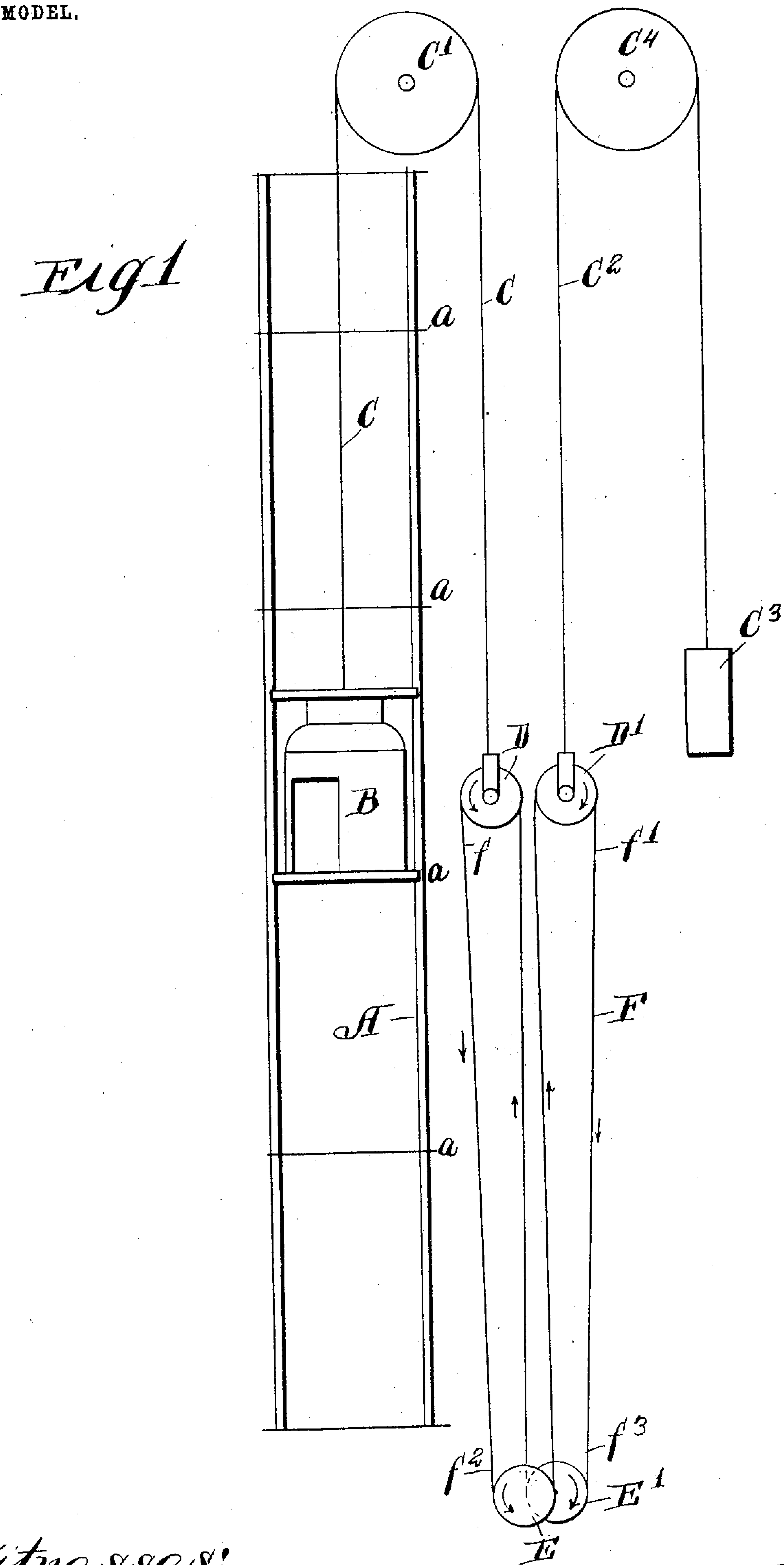
No. 750,765. PATENTED JAN. 26, 1904.

T. W. HEERMANS.

ELECTRIC MOTOR.

APPLICATION FILED JAN. 22, 1900.

NO MODEL. 3 SHEETS—SHEET 1.



Witnesses:
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William L. Hall

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His Attorneys

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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NO MODEL. 3 SHEETS—SHEET 2.

