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ELEVATOR APPARATUS

The present invention relates to an elevator apparatus, and particularly, to an elevator apparatus having a detector for detecting the position of a car.

One form of art for detecting the position of an elevator car is disclosed in U. S. Patent No. 5,052,522. In this art, a roller is kept in contact with a rotary portion, such as an idler sheave, of an elevator hoist constituting a part of the drive system, so as to drive a position detector.

In another form, a position detector is driven by utilizing the rotation of a governor (Japanese Patent Unexamined Publication No. 3-177283).

In the former art, since the idler sheave is driven by the main rope by which the car is suspended, wire-lubricating oil contained in the main rope may bleed to the surface of the idler sheave on which the roller of the position detector rolls, and thus cause adhesion of dust to the sheave surface. As a result, the roller may slip on the sheave surface, or may have to run on dust adhered to and deposited on the sheave surface, thereby making it impossible to effect accurate detection of position. In order to avoid this problem, an arrangement

1 is disclosed, for example, in Japanese Patent Unexamined
Publication No. 62-27283, in which the roller of the
position detector rolls on the outer peripheral surface
of a brake drum which surface is free from influence by
5 lubricating oil on the rope. With this arrangement,
however, since the brake drum is provided in the drive
system, accurate position-detection is impossible when
there is slip between the drive system and the main rope.
Actually, therefore, the adoption of the arrangement is
10 combined with the use of another position detector.

In the latter art, the rotary shaft of the
position detector is directly connected mechanically with
the rotary shaft of the governor. It is difficult to
effect connection in such a manner as to achieve
15 alignment between the axis of rotation of the position
detector, which is a precision instrument, and the axis
of rotation of the governor. As a result, when there is
a deviation in the axis of rotation, it is difficult to
effect precise position-detection. Another drawback is
20 that no consideration is given to an arrangement for
increasing the number of pulses generated for position
detection so that it is not readily possible to effect
accurate position-detection.

25 An object of the present invention is to provide
an elevator apparatus capable of accurately detecting the
position of a car.

Another object of the present invention is to provide an elevator apparatus having a position detector which can be easily incorporated.

Still another object of the present invention is to provide an elevator apparatus capable of increasing the level of precision of position detection.

A further object of the present invention is to provide an elevator apparatus capable of accurately detecting a position even with regard to a car moving vertically at a relatively high speed.

The above objects are achieved by providing an elevator apparatus having: a governor driven by a cable connected to an emergency stop device mounted on a car, and capable of actuating the emergency stop device when the speed of the car has exceeded a prescribed speed; and a position detector driven by the governor, the apparatus including a power transmission mechanism for increasing the speed of rotation of the governor and transmitting rotation at an increased speed to the position detector. The power transmission mechanism may employ an endless member.

With the above construction, it is possible to increase the number of revolutions per unit time in the position detector. Since the number of pulses generated is accordingly increased, it is possible for the detection of the position of the car, which is performed by counting pulses, to be stable and have increased precision. The position detector is mounted through the

1 power transmission means, and thus, it is possible to
simply incorporate the position detector. When a power
transmission mechanism employs an endless member, the
contact surfaces for transmitting power have an increased
5 area, thereby making it possible to transmit power
without involving slip even during high-speed movement,
and hence, possible to effect accurate position-
detection.

In the drawings:

10 Fig. 1 is a view schematically showing an
embodiment of an elevator apparatus according to the
present invention;

Fig. 2 is a side view schematically showing a
governor of the elevator apparatus shown in Fig. 1;

15 Fig. 3 is an enlarged sectional view of the
governor shown in Fig. 2, taken along line III-III shown
in Fig. 2;

Fig. 4 is a plan sectional view showing a
specific example of a structure for mounting a position
20 detector shown in Fig. 3;

Fig. 5 is a side view schematically showing
another embodiment of a governor of an elevator apparatus
according to the present invention;

Fig. 6 is a side view schematically showing
25 still another embodiment of a governor of an elevator
apparatus according to the present invention;

1 Fig. 7 is a side view schematically showing
another embodiment of an elevator apparatus according to
the present invention;

 Fig. 8 is a side view schematically showing a
5 further embodiment of a governor of an elevator apparatus
according to the present invention

 Fig. 9 is a side view schematically showing a
still further embodiment of a governor of an elevator
apparatus according to the present invention; and

10 Fig. 10 is a side view schematically showing
another example of a structure for mounting a position
detector shown in Fig. 8 or Fig. 9.

 An embodiment of the present invention will now
15 be described with reference to Figs. 1 to 4. Referring
mainly to Fig. 1, an elevator apparatus according to the
embodiment has a drive sheave 1 of a hoist provided in a
machine house at an uppermost location of the elevator
shaft, and a main rope 2 wound on the drive sheave 1. An
20 elevator car 3 is fastened to one end of the main rope 2
and a counterweight 4 is fastened to the other end in a
manner exactly like that of a pair of roped well-buckets.
When the drive sheave 1 rotates, the main rope 2 is moved
causing the car 3 to ascend or descend along guide rails
25 (not shown), so as to provide a vertical transportation
means which allows passengers to move between floors.

1 The drive shaft 4 is connected to an induction
motor 5 either directly through a reduction gear (not
shown) so as to be driven by the motor 5. The induction
motor 5 is supplied with variable-voltage variable-
5 frequency three-phase alternating current from a three-
phase alternating current power source (not shown)
through a switch 6 and a power inverter 7.

 The car 3 is equipped with an emergency stop
device (not shown) having a wedge capable of being
10 inserted into the gap between the car 3 and the guide
rails in emergency for forcibly stopping the car 3.
Normally, the wedge of the emergency stop device is held
by a wedge holder in a state of non-contacting the guide
rails. The holder is linked with an operating lever 3L
15 through a link mechanism or the like, and the lever 3L is
connected with an endless governor rope 8. The governor
rope 8 has an intermediate portion extending in the same
direction as the main rope 2 constituting a part of the
drive system of the elevator apparatus, an upper bent
20 portion wound on a governor pulley 9 of a governor
provided in the machine house, and a lower bent portion
wound on a tension pulley 10 disposed at a bottom
location of the elevator shaft.

 As shown in Fig. 2, the governor pulley 9 has a
25 rope groove 9G on which the governor rope 8 is wound, and
a roller rolling surface 11; the groove 9G and the
surface 11 are formed on the governor pulley 9 in such a
manner as to be adjacent to and concentric with each

1 other. As shown in Fig. 3, a roller 12 is disposed
contacting the roller rolling surface 11 for driving a
position detector 13. The position detector 13 is
capable of generating a certain number of pulses
5 proportional to the amount of each vertical movement of
the car 3 so that a signal indicating the count of such
pulses can be used as a position signal. The roller
rolling surface 11 has a radius extending outwardly to a
point coinciding with the axis of the governor rope 8
10 wound in the rope groove 9G. The roller 12 has a
diameter smaller than the diameter of the roller rolling
surface 11 formed on the governor pulley 9 so that the
roller 12 is able to transmit, to the position detector,
rotation of the governor pulley 9 at an increased speed.

15 Referring to Fig. 1, a position signal from the
position detector 13 is input to a control unit 14, which
gives a control command accordingly to a power inverter
controller 15. When the power inverter controller 15 has
received the control command, the controller 15 controls
20 the voltage and/or frequency at the power inverter 7, so
as to suitably control the rotation of the induction
motor 5.

Referring to Fig. 2, the governor pulley 9 of
the governor is supported by a frame unit 16 in such a
25 manner as to be rotatable about a supporting shaft 17,
the frame unit 16 being secured to, for example, a floor
18 of the machine house. On one side of the governor
pulley 9, a pair of swingable members 19A and 19B are

1 swingably supported by a pair of shafts 20A and 20B,
respectively, at mutually symmetrical positions with
respect to the supporting shaft 17. A connecting rod 21
interconnects the swingable members 19A and 19B in such a
5 manner that, during operation, these members 19A and 19B
are displaced by equal amounts.

A control switch 22 for giving an opening
command to the switch 6 is mounted on the frame unit 16,
and the control switch 22 has a switch lever 22L
10 projecting therefrom, the switch lever 22L being capable
of contacting the swingable member 19A or 19B when the
swingable members have been displaced by a predetermined
dimension. A catch weight 23 is supported by a lower
portion of the frame unit 16 in such a manner as to be
15 rotatable about a shaft 24. The catch weight 23 is
disposed facing a holding portion 16H of the frame unit
16 with a gap between the catch weight 23 and the holding
portion 16H. The governor rope 8 is passed through the
gap.

