

SPECIFICATION

Elevator emergency driving apparatus

The present invention relates to an emergency driving apparatus for use with an elevator system at the time of interruption of normal power supply service. In particular, the invention concerns an improvement in an elevator driving apparatus which allows an elevator cage to be operated by means of a small type d.c. motor even at the time of service interruption in the commercial power supply system.

In general, when the service interruption occurs in the normal power supply source such as commercial service line during a period of time of the running of an elevator cage, it is a general practice to brake the elevator cage to a stop instantly in order to protect passengers from any possible danger. Consequently, the passengers will be confined in the cage stopped in an inter-floor space of a building. As an attempt to rescue the passengers from the confined state instantly, various proposals have heretofore been made on the method for driving the elevator in an emergency at the time of the service interruption.

According to a typical one of the hitherto known methods, an independent electric power plant is operated at the time of the service interruption to supply electric power to a traction motor of the elevator. However, such an independent electric power plant is very expensive, so that there are many cases where the independent electric power plant is not installed in a building of a small scale. For that reason, there have been developed various systems for driving the elevator at the time of interruption of commercial power supply service without resorting to the use of the independent electric power plant. A typical one of such system comprises an emergency power supply source of a small capacity such as battery, and a direct current or d.c. motor provided with a flying-out gear for transmitting out the driving torque of the d.c. motor therethrough (hereinafter referred to as pinion). There is a method that when the power supply service is interrupted, the d.c. motor is energized from the emergency power supply source to drive the traction motor through the pinion, thereby allowing the elevator cage to be operated. This method is advantageous in that a d.c. power supply source of a small capacity will be sufficient for the emergency power source and that no complicated mechanism is required.

More specifically, the elevator driving apparatus is generally composed of a traction motor for normally driving the elevator cage and a winding machine operatively coupled to the traction motor through a coupling mechanism. A gear to be engaged with the pinion of the foregoing motor at the time of the service interruption (hereinafter referred to as emergency gear) is mounted on a rotating shaft of the traction motor at the end portion opposite to the other end connected to the winding machine and in that case the d.c. motor is installed at such position that when the pinion

flies out at the service interruption, the pinion may be engaged with the emergency drive gear. Consequently the emergency elevator driving system necessarily includes the traction motor and the coupling mechanism interposed in the transmission path between the d.c. motor and the winding machine, giving rise to degradation in the reliability of the emergency operation of the elevator. For example, when the elevator cage adapted to transport the passengers in a vertical direction is filled with passengers, the release of the safety brake will by itself result in spontaneous acceleration of the elevator cage. In other words, degraded reliability of the emergency driving system would lead to accidents dangerous to human life.

Accordingly an object of the invention is to provide an apparatus for driving an elevator at the time of service interruption with improved reliability and safety.

According to the invention, there is provided an emergency driving apparatus for use with an elevator system including a normal power supply source, a primary electric motor energized normally from said normal power supply source, a winding machine including at least a winding drum and a brake drum adapted to be normally driven by said primary electric motor, an elevator cage suspended from a rope passing around said winding drum and having the other end from which a counter-balancing weight is suspended; said emergency driving apparatus comprising an emergency power supply source, a d.c. motor adapted to be energized from said emergency power supply source at the time of service interruption at said normal power supply source, and an emergency drive gear arranged to be mounted on a rotating portion of said winding machine normally driven by said primary electric motor, said d.c. motor being disposed at such position that said emergency drive gear may be driven by said d.c. motor at the time of said service interruption thereby to transmit the driving torque of said d.c. motor to said rotating portion through said emergency drive gear.

The above and other objects, novel features and advantages of the present invention will become more apparent from the following detailed description on the preferred embodiments of the invention taken in conjunction with the accompanying drawings, in which:

Fig. 1 shows schematically a whole arrangement of an elevator system including an elevator driving apparatus to be used at the time of power service interruption according to an embodiment of the invention;

Fig. 2 is a front view showing an exemplary embodiment of the elevator driving apparatus destined for use at the time of the service interruption according to the invention; and

Fig. 3 is a side view of the exemplary embodiment of the elevator driving apparatus shown in Fig. 2.