Fig. 2.

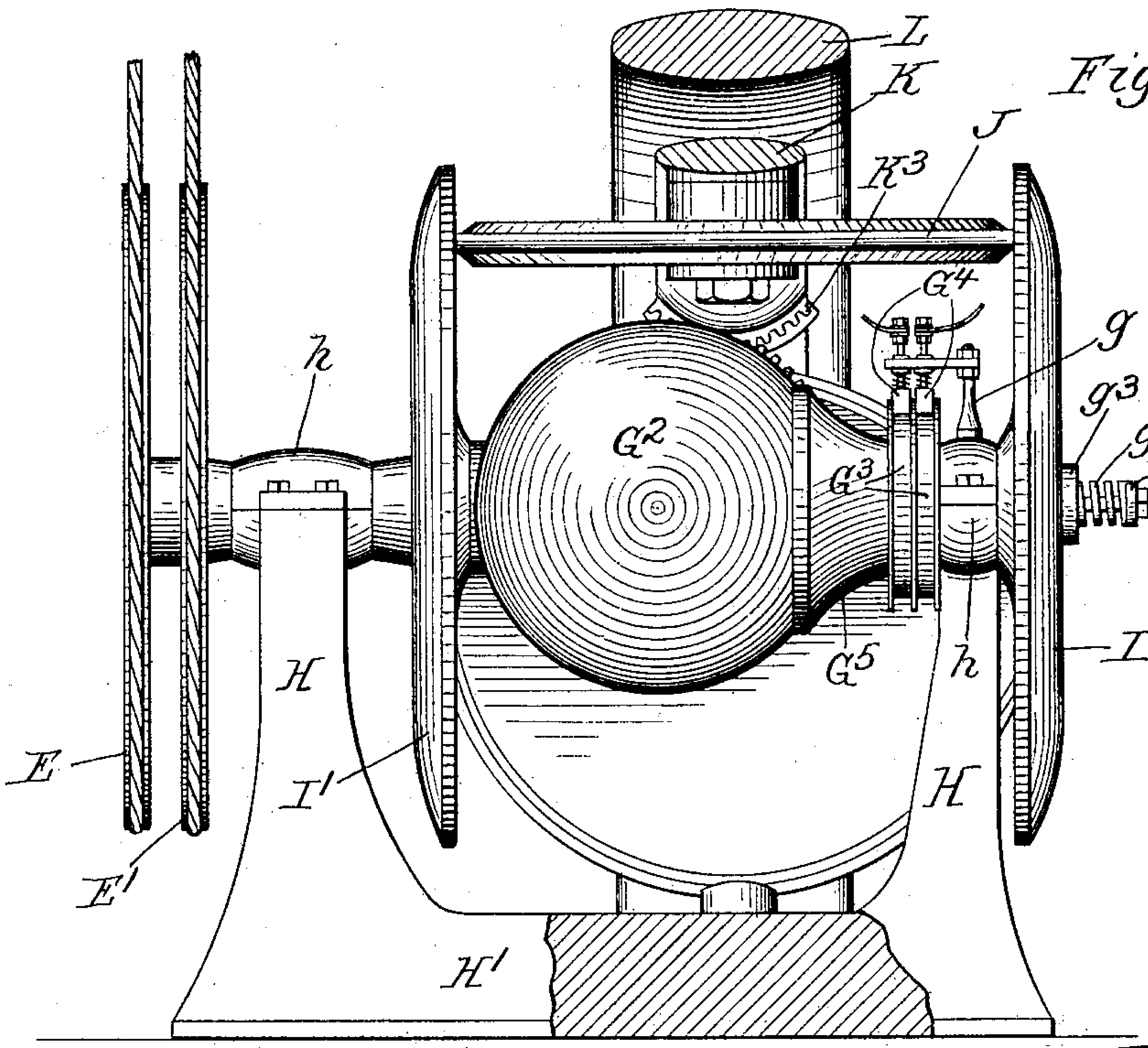
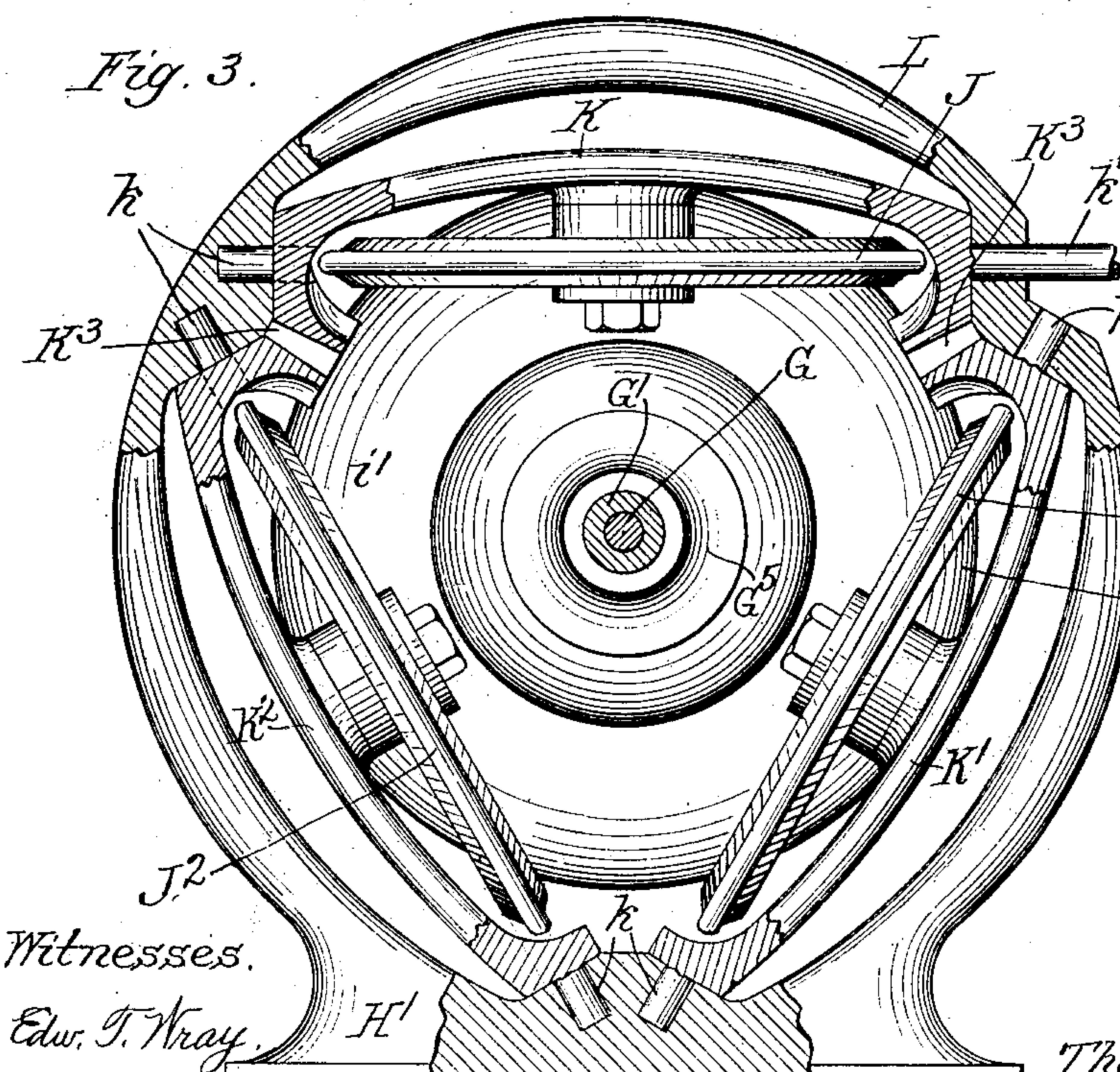


