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Elevator System and Counterweight Assembly

5 This invention relates to an elevator system which produces a smoother, quieter ride at high speed travel rates, and more particularly, to an elevator system having an aerodynamically improved counterweight assembly.

10 High speed elevator systems are necessary in modern high rise buildings in order to reduce passenger trip time. Such elevators commonly travel at speeds of one thousand feet per minute (5.1 ms^{-1}) and higher. When the elevator car travels at such high speeds, it is important that car noise and vibration be kept at a minimum to ensure passenger comfort. New car suspension assemblies and rail guiding improvements can achieve very quiet and smooth rides over the majority of
15 the path of travel of the car in the hoistway, however, air turbulence will result in the hoistway due to the confined nature of a hoistway, and the high rates of speed at which the elevator car and counterweight move through the hoistway. Such air turbulence is created both by the car
20 and by the counterweight. Car-induced turbulence can cause noise and vibration in the car as the latter passes each landing sill and hoistway door; and car-induced plus counterweight-induced turbulence can cause noise and vibration in the car when the car and counterweight pass

each other in the hoistway. This invention is directed toward the reduction of the latter cause of noise and vibration in the car.

5 U.S. Patent No. 3,945,468 granted March 23, 1976 to Miura, et al. concerns the reduction of noise and car vibration in an elevator. This patent suggests the use of a long skirt below the car door on the hoistway landing side of the car to reduce sill vibration and noise; and the use of guide plates mounted on the top and bottom of the
10 elevator car to deflect air away from the car. A problem with the car guide plates in the aforesaid patent is that they deflect air toward the counterweight assembly. Thus the guide plate will create a turbulent air condition in the path of travel of the counterweight. When the counterweight
15 passes through this turbulence it will be passing the car and will reflect the turbulence back toward the car. This type of arrangement will increase noise and vibration in the car as the car and counterweight pass each other in the hoistway.

20 It is therefore an object of this invention to provide an improved high-speed elevator system which provides for a smoother, quieter passenger ride.

It is a further object of this invention to provide an elevator system of the character described which produces
25 reduced air turbulence between the car and counterweight as they pass each other in the hoistway.

Thus, this invention is directed toward a solution to the problem of car noise and vibration induced by the counterweight.

30 According to one aspect of the present invention there is provided

an elevator counterweight assembly comprising:
a frame for holding a plurality of
counterweights; said frame having, in plan, a pair of
35 opposing relatively long sides which, in use, are parallel to the adjacent wall of the elevator car and a pair of

relatively short sides joining the ends of the long sides;
and

air deflector means mounted on at least one end
of said frame for deflecting air outwardly over the
5 relatively short sides of said frame when said assembly is
in motion.

According to another aspect of the present
invention there is provided

an elevator system comprising an elevator car
10 mounted for vertical travel in a hoistway, a counterweight
coupled to the car by a cable and disposed for vertical
travel in a path which passes adjacent a wall of the car,
the counterweight being provided on its upper and/or lower
end with air deflector means arranged to deflect air
15 outwardly of the counterweight in a direction parallel to
the adjacent car wall as the counterweight travels
vertically.

In order to control air flow in the hoistway in
the vicinity of the counterweight, the latter is provided
20 with air deflectors mounted on either the top, the bottom,
or both, of the counterweight frame. The cable and rope
compensator connections are preferably all disposed
inboard of the counterweight frame and deflectors, so that
there are no turbulence-inducing protruberances on the
25 counterweight at the connections. For ultra-high speed
elevator systems, the counterweight frame and components
can be jacketed front and back to produce smooth
continuous side surfaces facing the elevator car. The
invention provides for air which would otherwise be
30 deflected towards the car to be deflected to the sides of
the counterweight.

These and other objects and advantages of this invention will become more readily apparent from the following detailed description of exemplary preferred embodiments thereof when taken in conjunction with the accompanying drawings, in which:

FIGURE 1 is a front elevational view of a counterweight assembly having air deflectors mounted on the top and bottom thereof in accordance with this invention;

FIGURE 2 is a side elevational view of the counterweight assembly showing the manner in which the compensator and cable hitches are recessed in the assembly;

FIGURE 3 is a fragmented front elevational view of a counterweight of the type having a cable sheave, and which is provided with air deflectors in accordance with another embodiment of the present invention; and

FIGURE 4 is a front elevational view of a counterweight assembly which has been completely jacketed to reduce air turbulence in accordance with a further embodiment of the present invention.

Referring now to the drawings, there is shown in FIGURES 1 and 2 an elevator counterweight assembly which is denoted generally by the numeral 2. The assembly 2 includes a frame 4 with an upper end cap 6 and a lower end cap 8. Rail guide roller groups 10 are mounted at the outer side edges of the upper and lower end caps 6 and 8 to engage the counterweight guide rails (not shown) which are mounted on the walls of the hoistway. Guide rods 12 extend between an upper cross plate 14 and a lower cross plate 16 and are bolted thereto. The weights 18 extend upwardly from a transverse support plate 20 to the upper cross plate 14, the weights 18 being telescoped over the guide rods 12. A cable hitch plate 22 receives the counterweight cable hitch thimble rod 24. It will be noted from FIGURE 2 that the hitchplate 22 and thimble rod 24 are inboard on the

