No. 676,899. Patented June 25, 1901.

C. KÖTTGEN & G. MEYERSBERG.

ELEVATOR APPARATUS.

(Application filed Jan. 6, 1900.)

(No Model.)

Fig. 1.

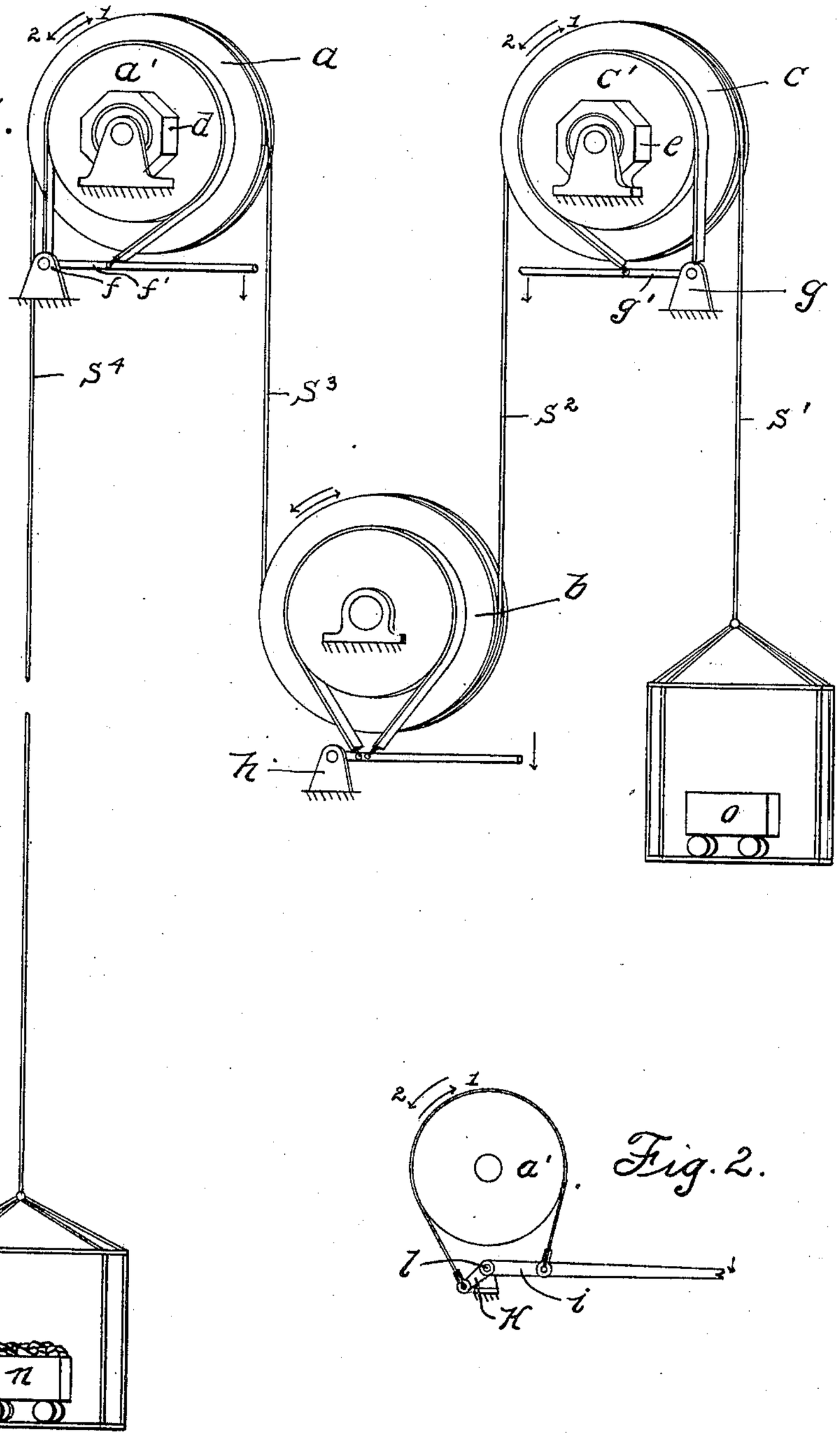

Fig. 2.

