No. 641,568. Patented Jan. 16, 1900.

C. WHITTIER.

ELEVATOR.

(Application filed Sept. 17, 1894.)

(No Model.) 4 Sheets—Sheet 1.

Fig. 1.

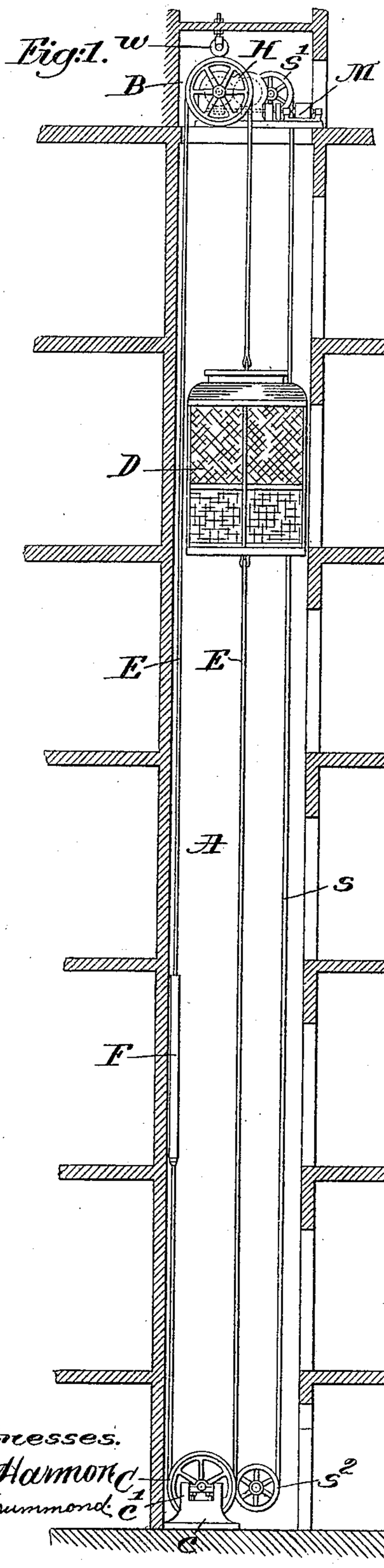
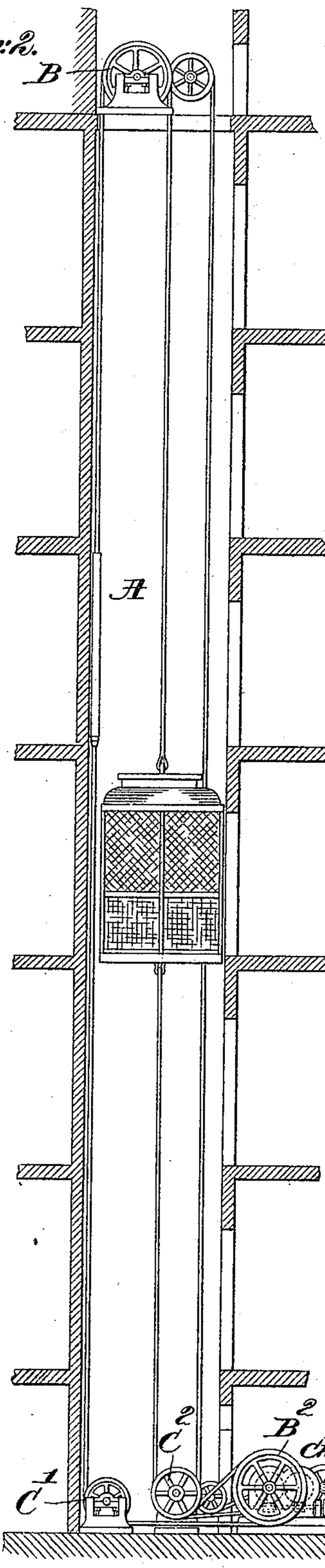


Fig. 2.



Witnesses.
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T. J. Drummond.

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No. 641,568. Patented Jan. 16, 1900.

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(No Model.) 4 Sheets—Sheet 2.

