E. L. GALE, Sr.

BELT DRIVE ELEVATOR.

APPLICATION FILED MAR. 27, 1908.

**1,011,423.** **Patented Dec. 12, 1911.**

4 SHEETS—SHEET 1.

Fig. 1a.

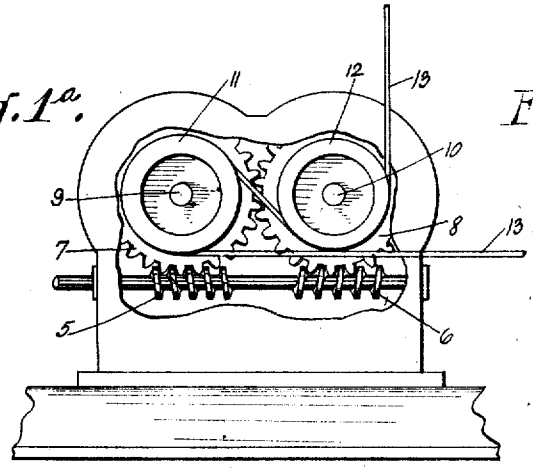


Fig. 1.




Witnesses

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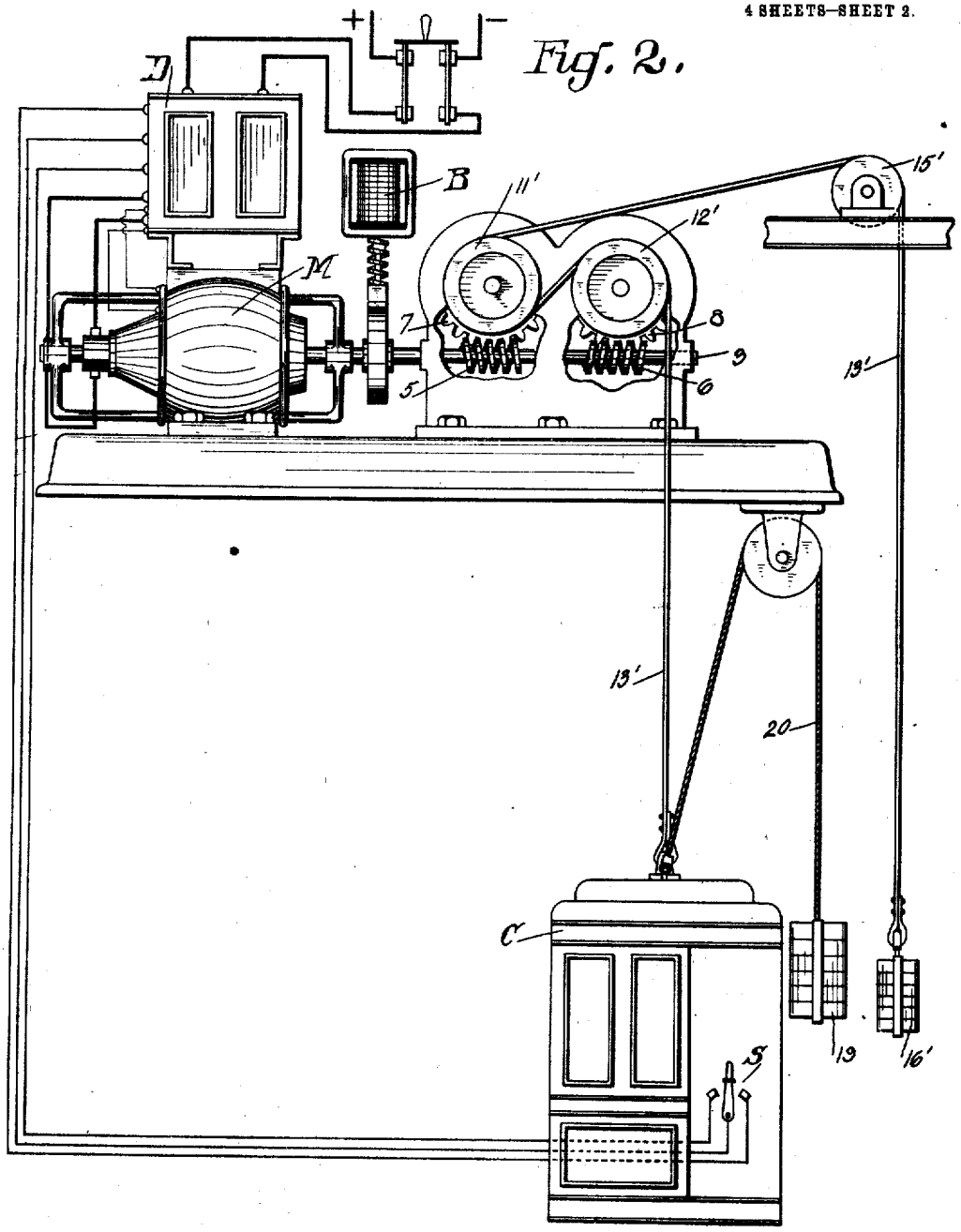
4 SHEETS—SHEET 2.

