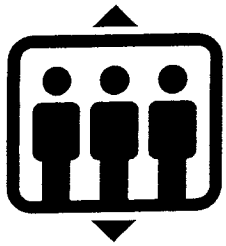
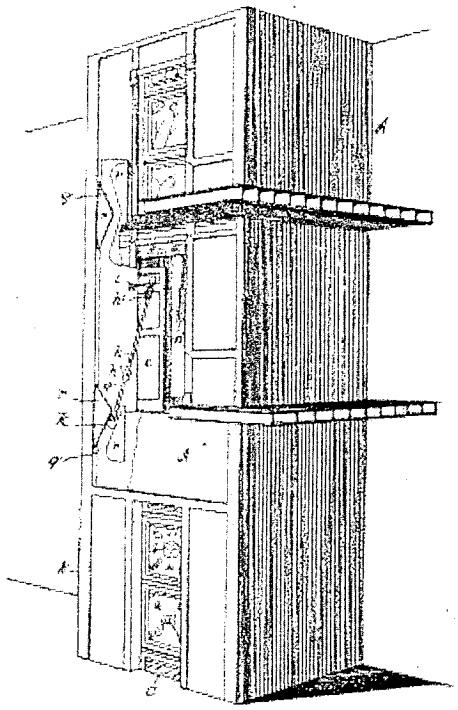


Elevators

History



Primitive elevators were in use as early as the 3rd century BC, operated by human, animal, or water wheel power. From about the middle of the 19th century, power elevators, often steam-operated, were used for conveying materials in factories, mines, and warehouses.

By 1850 steam and hydraulic elevators had been introduced. In 1852, the invention of the world's first safety elevator by Elisha Graves Otis changed the relationship between human and elevator forever. The first passenger elevator was installed by Otis in New York in 1857.
Electric elevators came into to use toward the end of the 19th century. The first one was built by the German inventor Werner von Siemens in 1880.
In 1903, Otis introduced the design that would become the "backbone" of the elevator industry: **The gearless traction electric elevator**, engineered and proven to outlast the building itself. This ushered in the age of high-rise structures, including New York's Empire State Building and the World Trade Center.

HOW ELEVATORS WORK

In a GEARED OR GEARLESS TRACTION system (used in mid-rise and high-rise installations, respectively), the elevator car is supported in a hoistway by several steel hoist ropes, usually two sheaves, and a counterweight. The weight of the car and counterweight provides sufficient traction between the sheaves and the hoist ropes so that the sheaves can grip the hoist ropes and move and hold the car without excessive slipping. The car and counterweights ride along vertical guide rails to keep them from swaying.

The machinery to drive the elevator is located in a machine room usually directly above the elevator hoistway. To feed electricity to the car and receive electrical signals from it, a multi-wire electrical cable connects the machine room to the car. The end attached to the car moves with it, so the cable is called the "traveling cable."

A geared machine has a higher-speed motor, and the drive sheave is connected to the motor shaft through gears in a gear box, which reduce the rotational speed of the motor shaft to a lower drive-sheave speed. The gearless machine has a slow speed motor, and the drive sheave is connected directly to the motor shaft.