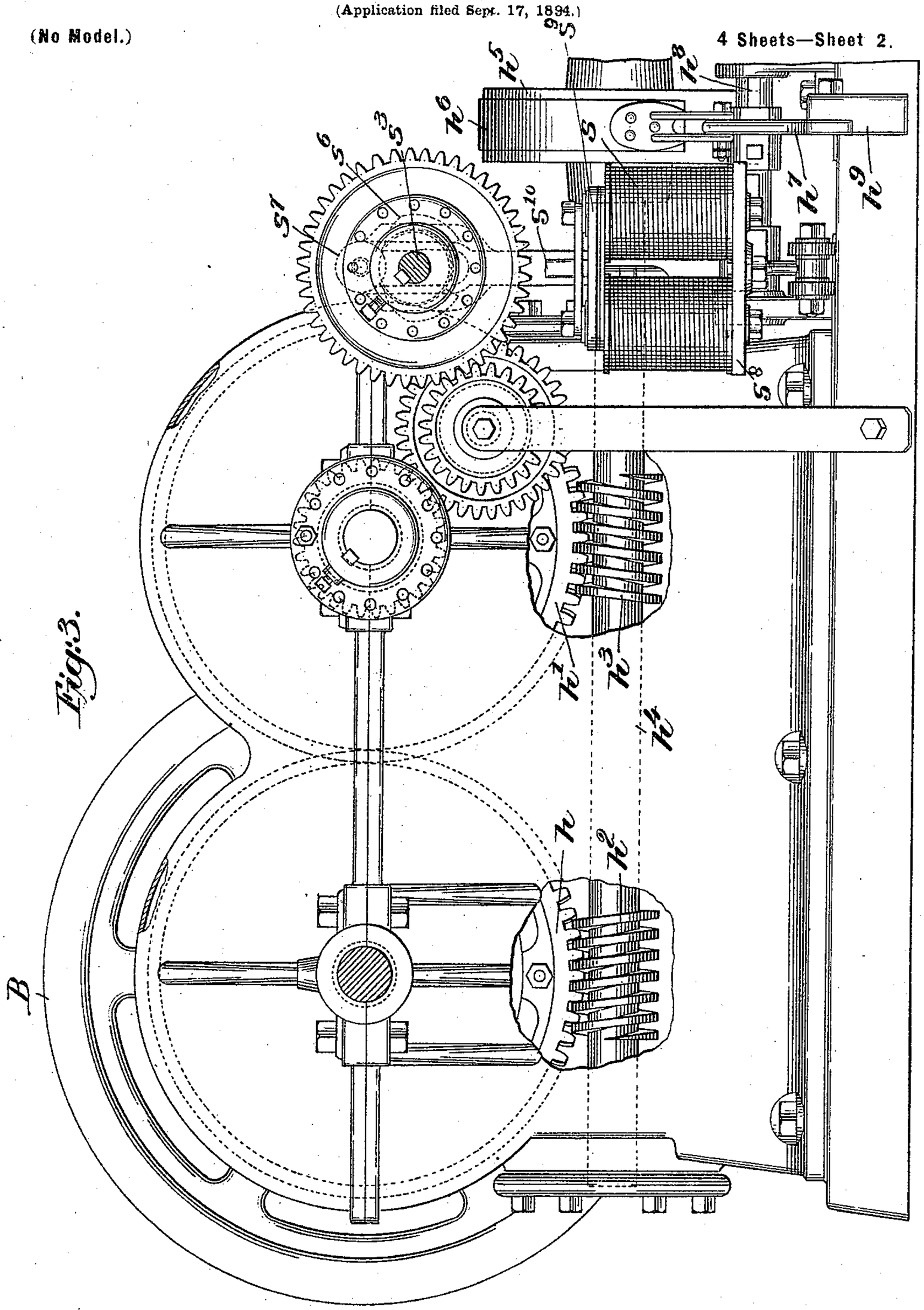

Fig. 3.

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(No Model.) 4 Sheets—Sheet 3.