*Fig. 2.*

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4 SHEETS—SHEET 3.

*Fig. 3*

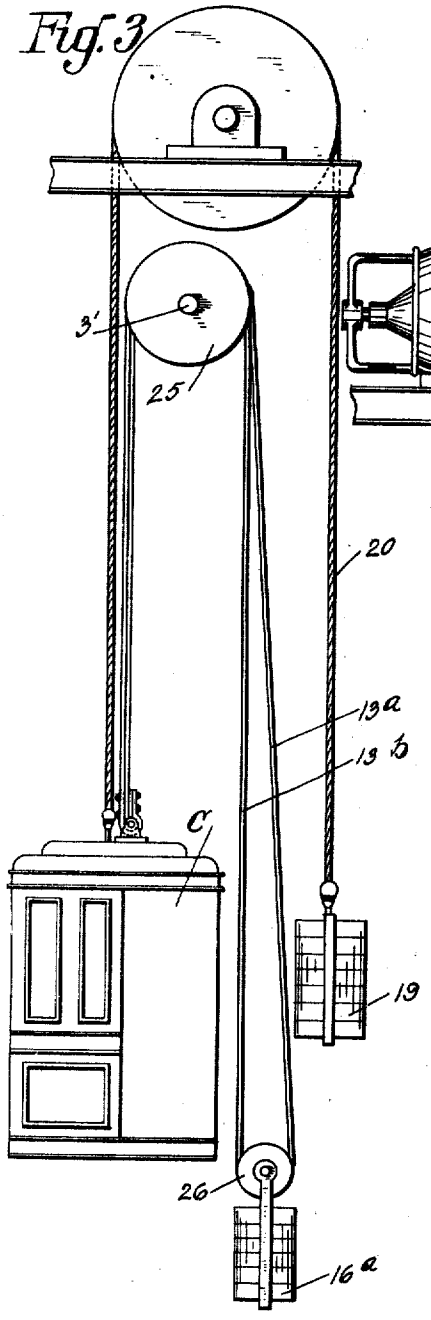



*Fig. 4.*

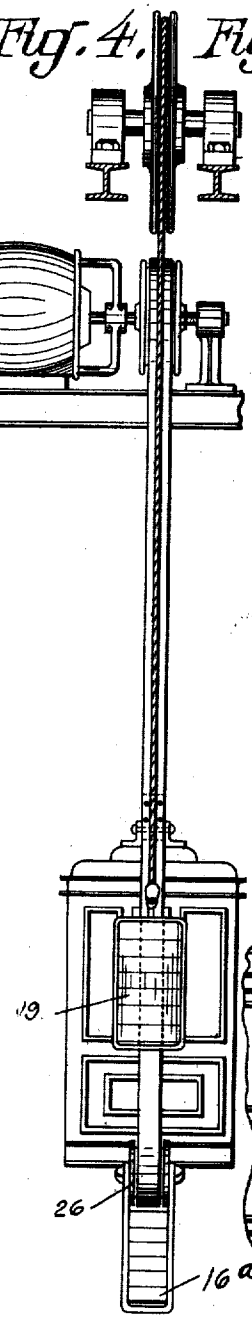