Fig. 3.



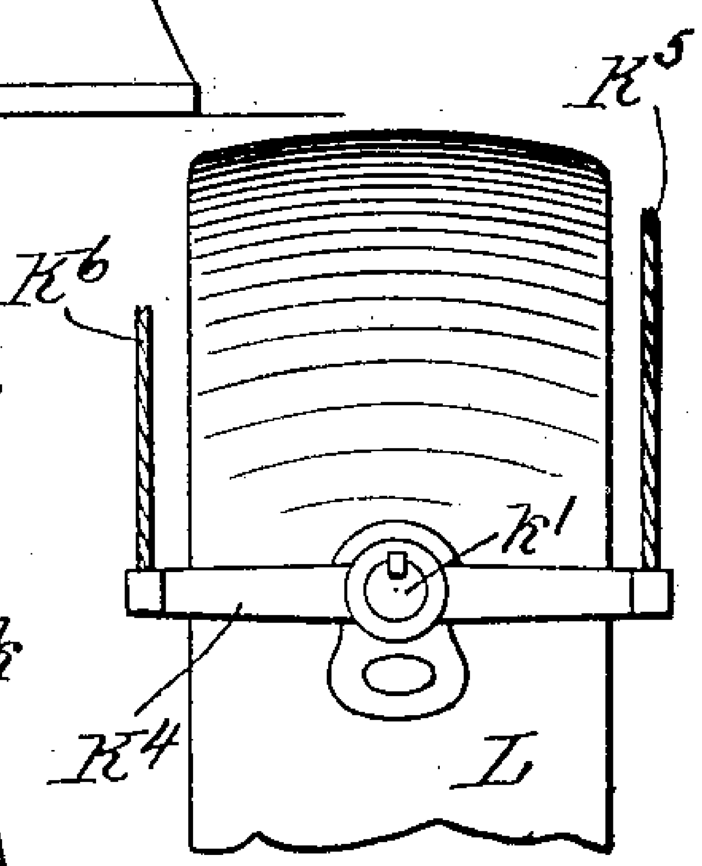


Fig. 3a.

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NO MODEL. 3 SHEETS—SHEET 3.