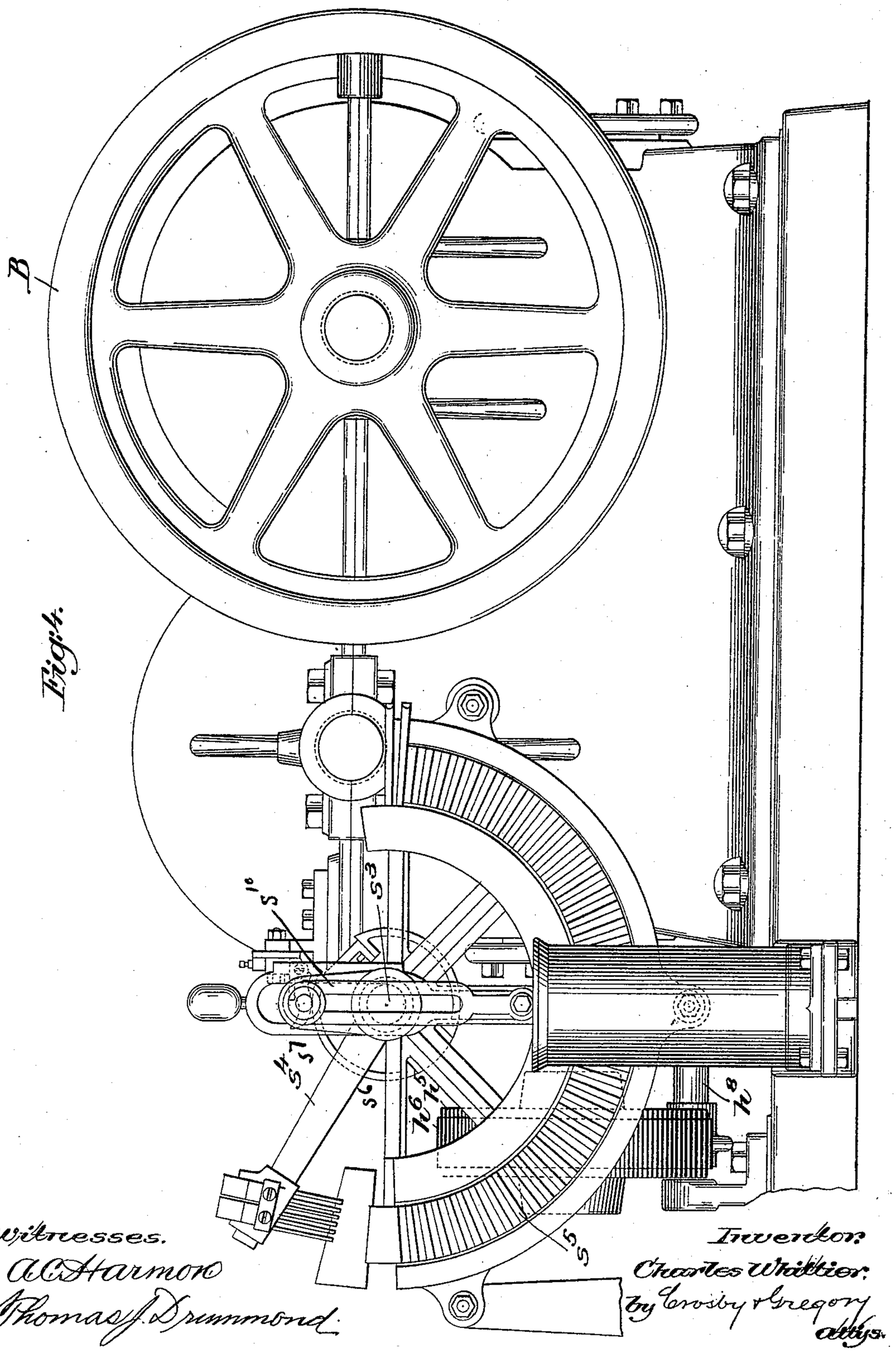

Fig. 4.