Referring to Fig. 1 showing a whole arrangement of an elevator system to which the

invention is applied, an electric traction motor 1 for driving an elevator cage 8 is normally supplied with electric power from a usual power supply source 3 such as a commercial power supply line through an elevator control unit 2. The traction motor 1 is adapted to drive a brake drum 5 and a winding drum 6 connected directly to the brake drum 5 by way of a driving torque transmission mechanism 4 such as a motor coupling mechanism. When the traction motor 1 is energized by the elevator control unit 2 simultaneously with the release of an electromagnetic brake 15 in response to an elevator start command, the winding drum 6 is rotated thereby to move the elevator cage 8 in the up- or down-direction. The elevator cage is of course suspended from a rope passing around the winding drum 6 and having the other end at which a counter-balancing weight 7 is secured. The brake drum 5 and the winding drum 6 constitute a winding machine 9 which in turn constitutes an elevator driving apparatus in cooperation with the traction motor 1.

A d.c. electric motor 12 is additionally provided and adapted to be energized from an emergency d.c. power supply source 14 through the elevator control unit 2 at the time when the service interruption takes place in the usual power supply source 3. A flying out gear or pinion 11 is connected to the output shaft of the d.c. motor 12. On the other hand, an emergency gear 10 to be meshed with the pinion 11 at the time of the service interruption of the usual power supply source 3 is provided to drive the brake drum 5.

Assuming that the service interruption takes place during the normal operation of the elevator system for some reason, then the electromagnetic brake is electrically deenergized through the elevator control unit 2, whereby a braking force is produced thereby to stop instantly the elevator cage 8. At the same time, the service interruption is detected by an interruption detecting relay 13, the output signal of which is utilized in the elevator control unit 2 to change over the usual power supply source 3 to the emergency power supply source 14. Thus, the d.c. motor 12 is energized from the emergency power supply source 14 with the electromagnetic brake 15 being released. The pinion 11 is also moved to mesh with the emergency drive gear 10.

Consequently, the brake drum 5 and hence the winding drum 6 are driven by the d.c. motor 12 from the emergency power source 14 to move the elevator cage 8 in the up- or down-direction after the temporary stoppage. In this manner, the passengers in the elevator cage can be rescued without being confined in the stopped cage even when service interruption taken place in the power supply service network.

As can be appreciated from the above description, the brake drum 5 of the winding mechanism 9 is directly driven by the d.c. motor 12 without any interposed torque transmission mechanism 4 such as a coupling mechanism. By virtue of such arrangement, a remarkably

enhanced reliability may be assured in the emergency operation of the elevator system. Further, provision of the emergency driven gear 10 for the brake drum 5 will allow the elevator driving apparatus to be implemented inexpensively in a small size with an improved safety, as will be made apparent as description proceeds.

Now, description will be made on the elevator driving apparatus by referring to Fig. 2 showing the same in a front view and also to Fig. 3 which is a sectional view as viewed in the direction indicated by arrowed line III—III in Fig. 2.

In Fig. 2, components shown at the right-hand side of the line III—III constitutes the winding machine 9 to be normally driven by the traction motor 1. Reference numeral 25 denotes a mounting flange for securing fixedly the traction motor 1 to the winding machine 9. The brake drum 5 is mounted on a worm shaft 16 at one end portion thereof which has a worm gear 17 formed at the other end portion and meshed with a worm wheel 18 which in turn is mounted fixedly on a drive shaft 19 to rotate the winding drum 6. Disposed within the brake drum 5 is a coupling mechanism constituting the motor coupling mechanism 4 and positioned at the side of the winding machine 9, which coupling member is adapted to be engaged with a counterpart coupling member of the motor coupling mechanism 4 secured to the output shaft of the traction motor 1 for transmitting the driving torque thereof to the brake drum 5. There are provided a brake coil 21 and a brake shoe 23 in association with the brake drum 5. The brake shoe 23 is mounted on an actuator arm 22. When the brake coil or solenoid 21 is electrically energized, the actuator arm 22 is actuated to move the brake shoe 23 away from the brake drum 5 which is then set in the rotatable state. The winding machine is shown with the brake coil 21 being electrically energized. The emergency drive gear 10 is mounted fixedly on the brake drum 5, while the d.c. motor 12 is mounted on the winding machine 9. At the time of the normal service interruption, the pinion 11 is brought into meshing engagement with the emergency drive gear 10 through the rotation of the d.c. motor 12 thereby to drive directly the brake drum 5 and hence the whole winding machine 9, as described hereinbefore in conjunction with Fig. 1.

The structure described above involves following advantages in addition to the advantageous effects described hereinbefore in conjunction with Fig. 1.