20 The catch weight 23 has an engagement pin 23P.
Normally, the engagement pin 23P is kept in engagement
with a hook 25H at a first end of a holding piece 25 so
that the catch weight 23 is held at a position at which
the catch weight 23 does not catch the governor rope 8.
25 The holding piece 25 is rotatably supported by the frame
unit 16, and has a second end portion which is so
positioned as to be capable of contacting the swingable

1 members 19A or 19B when the swingable members have been
displaced by a predetermined dimension. The position of
the second end portion of the holding piece 25 is
arranged such that the swingable members 19A and 19B can
5 contact the second end portion after contacting the
switch lever 22L.

The position detector 13 is mounted to the frame
unit 16. Referring to Figs. 3 and 4, the position
detector 13 is supported by a supporting unit 26 with an
10 elastic member 13S, such as a plate spring, disposed
between the position detector 13 and a first side wall
26A of the supporting unit 26. The supporting unit 26
has a second side wall 26B opposing the side wall 26A.
The roller 12 is mounted to the second side wall 26B in
15 such a manner as to be rotatable about a shaft 12S. As
shown in Fig. 4, the roller 12 is fixed to the outer
peripheral surface of an inner, hollow cylindrical
support 12F with a roller bearing 12B disposed between
the cylindrical support 12 and the shaft 12S. A
20 connecting member 12R has a mounting portion 12A fixed to
a first end face of the cylindrical support 12F, and is
connected to a rotary member (not shown) of the position
detector 13 for transmitting power. Specifically, the
connecting member 12R and the rotary member of the
25 position detector 13 are interconnected in such a manner
that these members are mutually engaged for movement in
the direction of rotation of the roller 12 and that the
members are slidable independently of each other, and

1 hence displaceable relative to each other, in the
direction of the axis of rotation of the roller 12. The
supporting unit 26 is fixed to the frame unit 16 by a
mounting frame 27, to which the supporting unit 26 is
5 mounted in the following manner: The second side wall
26B of the supporting unit 26 is fixed to a first end
portion of a hollow cylinder 26C, in which a supporting
shaft 27S is relatively rotatably supported through a
roller bearing 27B with the mounting frame 27 being fixed
10 to the supporting shaft 27S. An extension spring 28,
such as a coil spring, is disposed on the outer periphery
of the cylinder 26C with one end of the spring 28
engaging with the mounting frame 27 and the other end
engaging with the supporting unit 26 so that the roller
15 12 presses against the roller rolling surface 11 with an
adequate pressing force.

With the elevator apparatus having the above
construction, when the switch 6 is closed, and the power
inverter 7 supplies controlled power to the induction
20 motor 5, the drive sheave 1 is rotated so that the main
rope 2 wound on the sheave 1 moves in accordance with the
direction and amount of rotation of the drive sheave 1,
causing the car 3 to move vertically. The vertical
movement of the car 3 causes the governor rope 8
25 connected to the car 3 through the operating lever 3L to
move in the same direction as the car 3, so that the
governor pulley 9 is rotated accordingly. The power of
rotation of the governor pulley 9 is transmitted through

the roller 12 to drive the position detector 13. The position detector 13 generates pulses, the number of which is counted to detect the current position of the car.

5 The rotary member of the position detector 13 is rotated by the roller 12 contacting an outer peripheral portion of the governor pulley 9. Since the roller 12 has a diameter smaller than that of the roller rolling surface 11, the roller 12 rotates at an increased speed. 10 As a result, the position detector 13 undergoes high-speed rotation so as to generate an increased number of pulses, thereby enabling detection with increased precision.

 The position detector 13 may have various 15 constructions for generating pulses. For example, the position detector 13 may be of a type in which a multiplicity of slits are formed in a rotary disk, and pulses are generated by causing the light to be passed through and blocked by the slits and intervals 20 therebetween, respectively. In another type, a multiplicity of magnetic poles are formed on the outer periphery of a rotary member, and pulses are generated in accordance with the presence and absence of the magnetic poles. In either case, the greater the number of 25 generated pulses, the more accurate the detection of position. In order to increase the number of generated pulses, the number of slits or magnetic poles may be increased. However, slits or magnetic poles cannot be

1 provided beyond a limit determined by the size of an
available space. In another method, the rotary member
may be formed with a greater diameter so as to form a
greater number of slits or magnetic poles. However,
5 since increasing the diameter of the rotary member may
involve a greater risk of deforming the rotary member,
and require higher working techniques, this method cannot
be effective. According to the present invention, the
number of revolutions per unit time in the position
10 detector 13 is increased thereby increasing the number of
generated pulses.

Since the governor pulley 9 is rotated by the
governor rope 8 driven by the car 3, there is no factor
between the governor pulley 9 and the governor rope 8
15 that may cause rope slip which may occur between the
drive sheave and the main rope connected to loads (a car
and a counterweight). Furthermore, since no substantial
load is suspended from the governor pulley 9, there is no
risk of wire-lubricating oil bleeding from the governor
20 rope 8. Thus, there is no risk of detection errors being
caused by slipping of the roller 12 or adhesion of oil.

Since the connection between the roller 12 and
the position detector 13 is such that only the movement
of the rotary member of the position detector 13 in the
25 direction of rotation of the roller 12 is restricted by
the connecting member 12R of the roller 12, and that
movement of the rotary member in other directions is not

1 restricted by the connecting member 12R, alignment
between the roller 12 and the position detector 13 can be
easily performed by utilizing the feature that the rotary
position of the position detector 13 changes following
5 changes in the rotary position of the connecting member
12R. Since the construction for transmitting power from
the roller rolling surface 11 to the roller 12 is one
merely utilizing contact, no precise alignment is
necessary except that the parallelism of the relevant
10 axes of rotation has to be checked carefully.

In the above-described embodiment, high-speed
rotation is achieved in the position detector 13 by an
arrangement in which the roller 12 of a diameter smaller
than that of the governor pulley 9 is kept in contact
15 with an outer peripheral portion of the governor pulley
9. However, where it is impossible to provide the roller
12 in contact with an outer peripheral portion of the
governor pulley 9, another arrangement shown in Fig. 5
may be adopted to achieve high-speed rotation in the
20 position detector 13.

Referring to Fig. 5, the second embodiment has
the following construction which is the same as the
corresponding construction of the first embodiment: a
governor pulley 9 is supported by a frame unit 16 in such
25 a manner as to be rotatable about a supporting shaft 17.
The frame unit 16 also supports a switch 22 having a
switch lever 22L, a catch weight 23 and a supporting
piece 25. The governor pulley 9 supports swingable

1 members 19A and 19B through the respective shafts.

In the second embodiment, the free end portion of the supporting shaft 17 projects outwardly from the frame unit 16, and a rotary disk member 29 is mounted to
5 the projected end. The rotary disk member has a roller rolling surface 30 formed on the outer periphery thereof, and the roller 12 for driving the position detector 13 is kept in contact with the roller rolling surface 13. In this embodiment, the position detector 13 is mounted to
10 the frame unit 16 by the same structure as that in the first embodiment.

With the second embodiment, since the rolling surface for the roller 12 is provided when the rotary disk member 29 is mounted to the mated end of the
15 supporting shaft 17, the position detector 13 can be easily incorporated without requiring a special processing for forming the roller rolling surface on the governor pulley 9. Thus, the second embodiment is advantageous in that a commercially-available product can
20 be readily used.

In the second embodiment, the position detector 13 is mounted on a governor having swingable members 19A and 19B supported on one side of the governor pulley 9. However, this is a mere example of the application of the
25 present invention, and present invention may be applied to another type of governor shown in Fig. 6.