counterweight frame 4 so as not to create any turbulence-inducing protrusions on the assembly 2. A compensating rope hitch channel 26 is mounted on the frame 4 to receive the compensating hitch thimbles 28. It will be noted from FIGURE 2 that the compensating hitch channel 26 and thimbles 28 are also inboard on the frame 4. An air deflector or foil assembly 30 is mounted on the top or upper end of the counterweight assembly 2. Mounting plates 32 are secured to the upper end cap 6 and extend therefrom above the guide roller sets 10. Downwardly and outwardly flared side air deflectors 31 are connected to the plates 32, and a transverse leading deflector 34 spans the gap between the side deflectors 32 and is connected thereto. As noted in FIGURE 2, the deflectors 32 and 34 are trough-shaped. Side deflectors 36 are mounted on plates 38 secured to the lower crossplate 16 on either side of the bumper 40 which contacts the oil buffer mounted in the hoistway pit. The lower deflectors 36 channel air to the sides of the counterweight as the latter moves downwardly through the hoistway.

FIGURE 3 illustrates a counterweight assembly 2 in a 2:1 roped elevator system wherein the counterweight includes a sheave 42 mounted thereon for engagement by the elevator rope 43. The deflectors have two components 44 and 46 which are separated by a gap 48 through which the rope 43 passes.

FIGURE 4 shows an embodiment of the counterweight 2 wherein the counterweight frame and components are completely encased on the front and back by a plurality of removable plates 50.

It will be readily appreciated that this invention will result in a decrease of hoistway air turbulence induced by the counterweight and directed toward the car as the two pass each other in the hoistway. By eliminating projecting surfaces from the counterweight assembly, and by deflecting air to the sides of the counterweight, the car is subjected to less air turbulence whereby a smoother, quieter ride is attained. The invention has particular advantages in high-speed or ultra high-speed elevator systems.

Since many changes and variations of the disclosed embodiment of the invention may be made without departing from the inventive concept, it is not intended to limit the invention otherwise than as required by the appended claims.



Claims

- 5 1. An elevator counterweight assembly comprising:
a frame for holding a plurality of counterweights;
said frame having, in plan, a pair of opposing
relatively long sides which, in use, are parallel to the
adjacent wall of the elevator car, and pair of
10 relatively short sides joining the ends of the long
sides; and
air deflector means mounted on at least one end of
said frame for deflecting air outwardly over the
relatively short sides of said frame when said assembly
15 is in motion.
2. The assembly of claim 1 wherein said air deflector
means comprises opposed channel-shaped deflectors
disposed above the upper end of said frame and sloped
20 downwardly and outwardly toward said short sides of said
frame.
3. The assembly of claim 2 further comprising a cable
sheave mounted adjacent said upper end and inboard of
25 said frame, said cable sheave being disposed beneath
said channel-shaped deflectors.
4. The assembly of claim 3 wherein each deflector
comprises two components which are separated by a gap
30 through which a cable may pass.
5. The assembly of any preceding claim wherein said
air deflector means comprises opposed trough-shaped
deflectors disposed below the lower end of said frame
35 and sloped upwardly and outwardly toward said short
sides of said frame.



6. The assembly of any preceding claim further comprising a plurality of cable hitches on said frame for connection with elevator cables, said hitches being disposed inboard of said frame so as to minimize
5 outboard air turbulence-inducing protuberances on the counterweight assembly.

7. The assembly of any preceding claim wherein said counterweights are enclosed in an aerodynamic jacket.
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8. The assembly of any preceding claim wherein said air deflector means comprises: side deflectors connected to at least one end of said frame via mounting plates, and
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a transverse leading deflector spanning the gap between said side deflectors and connected thereto.

9. An elevator system comprising an elevator car mounted for vertical travel in a hoistway, and a
20 counterweight coupled to the car by a cable and disposed for vertical travel in a path which passes adjacent a wall of the car, the counterweight being provided on its upper and/or a lower end with air deflector means arranged to deflect air outwardly of the counterweight
25 in a direction parallel to the adjacent car wall as the counterweight travels vertically.

10. The system of claim 9 wherein said counterweight comprises a frame and said air deflector means comprises
30 opposed channel-shaped deflectors disposed above the upper end of said frame and sloped downwardly and outwardly of said frame.

11. The system of claim 10 further comprising a cable
35 sheave mounted adjacent said upper end and inboard of said frame, said cable sheave being disposed beneath said channel-shaped deflectors.



12. The system of claim 11 wherein each deflector comprises two components which are separated by a gap through which the cable may pass.

5 13. The system of any of claims 9 to 12 wherein said counterweight comprises a frame and said air deflector means comprises opposed trough-shaped deflectors disposed below the lower end of said frame and sloped upwardly and outwardly of said frame.

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14. The system of any of claims 9 to 13 wherein said counterweight comprises a frame, and further comprising a plurality of cable hitches on said frame for connecting said frame to said cable, said hitches being
15 disposed inboard of said frame so as to minimise outboard air turbulence-inducing protruberances on the counterweight.

15 15. The system of any of claims 9 to 14 wherein said counterweight is enclosed in an aerodynamic jacket.

16. The system of any of claims 9 to 15 wherein said counterweight comprises a frame and wherein said air deflector means comprises: side deflectors connected to
25 at least one end of said frame via mounting plates, and a transverse leading deflector spanning the gap between said side deflectors and connected thereto.

17. An elevator counterweight assembly substantially as
30 hereinbefore described with reference to the accompanying drawings.

18. An elevator system substantially as hereinbefore described with reference to the accompanying drawings.