In the case of the hitherto known elevator driving apparatus for the emergency operation, the traction motor 1 is mounted on a floor in juxtaposition to the winding machine 9 with the emergency drive gear 10 being mounted on the projecting shaft of the traction motor 1 at the side opposite to the driving connection between the traction motor 1 and the winding machine 9. Besides, the d.c. motor 12 is mounted on the same floor in juxtaposition to the traction motor 1. Such arrangement requires a remarkably large

floor area for the installation of the elevator driving apparatus. However, in the construction of a building, there is a tendency to allot the minimum space possible to the penthouse or machine room for accommodating the elevator driving apparatus with a view to attaining the effective utilization of space available in the building. Consequently, when a large floor area is required for the installation of the elevator driving apparatus notwithstanding the restricted available area, the individual machines such as the traction motor, the winding machine, the d.c. motor or the like have to be disposed close to one another, which involves difficulty and trouble in maintenance and inspection. Additionally, installation of machines of a structure having rotating projections in a narrow space is very dangerous and undesirable from the viewpoint of the safety. In the case of the hitherto known apparatus, the d.c. motor 12 and the emergency drive gear 10 have to be shielded by suitable covers.

In contrast, in the case of the elevator driving apparatus according to the invention described above, the space between the traction motor 1 and the winding machine 9 is utilized for mounting the emergency drive gear 10, which allows the whole driving apparatus to be realized in a relatively small size and thus to be installed in a relatively narrow area without involving the difficulties described above. Further, since the emergency drive gear 10 is mounted on the brake drum 5 which is inherently a rotating member, no special protection cover will be required without involving any problem in respect of the safety and to an advantage for reducing the manufacturing costs. Additionally, by virtue of the arrangement that the d.c. motor 12 is mounted on the same winding machine as the emergency drive gear 10, there will occur no misalignment between the d.c. motor and the emergency drive gear which would lead to an accident. The emergency drive gear 10 may be formed in an annular configuration and mounted on the brake drum in a facilitated manner. In this connection, it should be mentioned that the emergency drive gear may be easily mounted on the existing elevator driving means by dividing the annular gear 10 into two or more parts.

In the foregoing, the invention has been described in connection with a preferred embodiment illustrated in the drawings. However, it will be easily appreciated that many modifications and variations will readily occur to those skilled in the art without departing from the scope of the invention. For example, the emergency drive gear 10 may be mounted on the worm shaft 16 in place of the brake drum 5 or alternatively at a side of the winding drum 6. However, the mounting of the emergency drive gear 10 on the brake drum is preferred in consideration of costs.

The elevator driving apparatus according to the

invention will assure a reliable operation of the elevator in the emergency situation such as interruption of the normal power supply. Because the rotating members of the winding machine may be directly driven by the emergency d.c. motor.

CLAIMS

1. An emergency driving apparatus for use with an elevator system including a normal power supply source, a primary electric motor energized normally from said normal power supply source, a winding machine including at least a winding drum and a brake drum adapted to be normally driven by said primary electric motor, an elevator cage suspended from a rope passing around said winding drum and having the other end from which a counter-balancing weight is suspended; said emergency driving apparatus comprising an emergency power supply source, a d.c. motor adapted to be energized from said emergency power supply source at the time of service interruption at said normal power supply source, and an emergency drive gear arranged to be mounted on a rotating portion of said winding machine normally driven by said primary electric motor, said d.c. motor being disposed at such position that said emergency drive gear may be driven by said d.c. motor at the time of said service interruption thereby to transmit the driving torque of said d.c. motor to said rotating portion through said emergency drive gear.

2. An apparatus as set forth in claim 1, wherein said emergency drive gear is arranged to be disposed at a rotating portion located between said primary electric motor and said winding machine.

3. An apparatus as set forth in claim 1 or 2, wherein said emergency drive gear is arranged to be mounted on said brake drum.

4. An apparatus as set forth in claim 3, wherein said emergency drive gear is composed of semi-circular gear segments arrayed in an annular configuration.

5. An apparatus as set forth in any preceding claim, wherein said d.c. motor is arranged to be mounted on said winding machine.

6. An apparatus as set forth in claim 1, wherein where said primary electric motor is mounted at a side of said winding machine and has a drive shaft connected to a rotating shaft of said winding machine through a coupling means and said brake drum is mounted on said rotating shaft, said emergency drive gear is arranged to be mounted on said brake drum, said d.c. motor being mounted on said winding machine at such position that a pinion of said d.c. motor is engageable with said emergency drive gear at the time of said normal service interruption.