Referring to Fig. 6, a first bevel gear 31 is provided on a governor pulley 9 supported by a frame unit

1 16 in such a manner as to be rotatable about a supporting
shaft 17. A second bevel gear 32 meshing with the first
bevel gear 31 is rotatably supported by the frame unit 16
with the axis of the second bevel gear 32 extending
5 vertically. A vertical shaft 33 is connected to the
second bevel gear 32 for rotation. Each of a pair of
levers 34 has a first end pivotally supported by an upper
portion of the vertical shaft 33, and a second end to
which a weight 35 is mounted. A link 36 has an upper end
10 pivotally mounted to an intermediate portion of a
corresponding lever 34, and a lower end pivotally
connected to a cylinder member 37 mounted on the vertical
shaft 33 in such a manner as to be vertically movable
thereon. A ring 38 is mounted on the cylinder member 37
15 in such a manner that the ring 38 follows only the
vertically movement of the cylinder member 37. The ring
38 is arranged to actuate, through a link mechanism (not
shown), a switch (not shown) and a catch weight (not
shown) respectively corresponding to the switch 22 and
20 the catch weight 23 shown in Fig. 2.

With the above construction, when the speed at
which the car descends increases, the speed of rotation
of the governor pulley 9 rotated by the governor rope 8
linked to the car 3 increases accordingly. Rotation of
25 the pulley 9 at an increased speed causes the weights 35
to be displaced upward by centrifugal force, whereby the
ring 38 is raised. As a result, the unillustrated switch

1 and the catch weight are actuated through the link
mechanism connected to the ring 38, so that the power
source will be disconnected from the induction motor 5,
and the governor rope 8 will assume its held position.

5 Also in the governor of the type shown in Fig.
6, a roller rolling surface 11 is formed in the governor
pulley 9, and a roller 12 is kept in contact with the
rolling surface 11 for rolling thereon, so that high-
speed rotation is achieved in a position detector 13. In
10 this construction, if it is not possible to form the
roller rolling surface 11 on the governor pulley 9, a
rotary disk member 39 with a roller rolling surface 40
formed on the outer periphery thereof may be mounted to a
supporting shaft 17, as indicated by two-dot-chain lines
15 in Fig. 6, so as to achieve high-speed rotation in the
position detector 13 by virtue of the roller 12.

 In each of the foregoing embodiments, the
position of a car is detected by utilizing a governor.
However, position detection may be performed by adopting
20 an arrangement shown in Fig. 7.

 Referring to Fig. 7, in general, in an elevator
apparatus, a main rope 2 is wound on both a drive sheave
1 and an idler sheave 41, and a car 3 and a counterweight
4 are suspended on either ends of the main rope 2. A
25 balance rope 42 belonging to a system different from the
drive system of the apparatus is suspended intercon-
necting the respective bottom portions of the car 3 and
the counterweight 4 so as to reduce unbalance in weight

1 which may be caused by changes in the position of the car
3. Lower bent portions of the balance rope 42 are wound
on a pair of tension pulleys 43A and 43B, each rotatably
supported by a supporting frame 44, so as to prevent the
5 balance rope 42 from having a loose or entangled portion.
A roller 12, connected with a position detector (not
shown), is kept in contact with one of the tension
pulleys 43A and 43B, for example, with the tension pulley
43A, and is supported by the supporting frame 44. The
10 roller 12, of course, has a diameter smaller than that of
the tension pulley 43A.

The above arrangement also makes it possible to
increase the rotational speed of the tension pulley 43A
and to transmit rotation at an increased speed, thereby
15 enabling the position of the car 3 to be detected with
increased precision.

Alternatively, the following arrangement may be
adopted: another rope driven by vertical movement of the
car 3 is provided separately from the main rope 2, a
20 governor rope 8 and the balance rope 42, and this car-
driven rope is wound on a rotary member. A small-
diameter roller is kept in contact with the rotary member
so as to drive the position detector with an increased
number of revolutions per unit time in the position
25 detector.

In each of the foregoing embodiments, a roller
is kept in contact with a rotary member so as to drive a
position detector with an increased number of revolutions

1 per unit time. Alternatively, the position detector may
be driven at an increased number of revolutions per unit
time by utilizing meshing gears. In this case, however,
since looseness due to meshing errors may cause unwanted
5 variations in the number of pulses generated, it is
necessary to increase the precision at which gears are
worked and/or to select materials capable of preventing
looseness, so as to minimize the risk of looseness.

In another embodiment shown in Fig. 8, instead
10 of driving the position detector with an increased number
of revolutions per unit time by using a roller contacting
a rotary member, the position detector is driven with an
increased number of revolutions per unit time by using an
endless member such as a belt or chain. In Fig. 8,
15 component parts denoted by the same reference numerals as
those shown in Fig. 2 have the same operations, and these
component parts will not be described to avoid
redundancy. In this embodiment, a first pulley 45 is
fixed to the supporting shaft 17 rotatable in unison with
20 the governor pulley 9. A second pulley 46 paired with
the first pulley 45 and having a smaller diameter than
the first pulley 45 is fixed to the frame unit 16 through
a supporting member 47. A belt 48 is wound on both
pulleys 45 and 46. A position detector 13, coaxial with
25 the second pulley 46 and rotatable about its own axis, is
supported by the supporting member 47.

With the above construction, rotation of the
governor pulley 9 is transmitted through the first pulley

1 45, which is coaxial with the governor pulley 9, and
through the belt 48 to the small-diameter second pulley
46, which is thus rotated at an increased speed. As a
result, high-speed rotation is caused in the position
5 detector 13, thereby enabling an increased number of
pulses to be generated, and enabling detection to be
performed with increased precision.

In order to prevent the belt 48 from undergoing
slip between the paired pulleys 45 and 46, these members
10 preferably comprise the types known as V belts and V-
groove pulleys that have trapezoidal cross-sectional
configurations. Further, in order to prevent slip from
being caused between the pulleys 45 and 46 by stretching
of the belt 48 after a long period of use, it is
15 preferable to provide a device for imparting tension in
such a manner that the tension of the belt 48 will be
substantially constant over a long period of time, or to
form the belt 48 using an elastic material having a core
made of metal thin wires, synthetic fiber or the like so
20 that the belt 48 will be stretched only slightly over a
long period of time.

In an elevator apparatus in which a car moves
vertically at relatively high speed, it is required to
detect the position of the car with higher precision. If
25 such is the case, the belt 48 may comprise a toothed belt
while the pulleys 45 and 46 comprise toothed pulleys, so
that rotation of the first pulley 45 can be positively
transmitted to the second pulley 46.

1 In another construction shown in Fig. 9, a
governor of the type constructed as shown in Fig. 6 is
arranged to have a power transmission mechanism including
an endless member. In Fig. 9, component parts denoted by
5 the same reference numerals as those shown in Figs. 6 and
8 have the same operations, and these component parts
will not be described to avoid redundancy.

 In a structure shown in Fig. 10, the position of
the second pulley 46 is rendered variable. The second
10 pulley 46 is rotatably supported to a first end portion
of a lever 49 having a second end supported by the
supporting member 47 in such a manner as to be rotatable
about a shaft 50. The position detector 13 is supported
in the same manner. A first seat 51 is provided on the
15 supporting member 47 while a second seat 52 opposing the
first seat 51 is provided on the lever 49. A first end
portion of a rod 53 is fixed to the first seat 51 with a
second end portion of the rod 53 passing through the
second seat 52 with a suitable play. A third seat 54
20 opposing the second seat 52 is provided on the rod 53,
and a compression spring 55 is disposed on a portion of
the rod 53 which is between the second and third seats 52
and 54. The compression spring 55 needs to be disposed
in such a manner that the compression force of the spring
25 55 acts in a direction in which tension is imparted to
the belt 48. An abnormality detection switch 56 is
provided with its contact member 57 disposed in spaced

1 opposition to that side of the second seat 52 remote from
the compression spring 55.

With the above arrangement, since a certain
tensile force always acts on the belt 48, even when the
5 belt 48 becomes stretched after a long period of use, no
slip occurs between the paired pulleys, and it is
possible to effect stable transmission of torque. When
the belt 48 has been cut, the force of the compression
spring 55 causes the lever 49 to rotate about the shaft
10 50 in the counterclockwise direction and press against
the contact member 57. As a result, the abnormality
detection switch 56 is actuated so that the fact that
position detection has become impossible is posted or
displayed for stopping the operation of the elevator
15 apparatus.

As has been described above, according to the
present invention, an elevator apparatus has an easily
mountable position detector, and is capable of detecting
the position of a car with high precision.