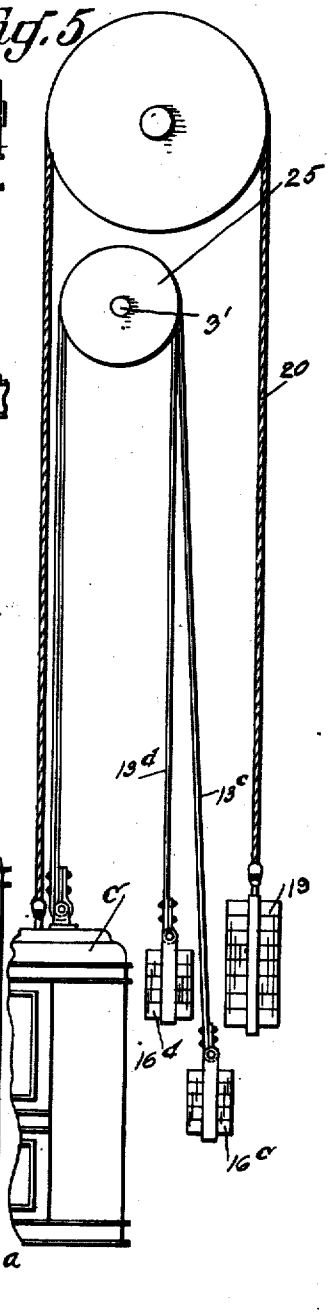



*Fig. 5*

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4 SHEETS—SHEET 4.

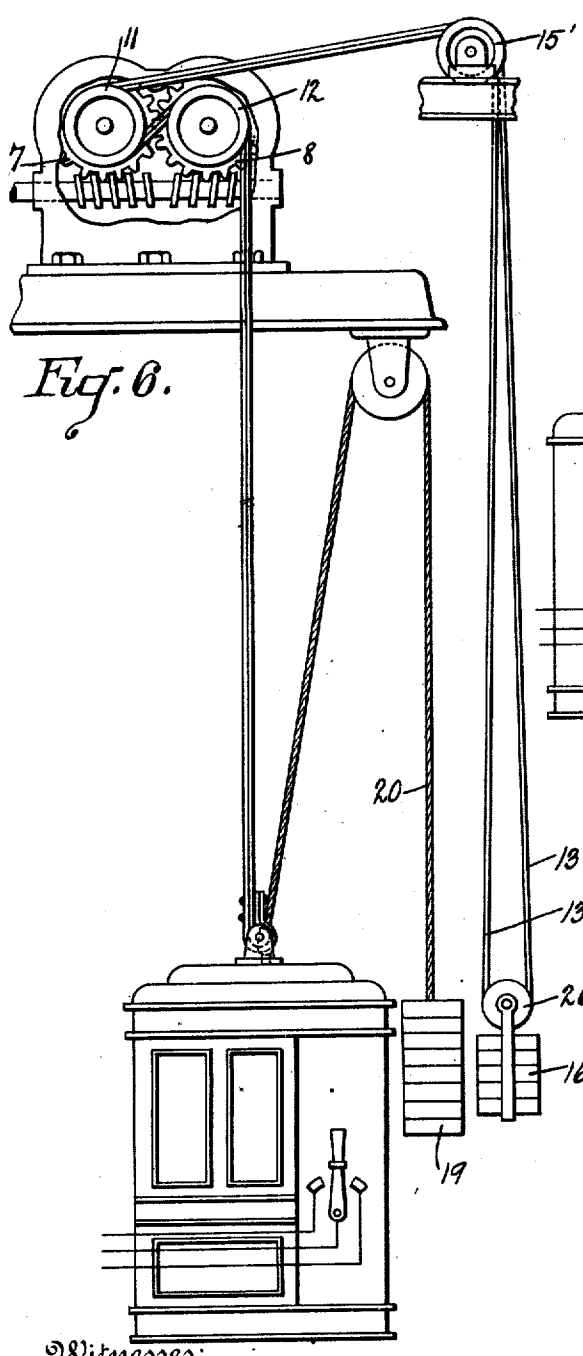


Fig. 6.