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UNITED STATES PATENT OFFICE.

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ELEVATOR APPARATUS.

SPECIFICATION forming part of Letters Patent No. 676,899, dated June 25, 1901.

Application filed January 6, 1900. Serial No. 571. (No model.)

To all whom it may concern:

Be it known that we, CARL KÖTTGEN, a subject of the Emperor of Germany, residing at Charlottenburg, and GUSTAV MEYERSBERG, a subject of the Emperor of Austria-Hungary, residing at Berlin, Germany, have invented a certain new and useful Improvement in Elevator Apparatus, (Case No. 298,) of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

Our invention relates to elevator apparatus, and has for its object the provision of improved braking means and an improved arrangement of the brake apparatus for checking and stopping the travel of elevator-cars.

Our invention relates more particularly to that class of elevator apparatus where a plurality of sheaves are employed for guiding the elevator-ropes in their travel; and it is one object of our invention to so arrange the braking apparatus that the travel of the rope or cable will not be checked solely by braking force applied at one point. To this end we employ a brake associated with each of several sheaves, so that the travel of the rope or cable may be checked by braking force applied at several points and not at one sheave, which heretofore gave rise to slippage between this sheave and the cable, especially under heavy loads.

Another feature of our invention is particularly useful in connection with elevator apparatus where empty elevator-cars only descend and loaded cars only ascend—such elevator apparatus as in mining, for example.

It is obvious that where the sheaves in the elevator apparatus last spoken of are rotated in one direction to elevate a heavy load and in an opposite direction to lower an empty car in order to stop and hold the cable a stronger braking action will be required on the stretch of rope leading to the loaded car that on the stretch of rope leading to the empty car. We provide an improved braking appliance which is adapted automatically to vary its braking action upon the sheave associated therewith according to the direction of rotation of the sheave. In practice we preferably employ a number of driving-sheaves and one or more idle sheaves and associate a braking appliance with each of the sheaves, each braking appliance being so related to its sheave that the braking effect of the said appliance upon its sheave is automatically varied as the sheave rotates in one direction or another where the stretches of rope are subjected to different strains. There may be, however, in the apparatus employing our invention a sheave or sheaves so arranged with relation to the rope or cable that the stresses upon the stretches of cable leading to the latter sheave or sheaves are equal, irrespective of the direction of rotation thereof or of the nature of the load that is carried by the cable. We preferably associate with each of these latter sheaves or sheave a braking appliance which is capable of checking the rotation thereof with equal force with the sheave rotating in either direction.

We will explain our invention more fully by reference to the accompanying drawings, illustrating one of many embodiments of our invention, in which—

Figure 1 illustrates diagrammatically an elevator apparatus equipped in accordance with our invention. Fig. 2 is a modification of a band-brake used in this connection.

The drawings show but three sheaves, two of which, *a* and *c*, are in this instance driving-sheaves and the third, *b*, an idler-sheave. It is obvious, however, that the number of sheaves in the elevator apparatus may be varied without departing from the spirit of the invention, and we do not therefore wish to be limited to the precise number and character of the sheaves illustrated.

A rope or cable is passed over the sheaves, preferably in the manner indicated, the rope preferably engaging one-half of the circumference of each sheave. The stretches of rope or cable $s' s^4$ support unloaded and loaded cars *o* and *n*, respectively. When the sheaves *a* and *c* turn in the direction indicated by the arrows 1, the car *n* is lifted and the car *o* is lowered. When the sheaves *a* and *c* are rotated in the direction indicated by the arrows

2, the car *n*, which was previously lifted and unloaded, is caused to descend, while the car *o*, previously lowered and loaded, is lifted.