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Claims

1. An elevator apparatus comprising: a governor driven by a cable connected to an emergency stop device mounted on a car, and capable of actuating said emergency stop device when the speed of said car has exceeded a prescribed speed; a position detector driven by said governor; and a power transmission mechanism for increasing the speed of rotation of said governor and transmitting rotation at an increased speed to said position detector.
2. An elevator apparatus comprising: a rotary member driven by a cable which is not belonging to a drive system connected to a car; rotational speed increasing means driven by said rotary member; and a position detector driven by said rotational speed increasing means.
3. An elevator apparatus according to claim 2, wherein said rotary member is provided at a fixed position.
4. An elevator apparatus according to claim 3, wherein said fixed position comprises the interior of a machine house at an uppermost location of an elevator shaft in which said car is vertically moved.
5. An elevator apparatus comprising: a rotary member driven by a cable which is not belonging to a drive system connected to a car, said rotary member being provided at a fixed position; and a position detector to which power of said rotary member is transmitted through

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rotational speed increasing means.

6. An elevator apparatus comprising: an endless rope which is not belonging to a drive system connected to a car; a rotary member driven by said rope; rotational speed increasing means for increasing the speed of rotation of said rotary member; and a position detector in which rotation is caused by said rotational speed increasing means.

7. An elevator apparatus including: a governor pulley; and a position detecting means driven from an outer peripheral portion of said governor pulley.

8. An elevator apparatus according to claim 7, wherein said position detecting means is driven by force of friction on said governor pulley.

9. An elevator apparatus according to claim 7, wherein said position detecting means is driven by meshing engagement on said governor pulley.

10. An elevator apparatus comprising: an emergency stop device mounted on a car; a governor having an endless governor rope connected to an operating lever of said emergency stop device, and a governor pulley driven by said governor rope wound in a rope groove of said governor pulley, said governor being capable of detecting an excessive speed of said car from the rotation of said governor pulley and actuating said emergency stop device; and a position detector driven by said governor, said apparatus further comprising: a roller rolling surface formed on said governor pulley and concentric with said

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rope groove; and a roller of a diameter smaller than the diameter of said roller rolling surface, said roller contacting said roller rolling surface, wherein said roller drives said position detector, and said roller rolling surface has a radius extending outwardly to a point coinciding with the axis of said governor rope.

11. An elevator apparatus including: a rotary member mounted in a governor and having a roller rolling surface formed thereon; a roller contacting said roller rolling surface and having a diameter smaller than the diameter of said roller rolling surface; and a position detector driven by said roller.

12. An elevator apparatus comprising: an induction motor supplied with power from an alternating-current power source through a power inverter; a drive sheave driven by said induction motor; a main rope wound on said drive sheave; a car suspended by said main rope; an emergency stop device mounted on said car; a governor having an endless governor rope connected to an operating lever of said emergency stop device and having an intermediate portion extending in the same direction as said main rope, and a governor pulley driven by said governor rope wound in a rope groove of said governor pulley, said governor being capable of detecting an excessive speed of said car from the rotation of said governor pulley and actuating said emergency stop device; a roller rolling surface formed on said governor pulley and concentric with said rope groove; a roller of a

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diameter smaller than the diameter of said roller rolling surface, said roller contacting said roller rolling surface for being driven thereby; a position detector driven by said roller; and a controller for controlling said power inverter on the basis of a position signal from said position detector.

13. A governor for an elevator apparatus, including: a rotary member having a measurement peripheral surface formed thereon.

14. A governor for an elevator apparatus according to claim 13, wherein said rotary member comprises a governor pulley having a rope groove in which a governor rope is wound.

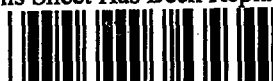
15. A governor for an elevator apparatus according to claim 14, wherein said measurement peripheral surface is formed adjacent to the portion of said governor pulley on which said governor rope is wound.

16. A governor for an elevator apparatus according to claim 14, wherein said measurement peripheral surface is formed having a radius extending outwardly to a point coinciding with the axis of said governor rope wound in said rope groove.

17. A governor for an elevator apparatus, including: rotary speed increasing means contacting with a governor pulley; and a position detector driven by said rotational speed increasing means.

18. An elevator apparatus comprising: a rotary member driven by a cable which is not belonging to a

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drive system connected to a car; a roller rolling surface formed on said rotary member; a roller of a diameter smaller than the diameter of said roller rolling surface, said roller contacting said roller rolling surface for being driven thereby; and a position detector connected with said roller for movement in the direction of rotation of said roller and displaceable relative to said roller for movement in the direction of the axis of rotation of said roller.

19. An elevator apparatus comprising: a governor driven by a cable connected to an emergency stop device mounted on a car, and capable of actuating said emergency stop device when the speed of said car has exceeded a prescribed speed; a position detector driven by said governor; and an endless member through which the speed of rotation of said governor is increased and rotation at an increased speed is transmitted to said position detector.

20. An elevator apparatus according to claim 19, wherein said endless member has a first end wound on a first pulley rotating in unison with said governor, and a second end wound on a second pulley of a diameter smaller than the diameter of said first pulley, said position detector being driven by said second pulley.

21. An elevator apparatus according to claim 19, wherein said second pulley is elastically supported in such a manner as to be displaceable in a direction in which the distance between said first and second pulleys

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increases.

22. An elevator apparatus comprising: a governor driven by a cable connected to an emergency stop device mounted on a car, and capable of actuating said emergency stop device when the speed of said car has exceeded a prescribed speed; a position detector driven by said governor; an endless member through which the speed of rotation of said governor is increased and rotation at an increased speed is transmitted to said position detector; means for imparting tension to said endless member; and means for detecting a cut state of said endless member.

23. An elevator apparatus comprising: an emergency stop device mounted on a car; a governor having an endless governor rope connected to an operating lever of said emergency stop device for being driven by vertical movement of said car, and a governor pulley driven by said governor rope wound on said governor pulley, said governor being capable of actuating said emergency stop device when the rotational speed of said governor pulley has exceeded a speed corresponding to a prescribed speed of said car so as to effect an emergency stop of said car; and a position detector driven by said governor, said apparatus further comprising: a first toothed pulley rotatable in unison with said governor pulley; a second toothed pulley of a diameter smaller than the diameter of said first pulley, said second toothed pulley being capable of varying the distance between said first and second pulleys; a toothed belt wound on said first

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and second pulleys; an elastic member urging said second pulley in a direction in which said second pulley imparts tension to said belt; and an abnormality detection switch for detecting an abnormal state of said belt by detecting displacement of said second pulley, wherein said position detector is connected to said second pulley.

24. An elevator apparatus substantially as herein described with reference to and as illustrated in Figs 1 to 4, or Fig 7 of the accompanying drawings.
25. A governor for an elevator apparatus substantially as herein described with reference to and as illustrated in Fig 5, or Fig 6 or Fig 8 or Fig 9 or Fig 10 of the accompanying drawings.

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Figure(s) to accompany sheet

ELEVATOR APPARATUS

An elevator apparatus having an easily mountable position detector, and capable of detecting the position of a car with good precision. The apparatus has a position detector (13), and a governor driven by a cable (8) connected to an emergency stop device mounted on a car (3) and capable of actuating the emergency stop device when the speed of the car (3) has exceeded a prescribed speed, the position detector being driven by the governor. The apparatus includes a power transmission mechanism (9, 12, 29, 39, 43A, 45, 46, 48) for increasing the speed of rotation of the governor and for transmitting rotation at an increased speed to the position detector (13).