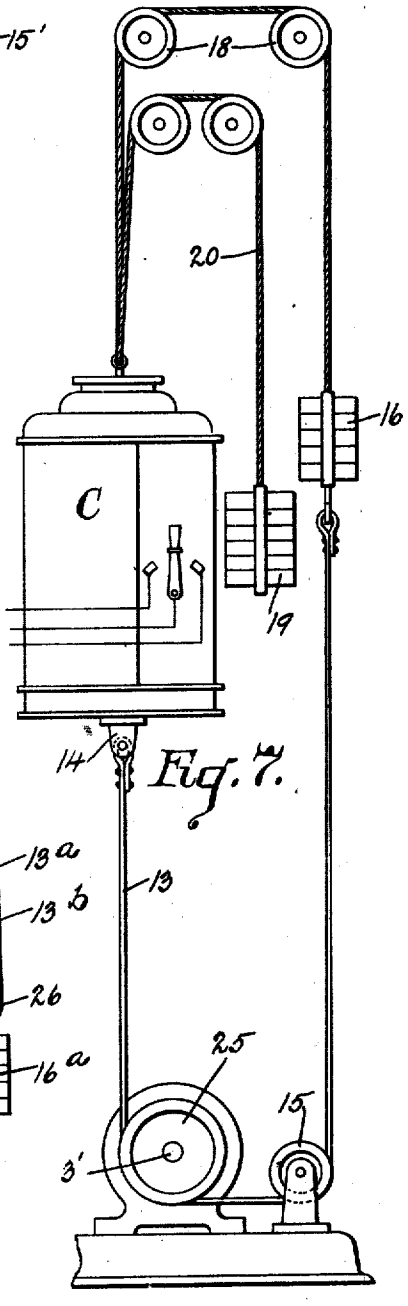


Fig. 7.

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By his Attorney
L. L. Campbell

# UNITED STATES PATENT OFFICE.

ERNEST L. GALE, SR., OF YONKERS, NEW YORK, ASSIGNOR TO OTIS ELEVATOR COMPANY, OF JERSEY CITY, NEW JERSEY, A CORPORATION OF NEW JERSEY.

## BELT-DRIVE ELEVATOR.

1,011,423. Specification of Letters Patent. **Patented Dec. 12, 1911.**

Application filed March 27, 1908. Serial No. 423,766.

*To all whom it may concern:*

Be it known that I, ERNEST L. GALE, Sr., a citizen of the United States, residing at Yonkers, in the county of Westchester and State of New York, have invented a new and useful Improvement in Belt-Drive Elevators, of which the following is a specification.

My invention relates to hoisting mechanism particularly adapted for use in traction elevator systems, although it may have a much more general application.

In the use of present traction elevators, great difficulty has been experienced on account of the slipping between the cables and driving pulleys. The use of flat belts in place of the round steel cables ordinarily used is unsatisfactory for various reasons. The great strain on the steel cables when the weight of the elevator car and counterbalance weights are supported thereby causes excessive wear and rapid deterioration, and necessitates the use of heavy cables. The severe strain on the drive pulley and shaft and its bearings also causes undue friction and wear.

The present invention aims to overcome these and other objections by combining the use of both belts and cables in such a way as to secure the advantages of each, while avoiding the disadvantages due to the use of either alone, and at the same time securing advantages not found in the use of either one alone.

Other objects of the invention will appear hereinafter, the novel combinations of elements being set forth in the appended claims.