In order that the sheaves *a* and *c* in the apparatus shown may be of simple construction and in order that the cables engaging the same may have sufficient frictional engagement therewith, the third sheave *b* is employed, stretches of cable s^2 s^3 leading from the sheaves *a* and *c* to the sheave *b*. It will be apparent that under all conditions of driving the stretches of cable s^2 s^3 are subjected to equal tension or strain irrespective of the direction of travel of the cable and of the load carried by the elevators. This being the case, the sheave *b* in the apparatus shown acts, preferably, as an idler, no motive device being attached thereto. The sheaves *a* and *c*, however, are each preferably provided with a motor adapted to rotate the same in opposite directions to elevate and lower the elevator-cars. We do not wish to be limited, however, to the employment of the sheave *b* merely as an idler.

As each driving-sheave can only supply power to the apparatus which is equal to the difference in the tensions between the stretches of rope or cable leading to and from the same, it may be determined mathematically (the sheaves *a* and *c* rotating in the direction indicated by the arrows 1 and the cars *n* and *o* being loaded and unloaded, respectively) that the tractive force of the sheave *a* upon the cable is greater than the tractive force of the sheave *c* upon the cable. If the cars *n* and *o* are unloaded and loaded, respectively, and if the sheaves *a* and *c* are rotated in the direction indicated by the arrows 2, then the tractive force of the sheave *c* upon the cable will be greater than the tractive force of the sheave *a*. The sheave *a* or sheave *c*, as the case may be, is subject to necessary frictional engagement in its bearings, whereby the difference in tensions in the stretches of rope is secured. In either of the foregoing cases the stresses or tensions upon the lengths of cable $s^2 s^3$ intervening between the sheaves *c b* and sheaves *a b*, respectively, are equal. In practice we have found it well to employ the sheave *b* merely as an idler to create a bite in the cable between the sheaves *a* and *c*, thereby to afford sufficient area of contact between the cable and the driving-sheaves, the friction between the driving-sheaves and the cable being sufficient to provide the requisite acceleration of movement of the elevator-cars. The motors *d* and *e*, associated with the driving-sheaves, are adapted to rotate each sheave in either direction and with varying force, according to the direction of movement of the cable. Each driving-sheave and also, preferably, the idler is provided with a braking appliance, the sheaves *a* and *c* having brakes *f* and *g* associated therewith and the idler-sheave *b* having the brake *h* associated with it. We have shown in connection with the sheaves *a* and *c* but one type of braking appliance and with the sheave *b* another type of braking appliance, but many styles of braking appliances may be employed without departing from the spirit of our invention.

In the form of brake shown in connection with the sheaves *a* and *c* simple friction-bands are employed, which surround reduced cylindrical extensions *a′ c′* of the sheaves *a c*, respectively. In the brakes *f* and *g* lever-arms *f′ g′* are employed, one end of a brake-band being anchored at the pivotal point of each lever-arm. The other end of each brake-band is attached to its lever-arm at a distance from the pivotal point thereof, this distance to be determined by the braking force that has to be exerted upon the sheaves. The braking mechanisms associated with the sheaves *a* and *c* are symmetrically arranged.

Assuming the sheaves *a* and *c* to be rotating in the direction indicated by the arrows 1, upon the depression of the lever-arms *f′ g′* the braking action of the lever *f* will be greater than the braking action of the lever *g*, which is desirable, as the car *n* is loaded and the car *o* unloaded. If the sheaves *a* and *c* are rotated in the direction indicated by the arrows 2, the car *o* being loaded and the car *n* unloaded, an application of the brakes will be followed by a greater braking action due to the brake *g* than that due to the brake *f*, which is desirable, as less force is required to check and hold the car *n*, which is now assumed to be empty, than the car *o*, which is now assumed to be loaded. The idler-sheave is provided with a brake, which exerts a uniform braking action thereupon irrespective of its direction of rotation.

In Fig. 2 we have shown another form of braking mechanism which may be employed, in which we preferably connect the ends of the brake-band to the lever-arm at unequal distances on opposite sides of the fulcrum *l*, the two lever-arms *k* and *i* being preferably angularly disposed.