Fig 1

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FIG. 1

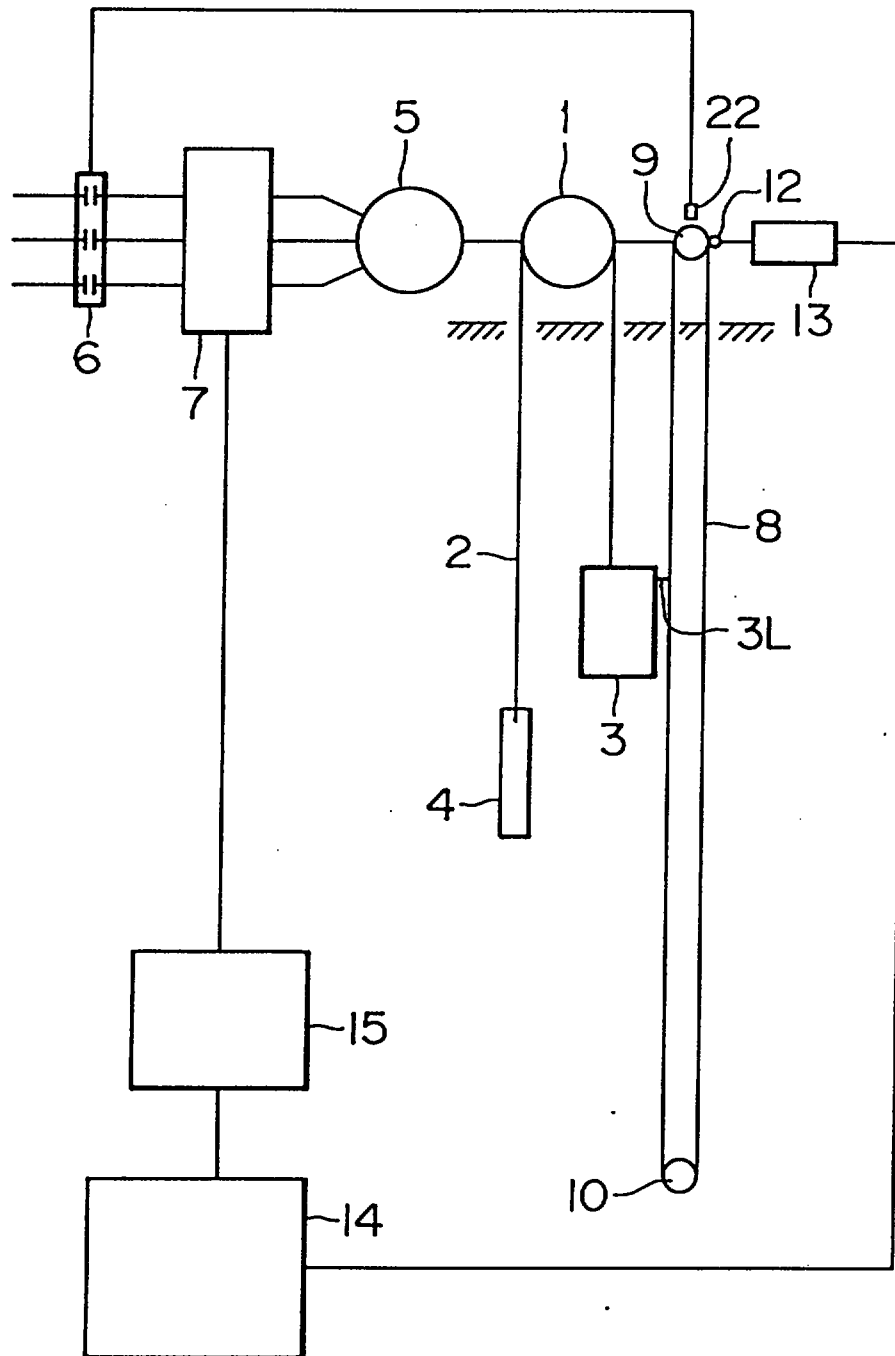
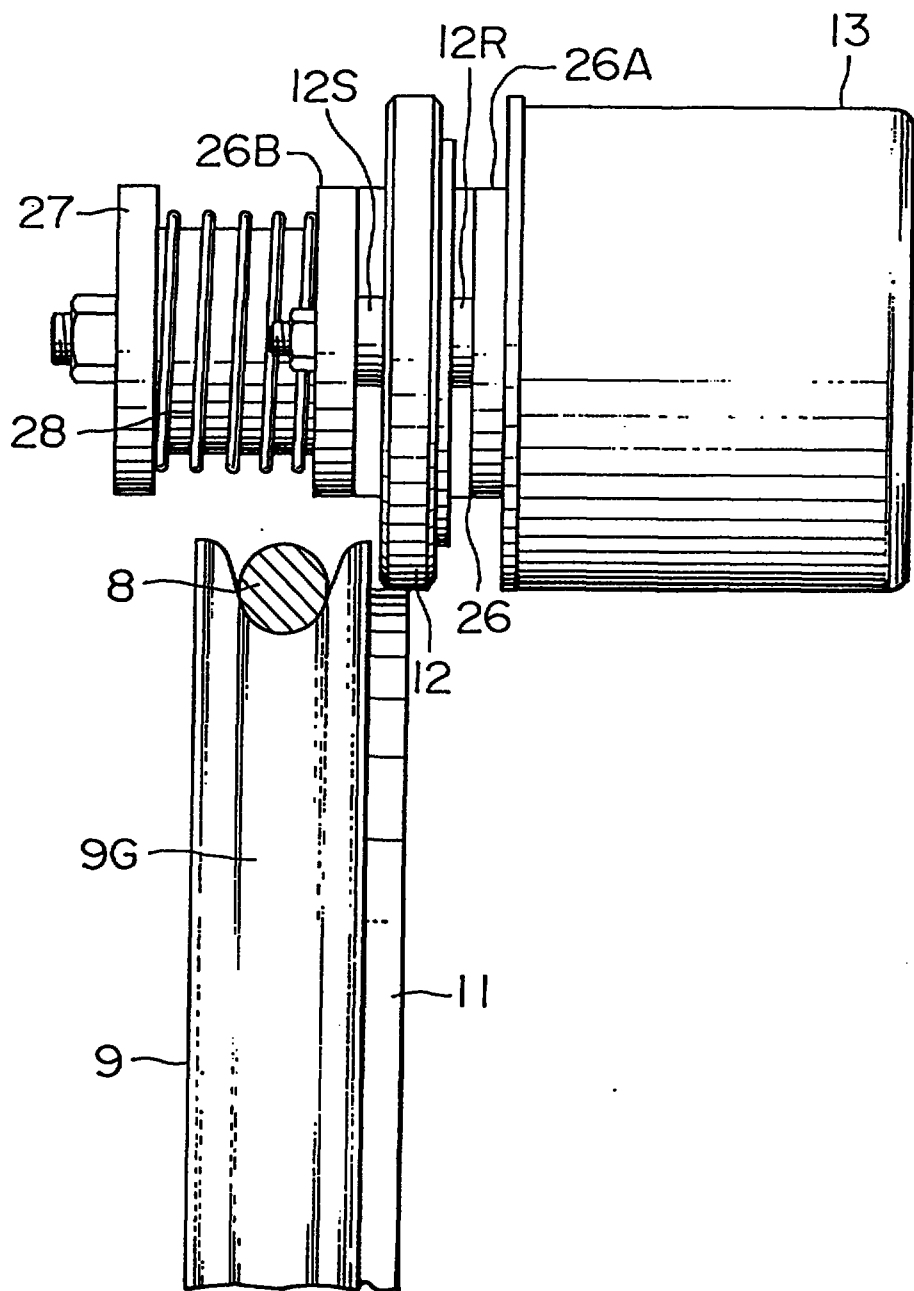