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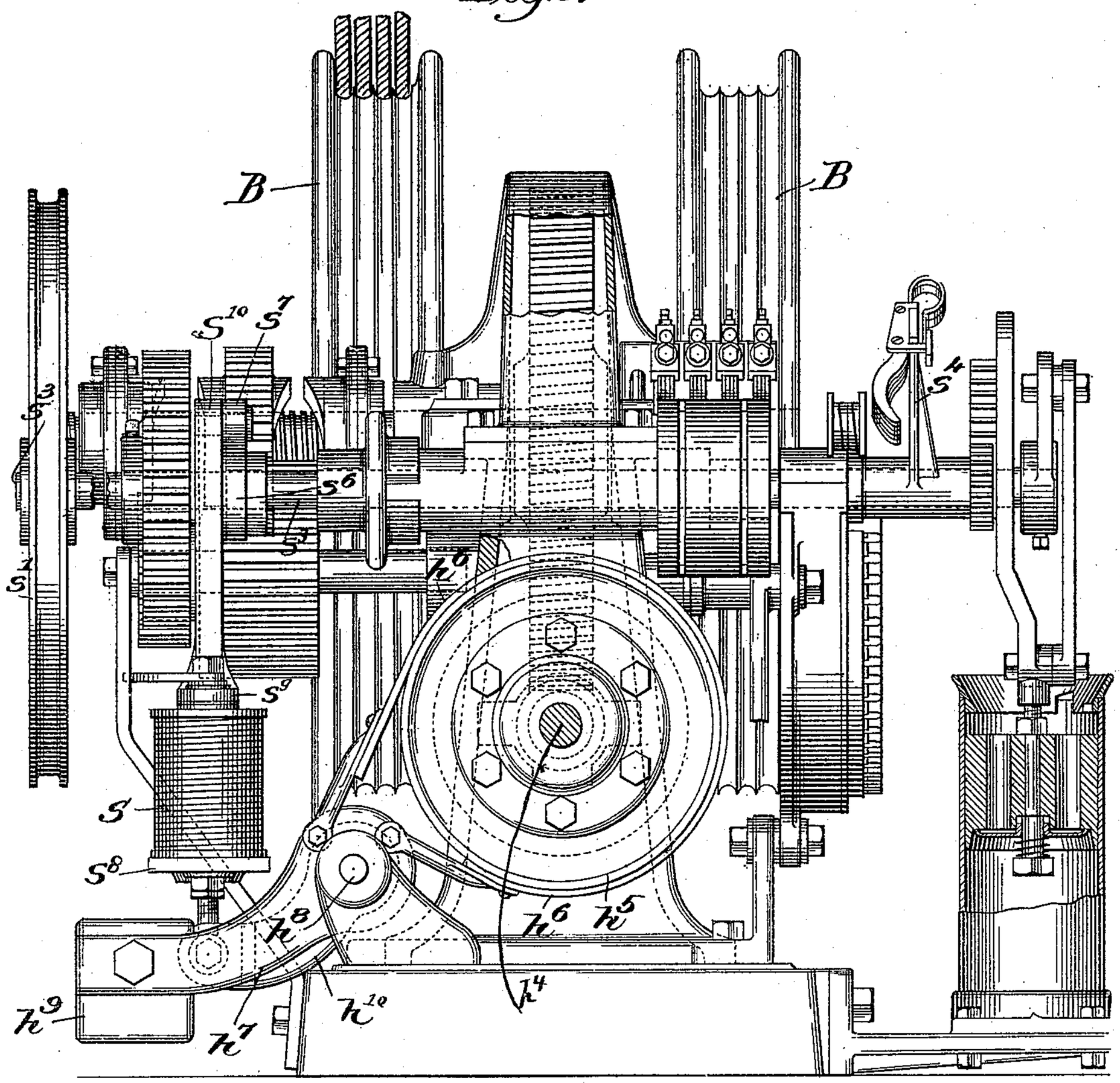
(Application filed Sept. 17, 1894.)

(No Model.) 4 Sheets—Sheet 4.

Fig: 5.



Witnesses.
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UNITED STATES PATENT OFFICE.

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ELEVATOR.

SPECIFICATION forming part of Letters Patent No. 641,568, dated January 16, 1900.

Application filed September 17, 1894. Serial No. 523,193. (No model.)

To all whom it may concern:

Be it known that I, CHARLES WHITTIER, of Boston, county of Suffolk, State of Massachusetts, have invented an Improvement in Elevator Systems, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

This invention has for its object the production of a novel and improved high-service elevator system, the term "high service," as herein used, denoting a system such as is used to operate elevators in modern high buildings.

In order that the nature and advantages of my improved system may be clearly understood, I will first briefly refer to the principal systems now in common use and to the difficulties attending the operation of the same in high service, which difficulties I have sought by my invention to overcome.