7. An emergency driving apparatus for use with an elevator system substantially as hereinbefore described with reference to the accompanying drawings.



14

floor area for the installation of the elevator driving apparatus. However, in the construction of a building, there is a tendency to allot the minimum space possible to the penthouse or machine room for accommodating the elevator driving apparatus with a view to attaining the effective utilization of space available in the building. Consequently, when a large floor area is required for the installation of the elevator driving apparatus notwithstanding the restricted available area, the individual machines such as the traction motor, the winding machine, the d.c. motor or the like have to be disposed close to one another, which involves difficulty and trouble in maintenance and inspection. Additionally, installation of machines of a structure having rotating projections in a narrow space is very dangerous and undesirable from the viewpoint of the safety. In the case of the hitherto known apparatus, the d.c. motor 12 and the emergency drive gear 10 have to be shielded by suitable covers.

In contrast, in the case of the elevator driving apparatus according to the invention described above, the space between the traction motor 1 and the winding machine 9 is utilized for mounting the emergency drive gear 10, which allows the whole driving apparatus to be realized in a relatively small size and thus to be installed in a relatively narrow area without involving the difficulties described above. Further, since the emergency drive gear 10 is mounted on the brake drum 5 which is inherently a rotating member, no special protection cover will be required without involving any problem in respect of the safety and to an advantage for reducing the manufacturing costs. Additionally, by virtue of the arrangement that the d.c. motor 12 is mounted on the same winding machine as the emergency drive gear 10, there will occur no misalignment between the d.c. motor and the emergency drive gear which would lead to an accident. The emergency drive gear 10 may be formed in an annular configuration and mounted on the brake drum in a facilitated manner. In this connection, it should be mentioned that the emergency drive gear may be easily mounted on the existing elevator driving means by dividing the annular gear 10 into two or more parts.

In the foregoing, the invention has been described in connection with a preferred embodiment illustrated in the drawings. However, it will be easily appreciated that many modifications and variations will readily occur to those skilled in the art without departing from the scope of the invention. For example, the emergency drive gear 10 may be mounted on the worm shaft 16 in place of the brake drum 5 or alternatively at a side of the winding drum 6. However, the mounting of the emergency drive gear 10 on the brake drum is preferred in consideration of costs.

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invention will assure a reliable operation of the elevator in the emergency situation such as interruption of the normal power supply. Because the rotating members of the winding machine may be directly driven by the emergency d.c. motor.

CLAIMS

1. An emergency driving apparatus for use with an elevator system including a normal power supply source, a primary electric motor energized normally from said normal power supply source, a winding machine including at least a winding drum and a brake drum adapted to be normally driven by said primary electric motor, an elevator cage suspended from a rope passing around said winding drum and having the other end from which a counter-balancing weight is suspended; said emergency driving apparatus comprising an emergency power supply source, a d.c. motor adapted to be energized from said emergency power supply source at the time of service interruption at said normal power supply source, and an emergency drive gear arranged to be mounted on a rotating portion of said winding machine normally driven by said primary electric motor, said d.c. motor being disposed at such position that said emergency drive gear may be driven by said d.c. motor at the time of said service interruption thereby to transmit the driving torque of said d.c. motor to said rotating portion through said emergency drive gear.
2. An apparatus as set forth in claim 1, wherein said emergency drive gear is arranged to be disposed at a rotating portion located between said primary electric motor and said winding machine.
3. An apparatus as set forth in claim 1 or 2, wherein said emergency drive gear is arranged to be mounted on said brake drum.
4. An apparatus as set forth in claim 3, wherein said emergency drive gear is composed of semi-circular gear segments arrayed in an annular configuration.
5. An apparatus as set forth in any preceding claim, wherein said d.c. motor is arranged to be mounted on said winding machine.
6. An apparatus as set forth in claim 1, wherein where said primary electric motor is mounted at a side of said winding machine and has a drive shaft connected to a rotating shaft of said winding machine through a coupling means and said brake drum is mounted on said rotating shaft, said emergency drive gear is arranged to be mounted on said brake drum, said d.c. motor being mounted on said winding machine at such position that a pinion of said d.c. motor is engageable with said emergency drive gear at the time of said normal service interruption.
7. An emergency driving apparatus for use with an elevator system substantially as hereinbefore described with reference to the accompanying drawings.