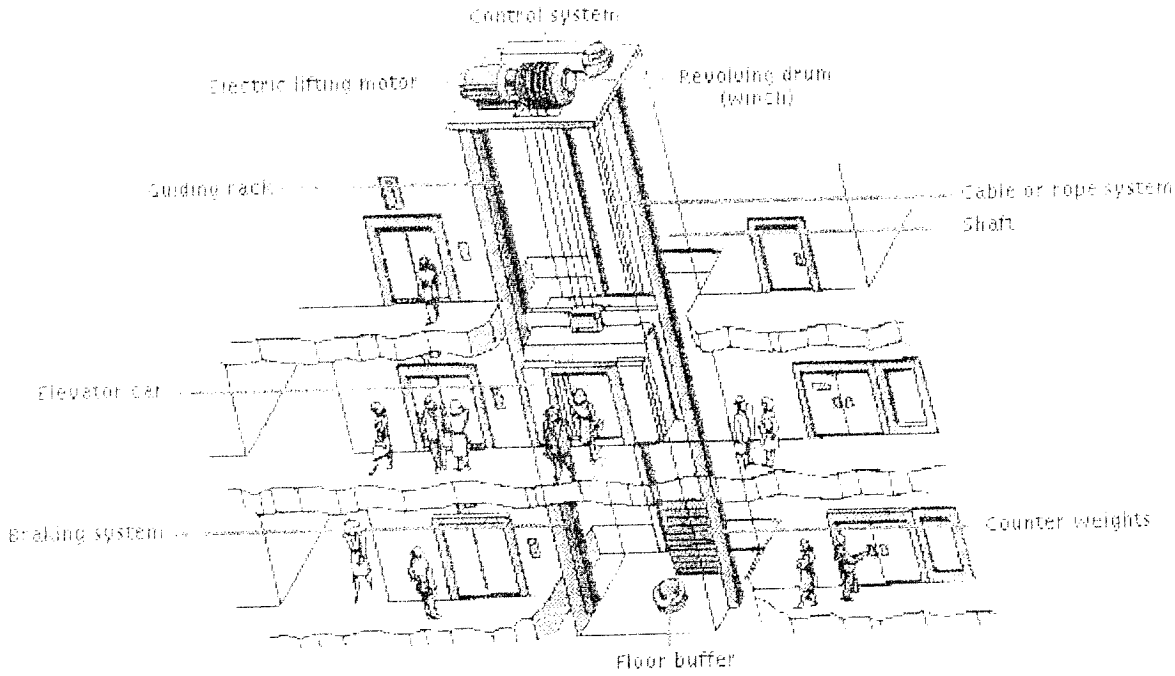
In a **HYDRAULIC system** (used primarily in low-rise installations, where moderate car speed is acceptable), a car is connected to the top of a long piston that moves up and down in a cylinder. The car moves up when oil is pumped into the cylinder from a reservoir, raising the piston. The car is lowered when the oil returns to the reservoir.

The lifting action can be direct (piston connected to the car) or roped (piston attached to car via ropes). In both methods, the work done by the motor pump (kinetic energy) to lift the car to a higher elevation gives the car the ability to do work (potential energy). This energy transfer occurs each time the car is raised. When the car is lowered, the potential energy is used up, and the energy cycle is complete. The up and down motions of the elevator car are controlled by the hydraulic valve

Most elevators use a direct current motor because its speed can be precisely controlled to allow smooth acceleration and deceleration. Motor-generator (M-G) sets typically provide to dc power for the drive motor. Newer systems use a static drive control. The elevator controls vary the motor's speed based on a set of feedback signals that indicate the car's position in the shaftway. As the car approaches its destination, a switch near the landing signals the controls to stop the car at floor level. Additional shaftway limit switches are installed to monitor over travel conditions.

Elevator Shaft

Elevators are so well-contained that even people who use them daily may not realize how they operate. When someone pushes a button to call an available elevator on another floor, the safety doors (frequently double doors) close and an electric lifting motor switches on. The motor turns a drum, around which the cable system is wound. Counterweights are used to balance the weight of the elevator car and relieve the tension on the cables, so that when the car is going up, the weights are going down, and vice versa. A guiding rack keeps the elevator moving smoothly in the shaft, and floor buffers prevent the car from bouncing when it comes to a stop. A safety braking system (located just below the car) and touch-sensitive doors prevent potential injuries to passengers.



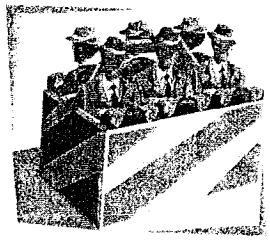
SAFETY REGULATIONS

The development of a safety code for elevators started before World War I. The first edition of the A17 Safety Code for Elevators was not completed nor published until 1921. It contained provisions for locking landing doors, safety equipment for the car to prevent falling and excessive speed, limit switches at the extremes of travel among other provisions. It was revised in 1925 and was adopted as an "American Standard" in 1931 as many jurisdictions and insurance companies insisted upon compliance with its provisions. It has undergone numerous changes and additions from a 25 page pamphlet evolving into its 14th edition in 1993 with over 350 pages.

Code rules are enforced by local jurisdictions through building departments, private inspectors and the elevator companies themselves. Safety violations can result in fines and, in extreme cases, shutting the equipment down. Most inspectors are members of the National Association of Elevator Safety Authorities (NAESA) and are certified as Qualified Elevator Inspectors (Q.E.I.).

In the past 150 years, technology has come a long way. Elevators falling due to rope breakage is unheard as modern elevators are supported by multiple steel ropes with each one with a safety factor of five or more. Electric operations is monitored by modern microprocessors that ensure the ride is safe. A trip on an elevator servicing about 6 to a 100 stories, is by a traction elevator whereas a low rise building may have a hydraulic elevator supported by a steel column and oil pressure.