Fig 4

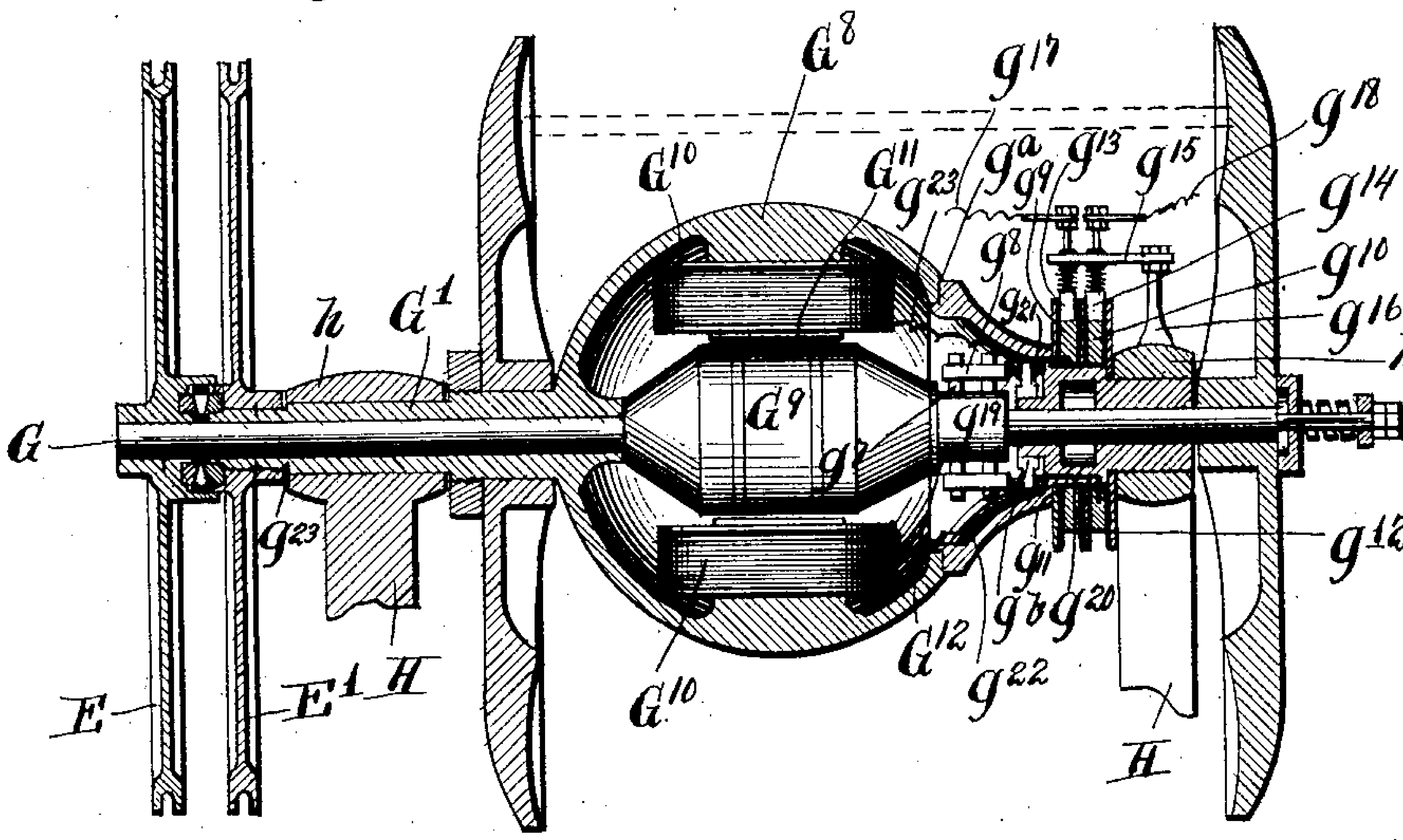


Fig 5

