shaft **216**. A downwardly depending arm **217** is rigidly fastened to the arm **215** and carries an adjustable stud **218** projecting therefrom.

The rod **207** is pivotally mounted with a low friction fitting **221**, similar to the fitting **208**, to the top of a generally vertical lever **222** which is mounted for rotation about the previously mentioned shaft **216**. A coil spring **223** urges the lever **222** clockwise, as viewed in FIGURE 19. A portion of the lever **222** below the shaft **216** is positioned opposite to but spaced from the stud **218**. As the rod **207** moves to the left, the lever **222** is rotated counterclockwise and the previously mentioned portion thereof moves to the right, eventually engaging the stud **218**. Such engagement moves the arm **217** to the right thereby moving the arm **215** and its projection **214** upward so as to release the latch **212**, allowing the jaw **123'** to move to the left and downward.

Motion of the rod **207** also trips a switch. In fact, less displacement of the rod **207** is required to trip the switch than is required to release the rope gripping jaw.

In FIGURE 20 there is shown a switch **226** including an actuator **227** in its normal, extended position. An arm **228** is pivotally mounted near one end thereof by a pin **229**. A compression spring **231** is positioned to act between a stationary bracket **232** and the arm **228** so as to urge the latter to rotate clockwise, as viewed in FIGURE 20, toward engagement with the actuator **227**. Such clockwise rotation is normally prevented by the presence of the lever **222** which engages a small projection **233** formed on the arm for that purpose. Rotation of the lever **222** in a counterclockwise direction as viewed in FIGURE 19 corresponds to motion to the right of the portion thereof illustrated in FIGURE 20. It is apparent that very little such motion is sufficient to disengage the lever **222** from the projection **233** so as to allow the spring **232** to rotate the arm **228** clockwise, as viewed in FIGURE 20, to actuate the switch **226**.

The lever **222** is formed with a rounded protuberance **234**. The arm **228** is formed with an inclined camming surface **235**. If for any reason the spring **231** should be inoperative or missing, continued movement of the lever **222** to the right would cause the protuberance **234** to engage the surface **235** and force the lever **228** into engagement with the actuator **227**.

The predetermined speeds at which the switch **226** is tripped and at which the latch **212** is released may be adjusted quite simply. The effective length of the rod **207** may be adjusted by means of the fittings **208** and

221. Such adjustment varies the distance between the shoulder **204** and the lever **202** (FIGURE 17) thereby adjusting the speed at which the rod **207** and the lever **222** start to move. This, of course, adjusts both the speed at which the lever **222** releases the projection **233** (FIG. 20) to trip the switch **226** and the speed at which the lever **222** engages the stud **218** (FIGURE 19) to release the latch **212**. The latter speed may be adjusted independently by adjusting the stud **218**.

From the above it is apparent that the operation of the modified form of the invention is similar to that of the previously described embodiment in that, in both cases, as the sheave **28** attains first, second and third successively higher predetermined speeds, a bank of switches is actuated, a switch is tripped, and a jaw is released to grip a rope. However, is is to be noted that, with regard to the switch tripping and jaw releasing operations, the modified form responds more quickly to changes in speed.

In the unmodified form of the invention, the attainment of the second or third predetermined speed, although causing radial movement of the weights **36** and **37**, has no control effect until the nearer of the projections **155** or **156** has travelled from the angular position it occupied at the instant such speed was attained to the position at which it strikes one of the lugs **153** or **154**. This angular distance travelled may be as much as one half of a revolution of the sheave **38** and during the time required to travel this distance, the speed of the sheave and of the elevator car may vary.

In the modified form of the invention illustrated in FIGURES 17–20, radial movement of the weights **36** and **37** is converted immediately into axial movement of the plunger **78'**. After the plunger **78'** has moved a distance sufficient to bring the shoulder **204** into engagement with the bell crank lever **202**, further radial movement of the weights **36** and **37** is converted immediately into rotation of the lever **222** which rotation, if sufficient, immediately trips the switch **226** and/or releases the rope gripping jaw **123'**. In the neighborhood of the critical speeds, no delay occurs.

Although a number of embodiments of the invention have been described in considerable detail for illustrative purposes, many modifications will occur to those skilled in the art. It is therefore desired that the protection afforded by Letters Patent be limited only by the true scope of the appended claims.