There are at least 600,000 passenger elevators in the US and each carries an estimated average of 225,000 people in a year or nearly 120 billion passengers annually. That means that elevators move a little more than the entire US population every day!



ELEVATOR MYTHS

MYTH: Many people believe elevators are held up by only one rope that can break, leaving passengers trapped in a falling car.

TRUTH: Elevators are supported by multiple steel cables. Each cable alone can support a fully loaded car. The only elevator fall due to a complete cable system failure occurred when the cables were severed by an airplane crashing into the Empire State Building in the 1940's.

MYTH: Some people believe that an overcrowded elevator will fall.

TRUTH: This will not happen. An overloaded elevator will usually not move. The doors will stay open and a buzzer may ring until enough people get off the elevator to reduce the weight.

MYTH: Some people believe they have been in an elevator where the elevator car fell several floors and then "caught itself".

TRUTH: This feeling is a mystery. Elevator experts believe people may think this happened because they 1) got on an elevator going in a different direction than expected, or 2) saw the elevator floor indicator lights flash by quickly which gave the visual impression of falling.

MYTH: Some people believe the hall doors will open when an elevator is not there.

TRUTH: The truth is that the elevator car controls whether the hall doors open. If the car is not at the landing, the hall doors can't open as their opening can only be triggered by the arriving car engaging an unlocking device after the elevator has stopped at the landing.

MYTH: Some people believe that if an elevator is stuck between floors that they are in danger of falling and should try to get out.

TRUTH: Absolutely not! Leaving the car on your own could result in injury. Elevator cars are designed as "safe rooms". The safest place is inside the car. Ring the alarm and wait for help. Leave the car only with the assistance of professional rescuers.

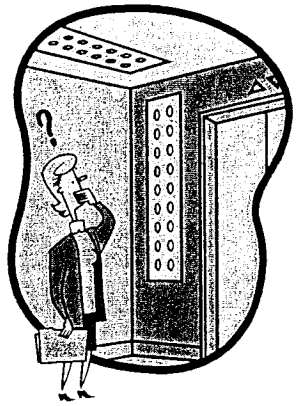
MYTH: Pushing the CALL button repeatedly will make the elevator appear faster.

TRUTH: The call button is registered **just once**; movement is in response to the elevator controllers.

MYTH: Pushing the DOOR CLOSE button closes the doors faster.

TRUTH: It may cause the doors to close sooner, but not faster. However, if a buzzer sounds, the doors may close slower; it is important to get out of the doorway as quickly as possible.

ELEVATOR SAFETY TIPS



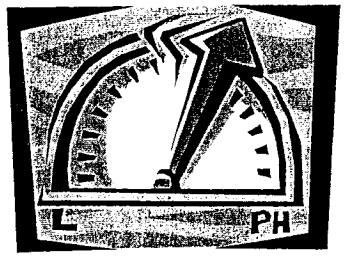
When you approach the elevator:

- Know your destination. Push elevator CALL button for the direction you want to go.
- **Stand aside for exiting passengers.**
- Wait for the next car, if the elevator is full.
- Take the stairs if there is a fire.
- **Don't try to stop a closing door. Wait for the next elevator.**

When you enter and leave the elevator:

- Enter and exit carefully. Step up or down if the elevator floor and hall floor are not level.
- Hold children and pets firmly.
- Stand clear of the doors - keep clothes and carry-ons away from the opening.
- **Push and hold the DOOR OPEN button if doors need to be held open, or ask someone to push the button for you.**

When riding on the elevator:

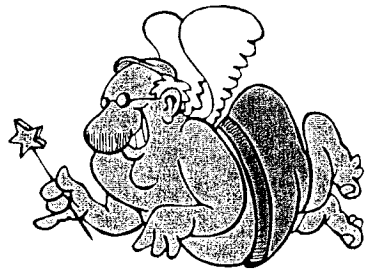


- Stand next to the elevator wall.
- Hold the handrail, if available.
- Pay attention to the floor indications.
- If the doors do not open when the elevator stops, push the DOOR OPEN button.

TIPS IF TRAPPED

- **Don't panic.** Take a few deep breaths, and remind yourself that there's plenty of oxygen in the car. Relax! Help is on the way.
- **Contact the outside world.** Every elevator should have an alarm button and an intercom or phone. In large buildings, an on-site custodian should respond to your call within five minutes.
- **Sit down.** Some people have fallen when the elevator suddenly restarted.
- **Don't worry about being in the dark.** Lighting runs on a separate circuit. Should the lighting go out, there is a backup system that would last up to four hours.
- **Stay put.** Never attempt to pry open the doors or crawl out of the opening on the roof of the car. The elevator could start moving again with fatal results. Wait until a qualified mechanic or rescue personnel comes to your aid.