Nearly all elevator systems now in use to any considerable extent may be divided into two general classes, known, respectively, as the "drum" and "multiplying-sheave" systems. In the first or drum system the operating or lifting cables are attached at one of their ends to the top of the elevator-car and at their opposite ends to the drum, the latter being spirally grooved, so that when rotated the entire lengths of the several cables may be coiled or wound thereupon. In high buildings these drums to take up the long lengths of cable must necessarily be of great length, so great, in fact, that though the operating mechanism therefor is most simple they are not as generally used for high service as other systems. In order to shorten the drums as much as possible, there is a temptation to reduce the number of operating-cables below the safety limit. In the second or multiplying-sheave system, used mostly in connection with hydraulic or electric power, a substantially short travel of the actuating piston or screw is made to take up and pay out great lengths of operating-cables by the use of a large number of fixed and movable multiplying-sheaves about which said cables are passed. The large number of multiplying-sheaves usually necessary for high service requires large floor-space where it often can be least spared and also renders the system difficult to handle with ease and accuracy.

The multiplying-sheave system is open to the further objection that during the operation of the elevator the cables are caused to pass rapidly about the rotating sheaves, and are thus continually being bent and straightened in many and constantly-changing places at once, causing them to quickly fracture, and, further than this, in systems of this type, wherein the speed is greatly multiplied between the piston or screw and the traveling car, the strain on the cables at or near their fixed ends is increased over and above that actually required to move the car at the required speed in the same ratio as that by which the speed is increased—that is, if the machine is speeded up five to one there is five times as much strain at or near the fixed ends of the cables as at the ends attached to the car.

In both the drum and multiplying-sheave systems and, in fact, in any system in which the cables are wound or taken up by suitable mechanism there is an inequality in the counterbalancing of the car which varies constantly with the changing position of the car. For example, if a car be properly counterbalanced when at the top of the well it when at the bottom thereof will be underbalanced by a weight represented by the aggregate weight of all the cables from the sheaves at the bottom of the well to the car, and if the car be properly counterbalanced when at the bottom of the well it is overbalanced when at the top. To obviate this great inequality in counterbalancing, it is customary to counterbalance the car when in a central position, midway top and bottom; but in such a case when a building is high a change in position for several floors, either above or below the central position, causes a very perceptible variation in the load which has to be equalized, and the counterbalancing is thus defective in proportion to the variation in load and length of traverse. This ever-changing inequality in counterbalancing necessarily causes unequal strain on the elevator engines and cables, exerts a corresponding effect on the ease and smoothness in running, and tends to cause the elevator-car to jump when stopped quickly,

which, besides the discomfort caused the passengers, is also likely to operate the automatic safety-stop.

Seeing the necessity for a high-service system free from the objections above referred to, I have devised the system forming the subject-matter of this present invention and which I will now describe.

In my improved system the operating-cables are attached to the car and are then passed over suitable drums or sheaves at the top of the well and are attached at their opposite ends again to the bottom of said car, thus forming, with the car, in effect, an endless belt. By placing a counterbalancing-weight on the cables, intermediate their ends, the car may be balanced and the whole, like a belt, run up and down at any speed and through any distance, be it for two or twenty stories, and at all times be perfectly counterbalanced and capable of being stopped accurately as well when at or near the top as at or near the bottom of the well. The car may be supported by any number of cables, and the drums or sheaves over which said cables pass need have only the requisite number of grooves or as many as there are cables and ring-like instead of spiral. The drums or sheaves at one end of the well are rotated or driven in suitable manner and operate, preferably, frictionally upon and to drive the cables passed thereover and their attached car.

My improved system also comprehends, in combination with the elements mentioned, suitable shipping mechanism to control the operation of the system from the car and suitable mechanical and other brakes to be described.

My invention generally, therefore, comprehends a high-service elevator system containing the following instrumentalities, viz: a rotatable drum communicating with an elevator-well, a plurality of cables driven thereby and sustained in said well, substantially as described, said cables being connected each at its opposite ends to the car, each cable between its points of connection with the car being connected to a counterbalance moved in unison with the car, but in an opposite direction, and elevator-controlling mechanism operable from the car, substantially as will be described.

Other features of my invention will be hereinafter described, and particularly pointed out in the claims.