FIG. 3



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FIG. 4

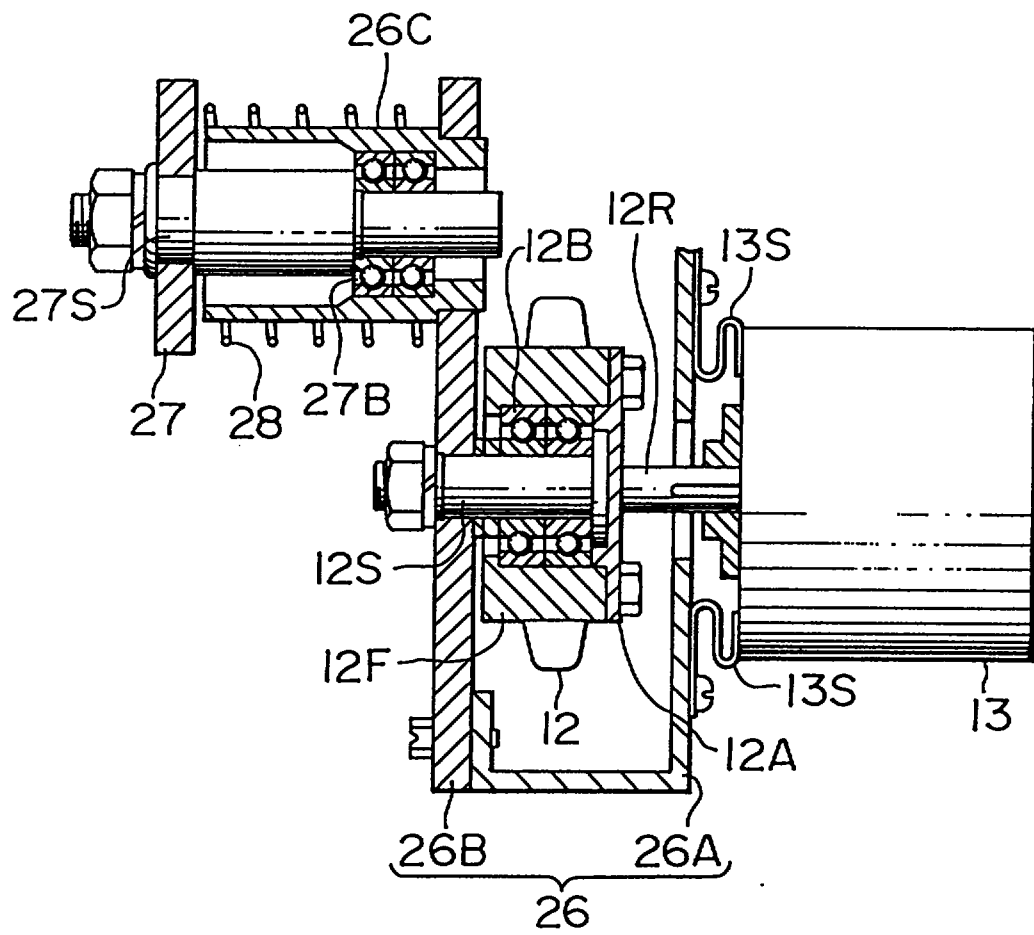


FIG. 5

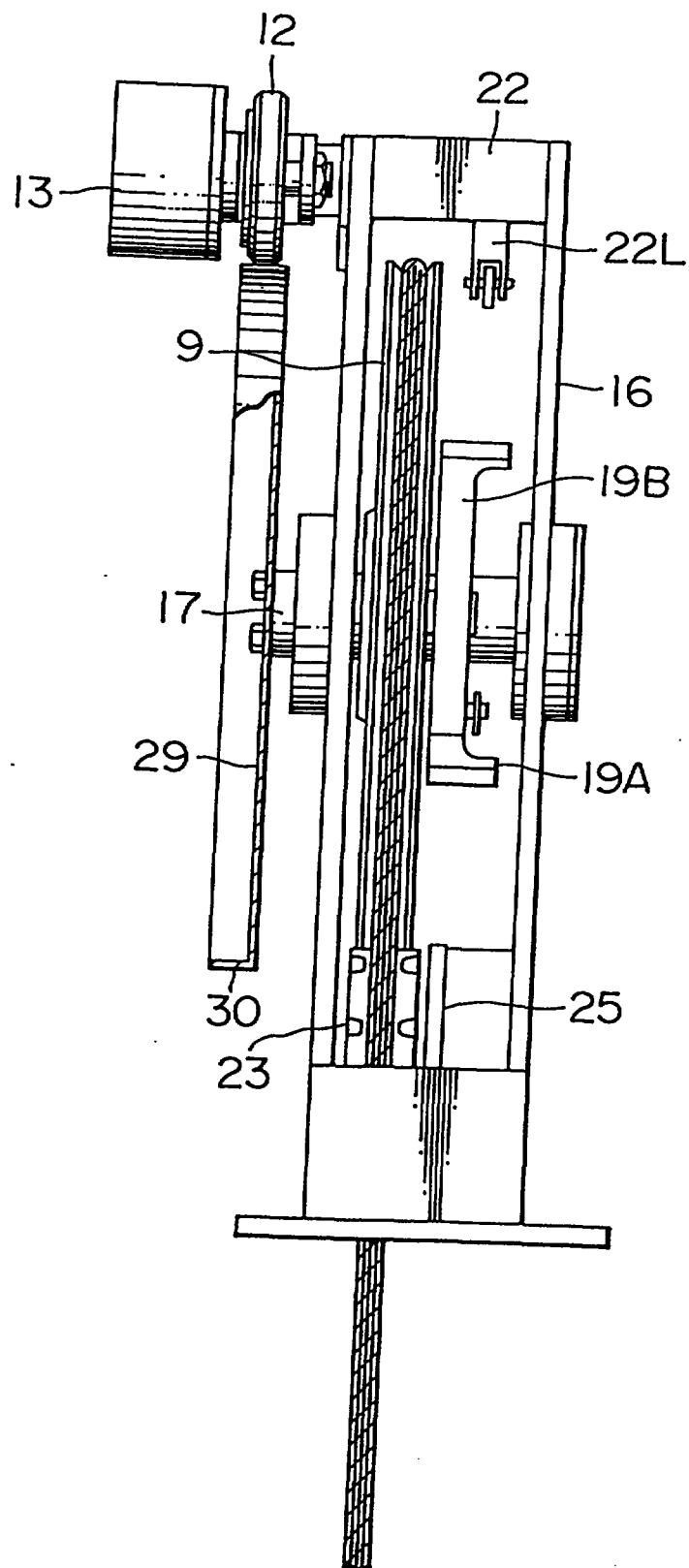


FIG. 6

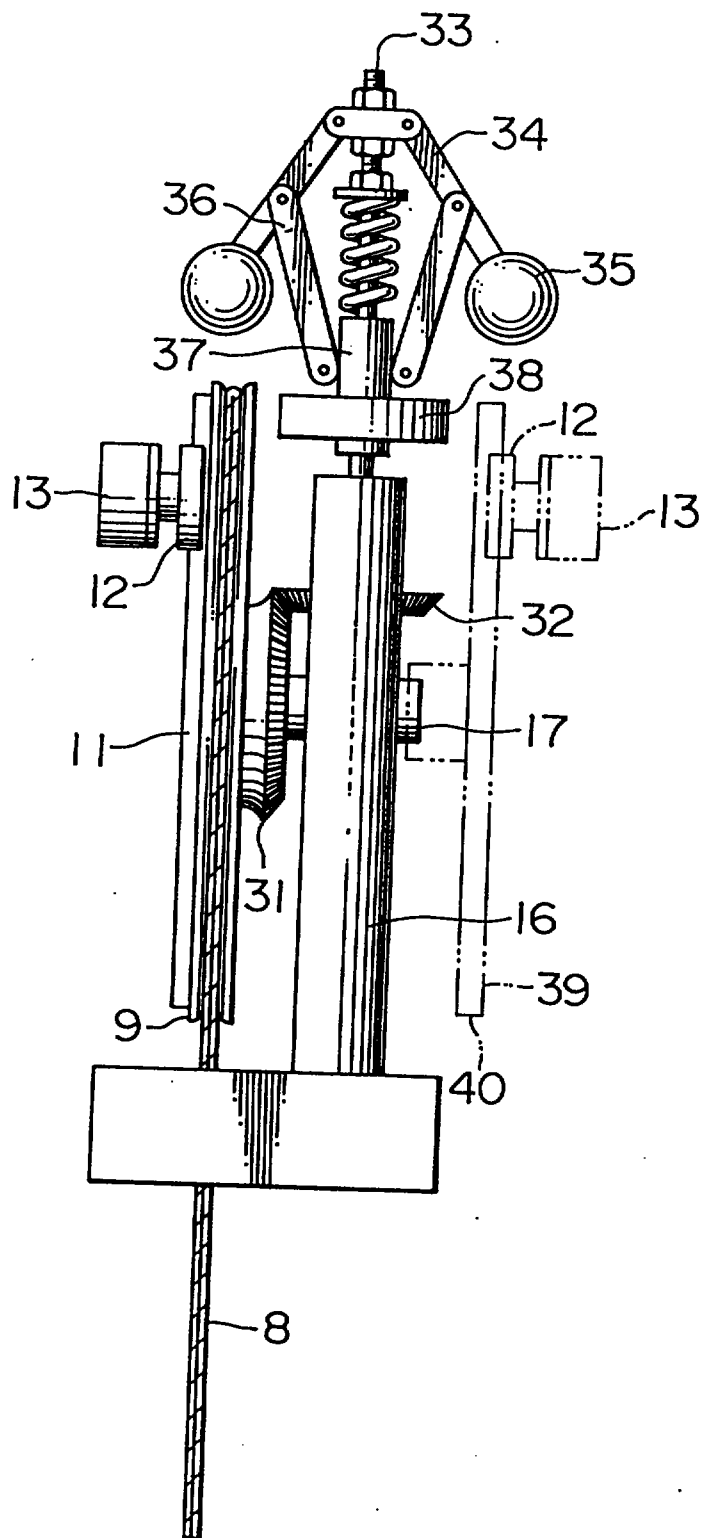