What is claimed is:

1. A governor for an elevator system, comprising,
an elevator car,
a sheave mounted for rotation about its axis,
a rope passing over said sheave and driven by said car for rotating said sheave at a speed proportional to the speed of said car,
a weight pivotally mounted on said sheave and resiliently urged radially inwardly, whereby said weight flies radially outwardly a distance depending upon the speed of rotation of said sheave,
a switch including an actuating means positioned to be struck by said weight when said sheave attains a first predetermined speed,
a pair of jaws operable when tripped to clutch said rope,
tripping means for said jaws positioned to be struck by said weight when said sheave attains a second predetermined speed,
a common mounting means for said switch, said actuating means and said tripping means,
means for adjusting the distance of said mounting means from said axis of said sheave,
whereby said first and second predetermined speeds may be adjusted simultaneously, and
means for adjusting the relative radial distance between said actuating means and said tripping means.

2. An elevator system, comprising,

an elevator car,
a sheave,
a rope passing over said sheave and driven by said car for rotating said sheave at a speed proportional to the speed of said car,
a first switch capable of assuming a plurality of states successively,
actuating means for shifting said first switch to and from said states,
a second switch capable of assuming a normal state or a tripped state,
tripping means for shifting said second switch from its normal to its tripped state,
jaw means gravity urged into clutching engagement with said rope,
latch means for normally holding said jaw means out of engagement with said rope,
means responsive to the speed of rotation of said sheave,
for operating said actuating means of said first switch as said speed exceeds a first predetermined value,
for operating said tripping means as said speed exceeds a second predetermined value in excess of said first value, and
for releasing said latch means as said speed exceeds a third predetermined value in excess of said second value,
said speed responsive means including
a weight pivotally mounted on said sheave, and
a spring urging said weight radially inwardly,
whereby upon rotation of said sheave said weight is urged by centrifugal force radially outwardly against the urging of said spring,
a plunger mounted to be axially movable within said hollow shaft, and
means interconnecting said weight and said plunger for imparting axial movement to said plunger in response to radial movement of said weight,
said actuating means for shifting said first switch being positioned to be operated by engagement with said plunger.

3. Apparatus according to claim **2** further comprising,
means for adjusting said second and third predetermined values of speed simultaneously, and
means for adjusting said second predetermined value independently of said third predetermined value.

4. Apparatus according to claim **2** further comprising,
means for adjusting said second and third predetermined values of speed simultaneously, and
means for adjusting said third predetermined value independently of said second predetermined value.

5. Apparatus according to claim **2** in which said actuating means for said second switch includes a tripping lever positioned to be struck by said weight when the speed of said sheave exceeds said second predetermined value.

6. Apparatus according to claim **2** in which said latch means includes a tripping lever positioned to be struck by said weight when the speed of said sheave exceeds said third predetermined value.

7. Apparatus according to claim **2** including means for operating said tripping means in response to axial movement of said plunger.

8. Apparatus according to claim **7**
in which said tripping means associated with said second switch includes
an arm pivotally mounted adjacent to said switch,
spring means urging said arm toward engagement with said switch,
a projection on said arm,
a lever normally engaging said projection for hold-said arm against the urging of said spring means,
and further comprising,
means mechanically interconnecting said plunger

and said lever for displacing said lever out of engagement with said projection in response to a predetermined axial movement of said plunger.

9. Apparatus in accordance with claim **2** including means for releasing said latch means in response to axial movement of said plunger.

10. Apparatus according to claim **2**
in which
said jaw means is pivotally mounted so as to be urged by gravity laterally and downwardly,
said jaw means is formed with a generally vertical abutment facing the direction in which it is urged by gravity,
said latch means includes a generally vertical latch member pivotally mounted, intermediate its upper and lower ends, about a substantially horizontal axis and normally positioned with the lower end thereof in engagement with said abutment to hold said jaw means in a raised position,
and further comprising
a generally horizontal arm pivotally mounted about a substantially horizontal axis and formed with a downwardly extending projection positioned to engage the upper end of said latch member to resist motion thereof as urged by said jaw means,
and in which
said means for releasing includes means responsive to a predetermined motion of said plunger for rotating said arm upward, whereby said latch member is released.

11. An overspeed governor, comprising,
a sheave including a hollow hub mounted for rotation about the centerline of said hub as an axis,
a rope engaging said sheave for rotating said sheave at a speed proportional to the speed of said rope,
a weight mounted on said sheave for limited movement relative thereto,
spring means for urging said weight radially inwardly toward said axis,
whereby centrifugal force arising by reason of rotation of said sheave urges said weight radially outwardly against the urging of said spring means,
a plunger mounted for axial movement within said hub,
means for converting radial movement of said weight to axial movement of said plunger,
first switch means normally actuatable to and from a series of states,
second switch means normally actuatable only from a first to a second state but not back again,
jaw means urged toward clutching engagement with said rope,
latch means normally holding said jaw means out of engagement with said rope, and
means responsive to axial movement of said plunger for actuating said first switch means, for actuating said second switch means and for releasing said latch means in that order at successively higher speeds of rotation of said sheave.

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