To enable my invention to be understood, I have illustrated in the drawings different ways of carrying it out, all embodiments of the same system, Figure 1 being a vertical section of an elevator-well with the elevator mounted therein in accordance with my invention, the elevator engine or motor, however, being preferably at the top or the bottom of the well. The engine or motor may be placed upon any intermediate story. Fig. 2 is a similar view showing the engine located at the bottom of the well or in the basement. Fig. 3 is a left-hand elevation of one form of an elevator engine or motor mechanism which may be used in connection with my improved system, one of its suspending and actuating sheaves or drums being broken off to more clearly show the parts; Fig. 4, a right-hand elevation of the mechanism shown in Fig. 3, and Fig. 5 a right-hand end view of Fig. 3.

Referring to the drawings, in the embodiment of my invention particularly illustrated in Fig. 1, A is an elevator-well of usual construction. It may be one of a group, I having herein shown such well as extending upwardly from the basement through six floors of a building, though it should be understood that my improved system, though adapted for short runs of four to six floors or less, is nevertheless particularly designed for and finds its greatest utility in the higher runs in buildings of ten to twenty or more floors.

At the top and bottom of the elevator-well I have mounted suitable sheaves B C, which may be in the form of drums provided with as many circumferential ring-like grooves as there are supporting or operating cables for the elevator-car, or there may be a separate sheave for each cable or groups of sheaves, each having two or more grooves.

D represents the elevator-car, and E the sustaining or operating cables, of which there are preferably eight or more, though any desired number may be employed. These cables are attached at one of their ends to the elevator-car, herein shown as attached to the top of said car, and are then passed up and over the sheaves B at the top of the well, thence down to and about the sheaves C at the bottom of the well, and in Fig. 1 up and attached at their opposite ends again to the car, shown as at the bottom of said car.

Intermediate the ends of the cables E and between the top and the bottom sheaves B and C, I have arranged upon the said cables a counterbalance weight or weights F, which, so far as this present invention is concerned, may be of any desired type or construction and attached to the said cables in any desired manner, I having herein shown the same, however, as made up of sections of pipe, preferably lead, slipped upon the cables and secured thereto in suitable manner.

In the embodiment of my invention shown in Fig. 1 the sheaves B are fast on the operating-shaft of the elevator machine or engine and constitute the winding-drums for the said machine.

The elevator machine or engine typified at H is of the well-known Whittier worm and worm-wheel type and illustrated on an enlarged scale in Figs. 3, 4, and 5. Referring to said Figs. 3, 4, and 5, h and h' are intermeshing worm-wheels operated by the double worms h^2 h^3 on the worm-shaft h^4, journaled in suitable bearings and connected in suitable manner with the motor, (shown as an electric

motor M, Figs. 1 and 2,) to the armature of which the said worm-shaft is directly connected.

The elevator-machine is provided with the usual mechanical brake, shown as a disk or pulley h^5, fast on the worm-shaft h^4 and encircled by a friction-brake band h^6, connected at its opposite ends with and operated by a lever h^7, mounted on the shaft h^8, and at its outer end carrying an actuating-weight h^9. The weight h^9 when permitted to drop acts to tighten the band about and to retard rotation of the disk and its worm-shaft referred to.

The machine is equipped with a usual shipper-rope s, operated from the car in suitable manner, herein passed directly through said car and operated directly, said shipper-rope at opposite ends of the well being passed about suitable sheaves s' and s^2, the former in the present instance being mounted upon a shipper-shaft s^3. The shaft s^3 carries an arm s^4, adapted to sweep a rheostat or current-regulator s^5, and thereby control the operation of the motor M. The rheostat s^5 and motor M may be of any usual or preferred kind, constructed and operating in well-known manner. Upon the shipper-shaft s^3 is also mounted an eccentric or cam s^6. A roller s^7, mounted on the upper end of a slotted link or rod s^{10}, rides upon the cam s^6, the rod s^{10} terminating or carrying an armature s^9 of a solenoid s, the latter being supported on the outer end of an arm h^{10}, extending from the shaft h^8, as clearly shown in Figs. 3 to 5. This mechanism constitutes a connection with the brake-actuating lever h^7, the solenoid being electrically connected in circuit with the motor, whereby when the motor-circuit is interrupted the said solenoid breaks the connection between the eccentric or cam and its brake-actuating lever, but when energized by the motor-current completes said connection, so that the lever and brake are operated by the said eccentric or cam. The machine is therefore, in effect, equipped with both a mechanical and an electrical brake, for whenever the shipper-shaft is rotated to cut off the motor-current its eccentric or cam permits the lever h^7 to drop by gravity and apply the brake to stop the machine, and whenever the motor-current fails the solenoid permits the said lever to drop and apply the brake in whatever position the shipper-shaft may be at that time.