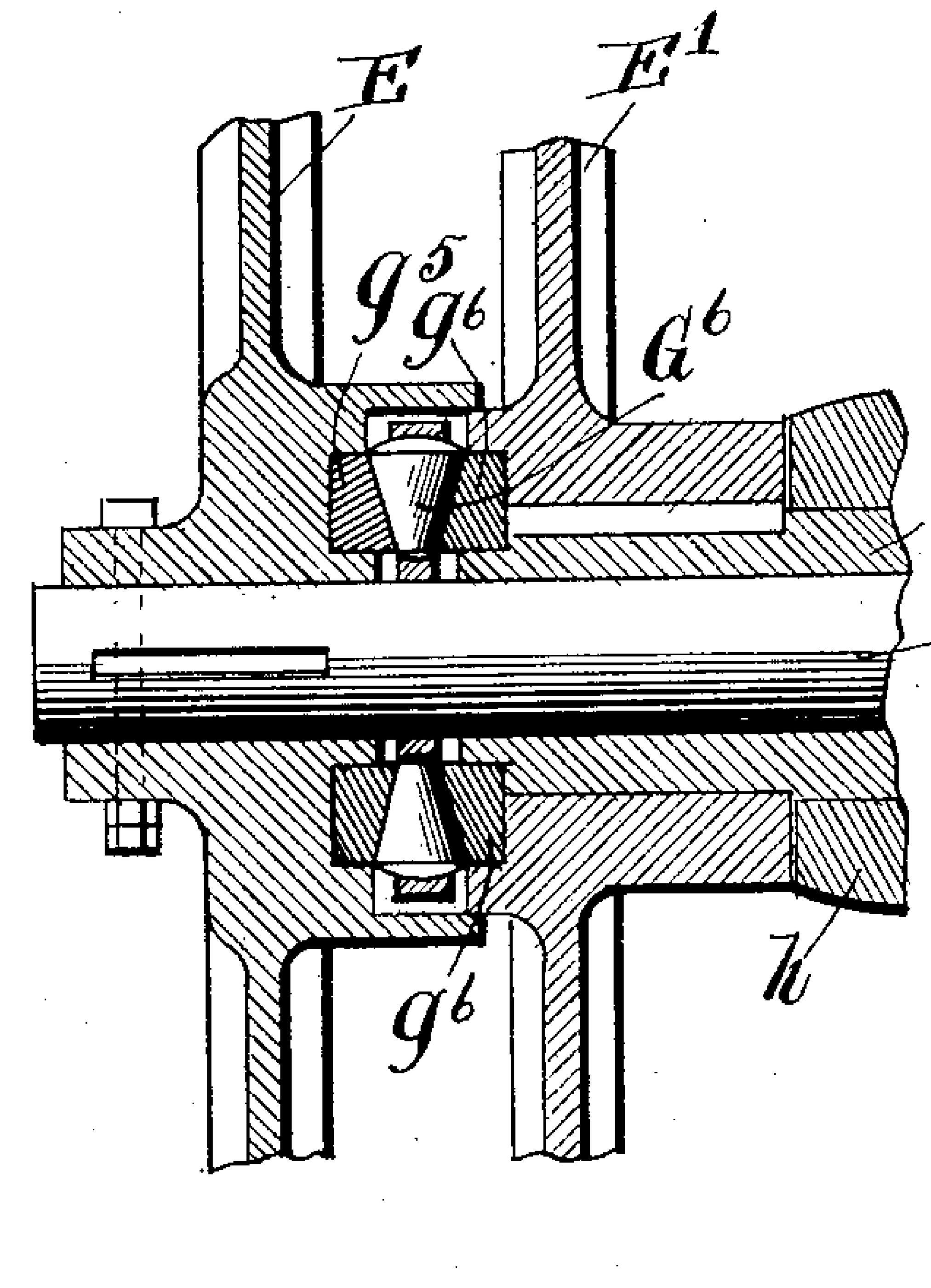
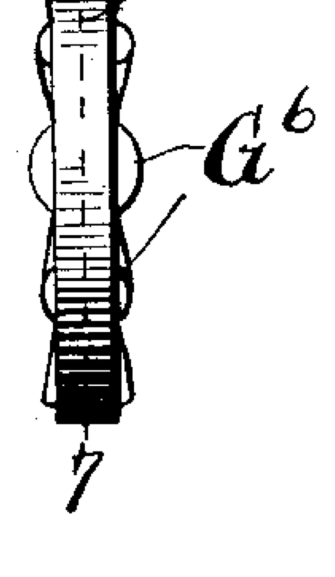