SOME COMMON MYTHS AND MISCONCEPTIONS



Some common myths as well as misconceptions exist about elevators. Here are a few:

Many people believe elevators are held up by only one rope that could break leaving passengers trapped in a falling car. Actually, elevators are supported by multiple steel cables, which individually can support a fully loaded car. In fact, the only elevator to ever fall due to a complete cable system failure occurred when the cables in the shaft of an elevator at the Empire State Building were severed by an airplane in the 1940s.

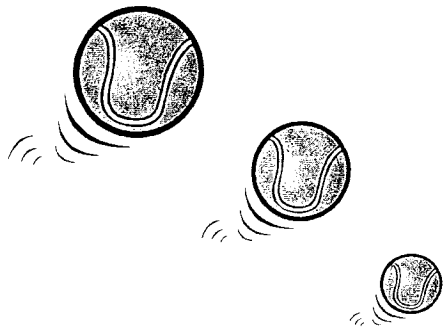
Could the cables snap and send an elevator plummeting down the shaft?

This can be a rider's worst fear, but experts say there's no need to worry. You're being supported by four to eight cables, each of which could support the weight of the car by itself. In fact, the only time an elevator has been known to go into freefall -- with all of its cables cut -- was during World War II, when an American bomber accidentally hit the Empire State Building. The plane's crew died, but the lone elevator passenger survived.

How do I know if an elevator is safe?

The vast majority of states and cities abide by the A17.1 Safety Code for Elevators, which calls for a minimum of semiannual inspections by certified elevator inspectors. A **certificate listing the last date of inspection should be hung in each elevator** (ir it should be available in the superintendent's office); if you don't see one, or if you notice that the **date listed is more than six months old**, contact the building's superintendent, or notify your local elevator inspection bureau and take the stairs.

If the car bounces, is that bad?



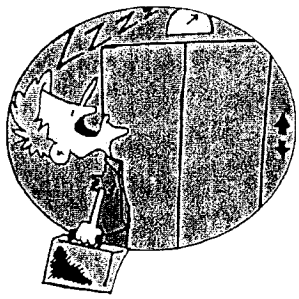
Hydraulic elevators, used in buildings of two to five stores, move when oil is pumped through a cylinder, lifting the cars up or letting them down the same way they're raised and lowered in an auto-body shop. Older elevators may jerk when the oil hasn't warmed up enough (usually early in the morning). While a less-than-smooth ride can be nerve-racking, it's not a safety concern.

Traction elevators usually used in buildings with six stories or more; use an electric motor, counterweight and pulley to move the car. They may bounce because of poor brake adjustments. This occurs with normal wear and tear but it doesn't pose an immediate danger to riders. You should however, inform your building superintendent so the brakes can be adjusted to prevent more serious problems in the future.

Am I in danger if it suddenly seems to speed up?

Traction elevators may briefly accelerate during power surges or when the pulleys are worn (something inspectors look for when checking elevators). If the car moves beyond a certain speed, an electric switch automatically shuts off the elevator. If that doesn't work, "safeties" (mechanical devices attached to the bottom of the car) atomically apply brakes to the side rails and bring the car to a halt.

What about when it moves too slowly?



This is probably caused by dirt or wear on acceleration switches located in the building's control room. Though a sluggish ride can be annoying, lack of pickup doesn't mean you're in immediate danger it does mean, however, that the elevator needs tending to, so inform your building superintendent.

Some believe that if an elevator is stuck between floors that they may be in danger of falling and should try to get out. Leaving the car on your own could result in serious injury. Elevator cars are carefully designed to provide a safe environment for its occupants if such an event should occur. First, make sure to ring the alarm, use the emergency phone, and wait for trained personnel to arrive.

Some believe the hall doors will open when an elevator is not there. The truth is, if the car is not at the landing, the hall doors can't open. Their opening can only be triggered by engaging an unlocking device after the elevator has stopped at the landing.

Should I get in an elevator that isn't level with the floor?

If an elevator arrives empty and is uneven with the floor, it needs mechanical adjusting but it's no more likely to get stuck or crash. An older car that's crowded with people may sink slightly below floor level due to the extra weight (newer elevators are equipped with load-weighing equipment that will atomically prevent the doors from closing). While elevators are designed to carry more than the maximum weight posted, if the car's over-crowded, it's a good idea to wait for the next one.

Going Up!