In the construction, Fig. 1, the sheave C at the bottom of the elevator-well is mounted in bearings c and made adjustable therein in suitable manner, as by adjusting devices c', whereby the said sheave may be adjusted to vary the tension upon the operating-cables or to keep the same taut at all times.

By reference to Fig. 1 it will be seen that the operating-cables attached at their opposite ends to the top and bottom, respectively, of the elevator-car constitute therewith, in effect, an endless cable or belt, and as the elevator-car is counterbalanced by the weight F it will be evident that the belt-like arrangement, perfectly balanced at all times in all positions, may be operated at any desired speed and be as easily controllable at one point in its travel as at another, or, in other words, the elevator-car, whether at the bottom or the top of the well or in an intermediate position, is always perfectly counterbalanced, the weight to be counterbalanced being constant and not variable, according to the position of the car, as in elevator systems now commonly constructed.

By carrying the operating-cables up from the car and over the sheaves at the top of the well, thence down and about sheaves at the bottom of the well, and again attaching them to the car a single groove in each sheave is sufficient for each cable, and ten cables may be employed to provide the proper margin of safety and require only ten grooves or sheaves, whereas ten cables attached at one of their ends to the elevator-car and at their opposite ends to and adapted to be wound upon drums, as in machines as ordinarily constructed, would require forty or fifty grooves or sheaves, according to the number of turns of the drum necessary to wind or coil the entire lengths of the cables thereupon. So, also, in the multiplying-sheave system the number of sheaves employed for each cable must be greatly increased to get the desired speed for the short travel of the driving piston or screw, and this must be doubled or tripled for each second or third cable, so that economy in space and also in cost of manufacture and maintenance is by my invention greatly reduced over any system now known to me. It will also be noticed that at any one time there are never more than two half-turns in any of the cables, whereas in the multiplying-sheave system now so generally used there are many turns of the cable, constantly changing, causing the said cables to be bent and turned so frequently and rapidly that the individual wires are quickly fractured.

The perfect counterbalancing of the parts in my improved system gives a smoother operation to the elevator-car, subjects the cables to less strain, and prevents any tendency of the latter to slacken or vibrate—a difficulty impossible to completely overcome in the prevailing systems.

It will be noticed that the operating-cables are not positively connected with the winding drums or sheaves, but simply rest in the grooves therein and are therefore operated solely by friction. This friction of the cables in the grooves of the operating drums or sheaves may, if desired, be increased by the use of adjustable presser or friction wheels typified at w.

In the construction, Fig. 1, the elevator engine or motor is at the top of the elevator-well and the cables simply hang over and rest in the grooves in the drums or sheaves at the top of the well, the weight of the car and its counterbalance being ample to create the

proper friction necessary to operate the elevator. In Fig. 2, however, I have shown the operating engine or mechanism at the bottom of the well—in the basement, for instance—the operating-cables in such an arrangement being passed over sheaves B′ at the top of the well and C′ and C² at the bottom of the well. By making the sheaves adjustable in well-known manner a proper friction may be created between the cables and the drums or sheaves B² of the elevator mechanism to insure proper and certain operation of the elevator under all conditions.

An elevator-car suspended and operated by cables as described and forming with said cables, in effect, an endless belt counterbalanced in all positions, in combination with the elevator engine or mechanism operated by an electric motor and with the shipper mechanism and mechanical and electrical brakes, constitute a complete and entire elevator system, a system differing from anything known to me at the present time, and presenting advantages not only as to safety, but also in construction and ease of operation, it being particularly useful in very high buildings such as are being built at the present time.

While I have herein typified the controlling mechanism by the well-known shipper-rope, my invention comprehends any suitable controlling mechanism by which to control the operation of the system from the car.

The construction is, in effect, the same, whether the counterbalancing-weight be attached to a continuous cable or interposed between separated parts of the cable, the adjacent ends of the cable being attached to opposite ends of the weight, so that the latter forms a connecting-link in the said cable.