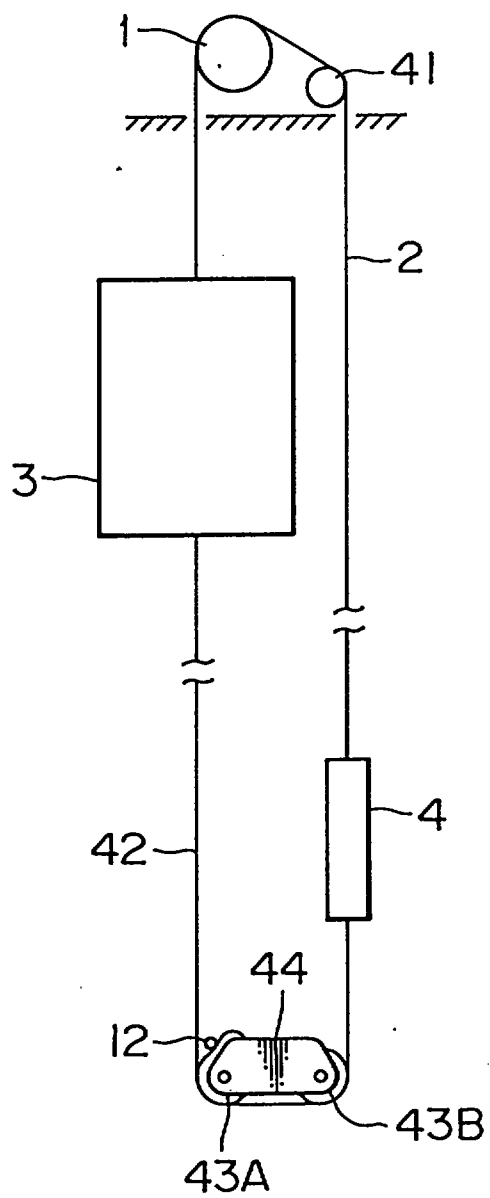
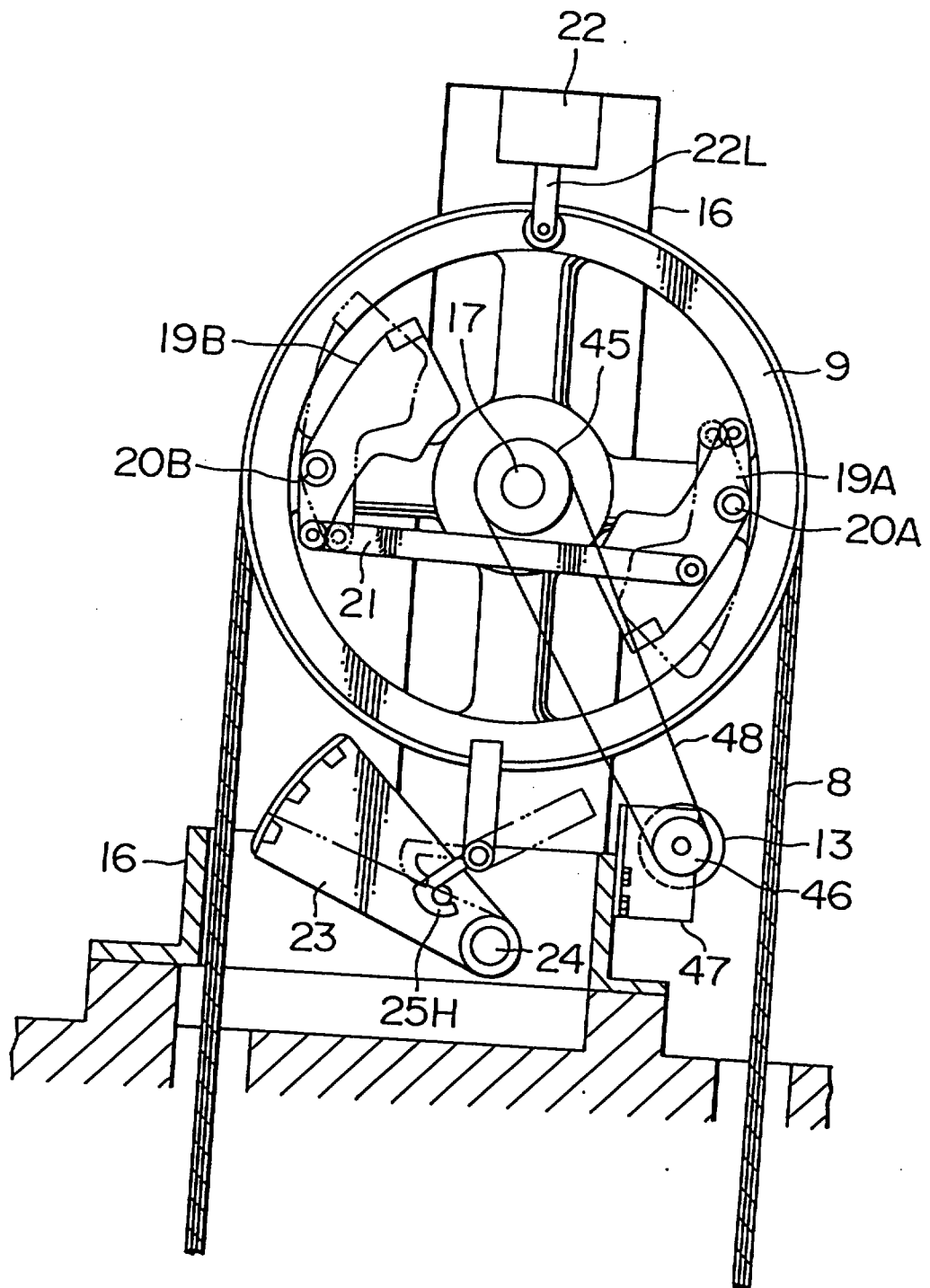


FIG. 7



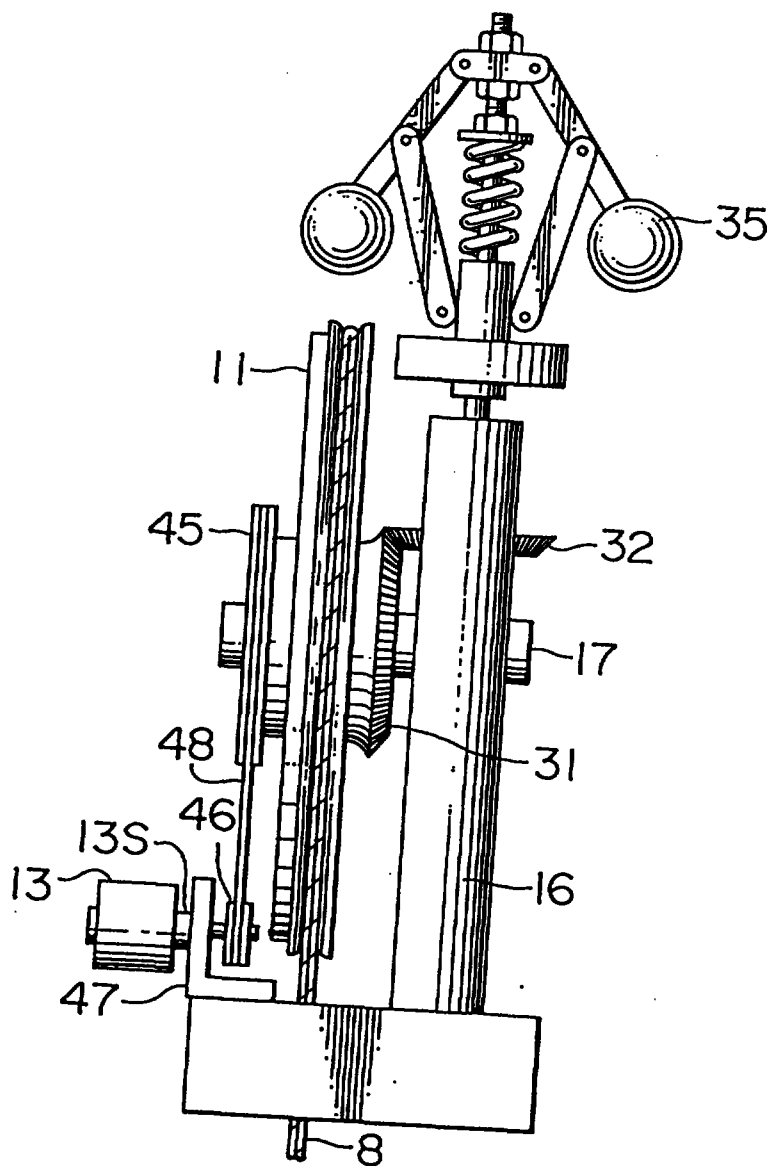
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FIG. 8