In the drawings, Figure 1 is an elevational view, largely diagrammatic, of a traction elevator system embodying my invention, the motor and drive sheaves being located at the bottom of the elevator shaft; Fig. 1ª is a detail view showing the gears 7 and 8 in mesh with each other; Fig. 2 is a similar view of a modification in which the motor and drive sheaves are located overhead; Figs. 3 and 4 are respectively a side and rear elevation of a further modification in which the driving sheave is mounted on the motor shaft; and Fig. 5 is a view similar to Fig. 3, but showing a modification of the traction belts. Fig. 6 is a view similar to Fig. 2 but showing the form of driving belt employed in Figs. 3 and 4. Fig. 7 shows an arrangement similar to that in Fig. 1 but employing the drive sheave mounted on the motor shaft.

Referring particularly to Fig. 1, the elevator car C is here shown as connected for operation to an electric motor M, supplied with current from the positive and negative mains (designated + and —, respectively) connected to a source of current supply. The operation of the motor is controlled from the elevator car by means of a switch S connected by the wires *a*, *b*, *c* to the controller D which may contain the usual reversing switches, starting resistance, etc. The motor in itself forms no part of the present invention and may be replaced by any suitable form of motor or prime mover.

An electromagnetic brake B of a well known form has its magnet winding connected to receive current whenever current is supplied to the motor. The brake magnet, when energized, lifts the brake shoe 1 off from the brake pulley 2 mounted on the motor shaft 3, and when the brake magnet is deënergized the spring 4 applies the brake shoe.

The motor shaft 3 carries right and left-hand worms 5 and 6 which drive respectively the worm gear wheels 7 and 8 secured to the shafts 9 and 10. Keyed to the shafts 9 and 10 are drive pulleys 11 and 12 adapted to drive the belt or belts 13. The belts may be made of leather or any other suitable material or composition found best suited for the requirements or conditions found in practice in any particular case. The drive pulleys may be made of wood, metal, fiber, or other material, and may, if desired, be faced with leather or other material to secure proper adhesion between the belts and pulleys. The belt 13 has one end secured at 14 to the bottom of the car and extends downwardly beneath the pulley 12, up over the pulley 11, thence horizontally to the direction sheave 15, and upwardly to the over-balance counterweight 16, to which the other end of the belt is connected. A steel cable 17 connected at one end to the top of the car, extends over the direction sheaves 18 and is connected at its other end to the weight 16. A car counterbalance weight 19, connected to the car by means of a cable 20, is adapted to support the dead weight of the car. The over-bal-

ance weight 16 may be adjusted to balance the average load carried by the car. A certain amount of tension on the driving belt is necessary to prevent slipping when the driving pulleys are at rest, and to secure sufficient tractive friction between the belt and pulleys when running. The tension on the belt when running will be at least that needed to support the unbalanced load and to overcome inertia and friction of parts, but as this is small compared with the tension on the counterweight cable the wear and strain on the belts are correspondingly reduced.

Fig. 2 shows an arrangement in which the motor and driving mechanism are located at the top of the elevator shaft. In this instance the driving belt 13′ is connected to the top of the elevator car, and extends upwardly to the overhead driving pulleys 11′ and 12′, to the idler pulley 15′, and thence down to the over-balance counterweight 16′. The tension on the belt 13′ is in this case due to the weight 16′.

Figs. 3 and 4 show another modification, in which the drive pulley 25 is keyed directly to the motor shaft 3′. The driving belt in this case is doubled to form a plurality of belt sections $13^a$ and $13^b$ extending between the car and the over-balance weight $16^a$. The weight $16^a$ is provided with a pulley 26 which serves to equalize the tension on the belt sections $13^a$ and $13^b$ which may be made smaller than when a single belt is used. These belt sections are superposed, so that only one section is in contact with the drive pulley.

Fig. 5 shows an arrangement similar to Fig. 3, except that the weight $16^a$ and pulley 26 are replaced by independent weights $16^c$ and $16^d$ on the free ends of the belts $13^c$ and $13^d$. The weight $16^c$ constitutes an adjustable over-balance weight, and the weight $16^d$ a tension device for the driving belt $13^d$. The frictional driving contact, however, between the drive pulley 25 and the belt $13^d$ is the combined result of the two weights $16^d$ and $16^c$, as the belts are superposed. The use of the two separate belts $13^d$ and $13^c$ constitutes a safety device, as in case either belt gives way, the other operates to prevent the car from dropping independently of the drive pulleys 25.