I claim—

1. A self-equalizing multicable driving and counterbalance system for operating an elevator-car, consisting of a series of endless cables each attached to said car, driving-sheaves about which said cables pass and by which they are frictionally driven in endless paths, and separate counterbalances for the respective endless cables, said counterbalances acting to counterbalance the car and in addition thereto acting automatically to maintain the respective cables under uniform tension and with uniform driving efficiency, thereby distributing automatically the total driving effect uniformly among the said cables and preventing impairment by stretching, &c., of any one cable more than another, substantially as described.

2. In an elevator system, the combination of the following-mentioned coöperative parts arranged and constructed to constitute an elevator system especially adapted for high-speed service in high buildings, viz: suitable driving mechanism, starting and stopping and braking devices therefor controllable from the elevator-car and governing the operation of the said driving mechanism, a plurality of endless combined hoisting and counterbalancing cables for said car, each passed over and in frictional contact with a driving drum or wheel and each provided with a suitable counterbalance, whereby said cables one and all bear their proportionate driving and counterbalancing load; the whole constituting an elevator system wherein the shocks incident to starting and sudden braking and stopping are uniformly equalized among and distributed through all the several elements of the combination, enabling the highest degree of speed and safety to be obtained, together with simplicity of construction and certainty of operation, substantially as described.

3. In an elevator system, the combination of the following-mentioned coöperative parts arranged and constructed to constitute an elevator system especially adapted for high-speed service in high buildings, viz: an elevator-well, sheaves at the top and bottom of said well, suitable driving mechanism, a plurality of endless combined hoisting and counterbalancing cables each attached to said car and passed over and under said top and bottom sheaves respectively, each cable between its points of attachment to the car being connected to a counterbalance moved in unison with the car but in an opposite direction, and means for regulating the tension of said cables in those portions thereof which are beneath said counterbalance and said car, substantially as described.

4. A self-equalizing multicable driving and counterbalance system for operating an elevator-car, consisting of a series of endless cables each attached to said car, driving-sheaves about which said cables pass and by which they are frictionally driven in endless paths, and separate counterbalances for the respective endless cables, said counterbalances acting to counterbalance the car and in addition thereto acting automatically to maintain the respective cables under uniform tension and with uniform driving efficiency, thereby distributing automatically the total driving effect uniformly among the said cables and preventing impairment by stretching, &c., of any one cable more than another, a hoisting-machine to rotate said sheaves, a connected electric motor to operate said hoisting-machine, a current-regulator, means operable from the elevator-car to move said regulator for the control of said elevator system, and a mechanical brake also operated by said controlling mechanism, substantially as described.

5. A high-service elevator system containing the following instrumentalities, viz: an elevator-well, a sheave or set of sheaves at the top and bottom of said well; a single cable or set of cables attached at one of their ends to the top of said car, passed up over and about the said top and bottom sheaves, and attached at their opposite ends again to the said car, said sheaves being provided with ring-like

grooves in which said cables lie, one groove for each cable; a counterbalance intermediate the ends of said cables and between said top and bottom sheaves, whereby uniformity of counterbalance is obtained at all times, unaffected by the changing position of the elevator-car, an elevator mechanism to rotate the sheaves to cause the said sheaves to frictionally drive said cables and the attached car; and controlling mechanism for the said elevator mechanism operable from the elevator-car, substantially as described.

6. A high-service elevator system, containing the following instrumentalities, viz: an elevator-well, and sheaves at the top and bottom thereof; a car movable in said well; a counterbalance-weight; a single cable or set of cables attached at one of their ends to the said car and passed up over the sheaves at the top of the well, thence down about the sheaves at the bottom of said well, and attached at their opposite ends again to the said car, and carrying intermediate their ends and between their top and bottom sheaves said counterbalancing-weight, whereby uniformity of counterbalance is obtained at all times unaffected by the changing position of the elevator-car; a hoisting-machine to rotate said sheaves, a connected electric motor to operate the same; a current-regulator, and means operable from the traveling elevator-car to move the same for the control of said elevator system; and a mechanical brake also operated by said controlling mechanism, substantially as described.

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

CHARLES WHITTIER.

Witnesses:

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EMMA J. BENNETT.