Having thus described our invention, we claim as new, and desire to secure by Letters Patent, the following:

1. In an elevator apparatus, the combination with two driving-sheaves, of means for rotating each sheave in opposite directions, an elevator-cable engaging the said sheaves and adapted to support unequal loads upon stretches of cable leading from said sheaves, a braking appliance associated with each driving-sheave serving to exert a greater braking effect upon its sheave when said sheave is rotating in one direction than when the sheave is rotating in the opposite direction, the said sheave coöperating with its braking appliance automatically to change the force of the brake upon the reversal of direction of rotation of the sheave, an idler about which the said cable is also passed, and a brake associated with the said idler to check its rotation, substantially as described.

2. In an elevator apparatus, the combination with two driving-sheaves, of means for

rotating each sheave in opposite directions, an elevator-cable engaging the said sheaves and adapted to support unequal loads upon stretches of cable leading from said sheaves, and a braking appliance associated with each driving-sheave serving to exert a greater braking effect upon its sheave when said sheave is rotating in one direction than when the sheave is rotating in the opposite direction, the said sheave coöperating with its braking appliance automatically to change the force of the brake upon the reversal of direction of rotation of the sheave, substantially as described.

3. In an elevator apparatus, the combination with two driving-sheaves, of means for rotating each sheave in opposite directions, an elevator-cable engaging the said sheaves and adapted to support unequal loads upon stretches of cable leading from said sheaves, a braking appliance associated with one of said driving-sheaves, serving to exert a greater braking effect upon the sheave when said sheave is rotated in one direction than when the sheave is rotated in the opposite direction, the said sheave coöperating with the braking appliance automatically to change the force of the brake upon the reversal of direction of rotation of the sheave, an idler about which the said cable is passed, and a brake associated with the said idler to check its rotation, substantially as described.

4. In an elevator apparatus, the combination with two driving-sheaves, of means for rotating each sheave in opposite directions, an elevator-cable engaging the said sheaves and adapted to support unequal loads upon stretches of cable leading from said sheaves, and a braking appliance associated with one of said driving-sheaves, serving to exert a greater braking effect upon the sheave when rotated in one direction than when the sheave is rotated in the opposite direction, the said sheave coöperating with the braking appliance automatically to change the force of the brake upon the reversal of direction of rotation of the sheave, substantially as described.

5. In an elevator apparatus, the combination with a plurality of driving-sheaves, of an elevator-cable engaging the same, an idler-sheave also engaging the cable, and a braking appliance associated with each of the said sheaves, substantially as described.

6. In an apparatus for raising heavy loads, the combination with a plurality of sheaves, of an elevator-cable engaging the said sheaves and adapted to support unequal loads upon the stretches of cable leading therefrom, means for operating said cable, and braking appliances for said sheaves constructed and arranged to exert a greater braking effect on the sheave nearest to the greatest load, substantially as described.

7. In an elevator apparatus, the combination with a plurality of sheaves, of an elevator-cable engaging the said sheaves and adapted to support unequal loads upon the stretches of cable leading therefrom, means for operating said cable, and braking appliances for the sheaves from which the stretches of cable lead, each of said braking appliances being constructed and arranged to exert a greater braking effect when the stretch of cable leading from the sheave with which it is associated, is being driven toward its sheave, substantially as described.

8. In an elevator apparatus, the combination with a plurality of sheaves, of an elevator-cable engaging the said sheaves and adapted to support unequal loads upon the stretches of cable leading therefrom, means for operating said cable, braking appliances for the sheaves from which the stretches of cable lead, each of said braking appliances being constructed and arranged to exert a greater braking effect when the stretch of cable leading from the sheave with which it is associated is being driven toward its sheave, an idler about which the said cable is also passed, and a braking appliance constructed and arranged to exert equal braking effects in both directions associated with said idler.

In witness whereof we hereunto subscribe our names this 7th day of December, A. D. 1899.

CARL KÖTTGEN.
GUSTAV MEYERSBERG.

Witnesses:
HENRY HASPER,
WOLDEMAR HAUPT.