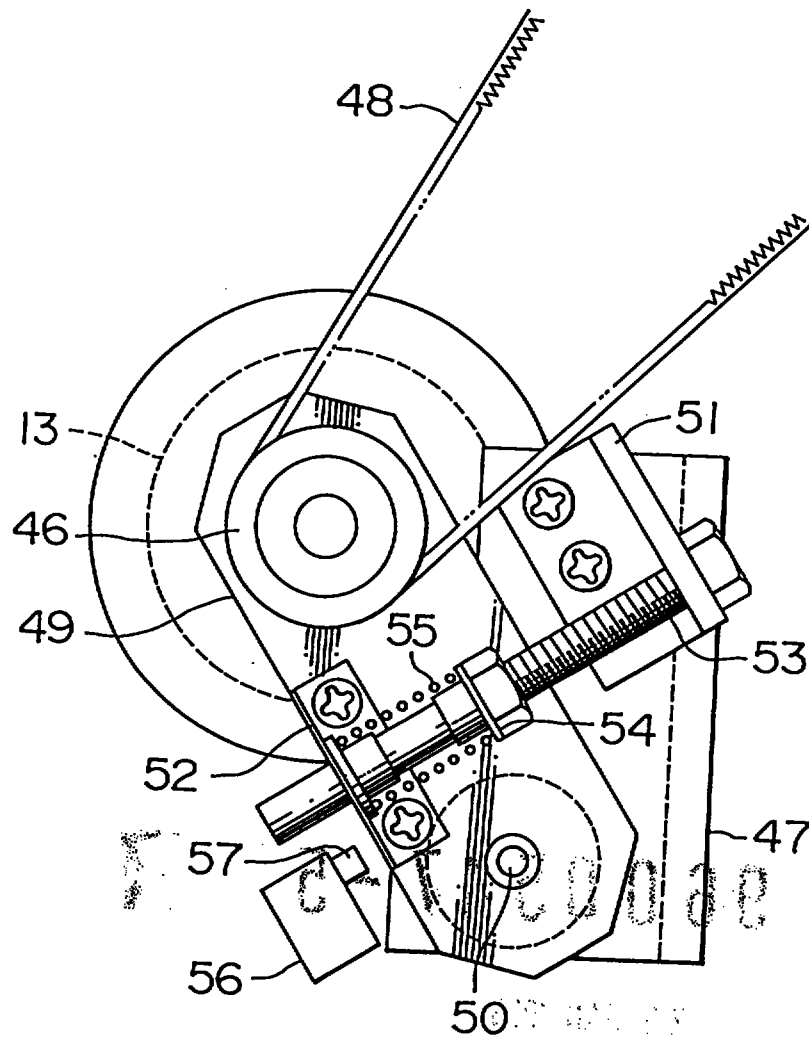
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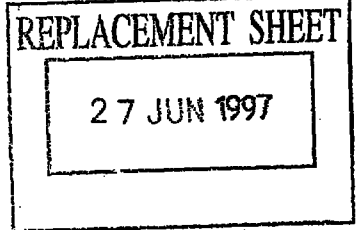
FIG. 9



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FIG. 10





CLAIMS

1. An elevator apparatus comprising:

a car suspended by a first cable; an endless second cable driven by vertical movement of said car; a first rotary member driven by said second cable; a second rotary member driven by said first rotary member and having a diameter smaller than the diameter of said first rotary member; and a position detector driven by said second rotary member.

2. An elevator apparatus according to claim 1, wherein said first rotary member is a governor pulley of a governor provided in a machine house at an uppermost location of an elevator shaft in which said car is vertically moved, and said second rotary member is a roller driven by contact with the outer periphery of said governor pulley.

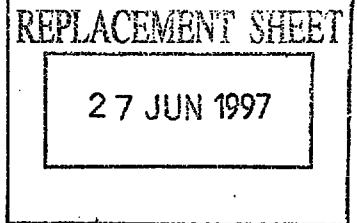
3. An elevator apparatus according to claim 1, wherein said first rotary member is a first pulley rotating together with a governor provided in a machine house at an uppermost location of an elevator shaft in which said car is vertically moved, said second rotary member is a second pulley arranged apart from said first pulley, and an endless member is extended around said first pulley and said second pulley.

4. An elevator apparatus according to claim 3, wherein said second pulley is elastically supported in such a manner as to be displaceable in a direction in which the distance between said first and second pulleys increases.



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5. An elevator apparatus according to claim 1, wherein said car includes an emergency stop device mounted thereon, said second cable is a governor rope connected to an operating lever of said emergency stop device, said first rotary member is a governor pulley including said governor rope wound in a rope groove thereof and provided in a machine house at an uppermost location of an elevator shaft in which said car is vertically moved, said governor pulley has a roller rolling surface concentric with said rope groove, said second rotary member is a roller in contact with said roller, rolling surface, and said roller rolling surface has a radius extending outwardly to a point coinciding with the axis of said governor rope wound in said rope groove.
6. An elevator apparatus according to claim 1, wherein said first rotary member is mounted in a governor provided in a machine house at an uppermost location of an elevator shaft in which said car is vertically moved.
7. An elevator apparatus according to claim 1, wherein said first cable is a main rope for suspending and vertically moving said car in an elevator shaft, said first cable being wound on a drive sheave mounted in a machine house at an uppermost location of said elevator shaft, said drive sheave is driven by an induction motor supplied with power from an alternating-current power source through a power inverter, said car includes an emergency stop device mounted thereon, said second cable is a governor rope connected to an operating lever of



said emergency stop device and extended in the same direction as said main rope, said first rotary member is a governor pulley mounted in the machine house at the uppermost location of said elevator shaft, said governor pulley is formed with a rope groove in which said governor rope is wound, and a roller rolling surface concentric with said rope groove, said secondary rotary member is a roller contacting said roller rolling surface for being driven thereby and having a diameter smaller than the diameter of said roller rolling surface, and said position detector is provided with a controller for controlling said power inverter on the basis of a position signal from said position detector.

8. An elevator apparatus according to claim 1, wherein said car includes an emergency stop device mounted thereon, said second cable is connected to an operating lever of said emergency stop device, said first rotary member is a first pulley rotating together with a governor provided in a machine house at an uppermost location of an elevator shaft in which said car is vertically moved, said second rotary member is a second pulley arranged apart from said first pulley, and endless member is extended around said first pulley and said second pulley, and means is provided for detecting a cut state of said endless member.

9. An elevator apparatus according to claim 1, wherein said car includes an emergency stop device mounted thereon, said second cable is an endless governor rope

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connected to an operating lever of said emergency stop device for being driven by vertical movement of said car, said first rotary member is a first toothed pulley mounted in a governor provided in a machine house at an uppermost location of an elevator shaft in which said car is vertically moved, said second rotary member is a second toothed pulley is provided having a diameter smaller than the diameter of said first toothed pulley, and being capable of varying the distance between said first and second pulleys, a toothed belt is wound on said first and second toothed pulleys, means is provided in said second pulley for imparting tension to said belt, an abnormality detection switch for detecting an abnormal state of said belt by detecting displacement of said second pulley is provided, and said position detector is connected to said second pulley.

10. An elevator apparatus substantially as herein described with reference to and as illustrated in Figs. 1 to 4, of the accompanying drawings.

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REPLACEMENT SHEET

ELEVATOR APPARATUS

An elevator apparatus having an easily mountable position detector, and capable of detecting the position of a car with good precision. The apparatus has a position detector (13), and a governor driven by a cable (8) connected to an emergency stop device mounted on a car (3) and capable of actuating the emergency stop device when the speed of the car (3) has exceeded a prescribed speed, the position detector being driven by the governor. The apparatus includes a power transmission mechanism (9, 12, 29, 39, 43A, 45, 46, 48) for increasing the speed of rotation of the governor and for transmitting rotation at an increased speed to the position detector (13).

Fig 1