In Fig. 6 is shown an arrangement substantially like that of Fig. 2 except that a driving belt is doubled as in Fig. 3 to form the belt sections $13^a$ and $13^b$. This figure also illustrates intermeshed worm gear wheels 11 and 12 as in Fig. $1^a$. Fig. 7 shows an arrangement substantially like that of Fig. 1 except that a drive sheave 25 mounted directly on the motor shaft is employed to drive the bolt 13.

Various changes in details of construction and arrangement of parts, other than those herein set forth, might be made by those skilled in the art without departing from the spirit or scope of the invention, and I wish therefore not to be limited to the exact constructions disclosed.

What I claim as new and desire to secure by Letters Patent of the United States is:—

1. In a traction elevator, the combination of a car, a cable and counterweight, a belt connected at one end to the car, a drive pulley engaging the belt, and a weight at the other end of the belt and supported thereby.

2. In a traction elevator, the combination with a car, of a cable and counterweight, an overhead friction drive pulley, a belt attached to the car and engaging said pulley, and a weight suspended by the belt.

3. In an elevator, the combination of a car, a friction drive element, a plurality of superposed belt sections directed and driven by said drive element, and means for placing tension on the belt sections.

4. In an elevator, the combination with a car, of a cable and counterweight, a plurality of superposed belt sections, means for placing tension on the belt sections, and a drive pulley in contact with one of the belt sections.

5. In a traction elevator, the combination with a car, of a plurality of superposed belt sections, a tension device for the belt sections, and friction driving means.

6. In a traction elevator, the combination with a car, of a plurality of superposed belt sections, a tension device, means for equalizing the tension on the belt sections, and friction driving means for the belt sections.

7. In a traction elevator, the combination of a car, a plurality of belt sections connected to the car, a weight suspended by said belt sections, means for equalizing the tension on the belt sections, and frictional belt driving means engaging one of the belt sections, said sections being superposed at the point of engagement of the said driving means.

8. In a traction elevator, the combination with a car, of a plurality of superposed belt sections connected to the car, means for placing tension on the belt sections, and a friction drive pulley engaging one of the belt sections.

In a traction elevator, the combination with a car, of a belt doubled to form two superposed belt sections and having the free ends connected to the car, an overhead friction drive pulley over which the belt sections pass, an equalizing pulley suspended in the bend formed by doubling the belt, and a weight supported by said equalizing pulley.

10. In a traction elevator, the combination with a car, of a counterweight and cable, a plurality of superposed flat belt sections,

a weight suspended from said belt sections, means for equalizing the tension on the belt sections, a friction drive pulley engaging one of the belt sections, and a motor to which the pulley is connected.

11. In an elevator, the combination of a car and a counterweight therefor, means connecting the car and counterweight, a belt connected to the car, two driving pulleys in engagement with said belt, worm wheels meshing with each other and respectively connected to said pulleys, two worms meshing respectively with said worm wheels, and a driving shaft carrying said worms.

12. In an elevator, the combination with a car and a counterweight, of a belt connected to the car, a plurality of driving members associated with said belt, intermeshing gears having a fixed connection with said members, and means for driving said gears to effect movement of the car.

13. In an elevator, the combination of a car, intermeshing gears, means to rotate the gears, drive pulleys fixed to and rotating with said gears, a flexible driving member engaging said pulleys, and means to connect said flexible driving member to the car.

14. An elevator comprising in combination a car, intermeshing worm gears, pulleys connected to and rotatable with the gears, a flexible member operated by said pulleys, and means to connect said flexible member to the car.

15. An elevator comprising in combination a car, driving pulleys, worm wheels meshing with each other and connected respectively to the pulleys, worms meshing with said worm wheels, a driving shaft carrying said worms, and a flexible member in engagement with the driving pulleys and connected to the car.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses.

ERNEST L. GALE, Sr.

Witnesses:
CHAS. M. NISSEN,
ERNEST L. GALE, Jr.