Fig 6



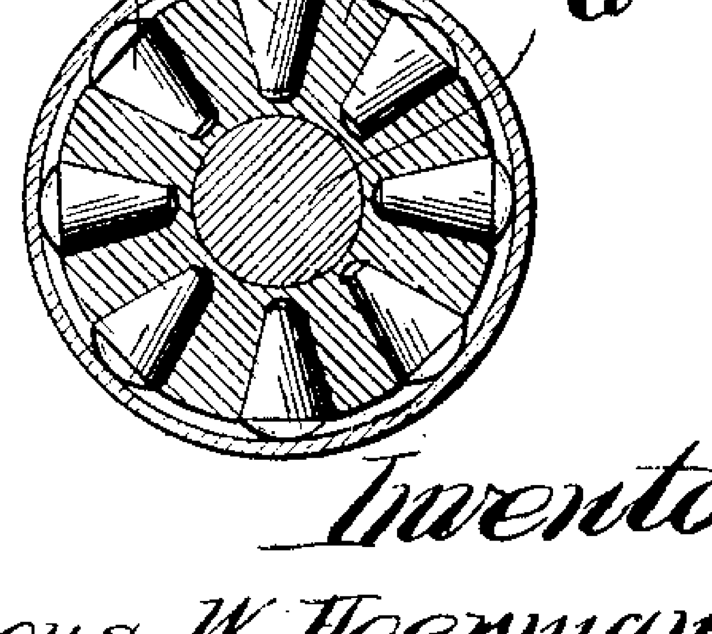


Fig 7

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UNITED STATES PATENT OFFICE.

THADDEUS W. HEERMANS, OF CHICAGO, ILLINOIS.

ELECTRIC MOTOR.

SPECIFICATION forming part of Letters Patent No. 750,765, dated January 26, 1904.

Original application filed December 4, 1899, Serial No. 739,068. Divided and this application filed January 22, 1900. Serial No. 2,289. (No model.)

To all whom it may concern:

Be it known that I, THADDEUS W. HEERMANS, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Electric Motors; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to improvements in electric motors constructed to drive two rotating parts in opposing directions and at correlatively differential speeds.

The invention is herein shown as applied to hoisting devices for elevators, but may be used to drive other machinery or apparatus wherein the requirements for power are similar.

In the drawings, Figure 1 is a diagrammatic view, in side elevation, of an elevator-shaft and its car and showing also the driving-pulleys of the motor and the rope connections between the same and said car. Fig. 2 is a side elevation, partly in section, of one form of motor and change-speed device which may be employed in actuating said car. Fig. 3 is a view thereof looking in a direction at right angles to the view shown in Fig. 2 and showing the same partly in section. Fig. 3^a is a fragmentary view of a portion of the speed-controlling mechanism of said motor. Fig. 4 is a vertical section of the motor, taken through the axis of the armature and field-magnet shafts. Fig. 5 is a fragmentary section taken on the line 5 5 of Fig. 4. Fig. 6 is an edge elevation of the antifriction-rollers and cage, which are shown in place in the machine in Figs. 4 and 5. Fig. 7 is a section taken on line 7 7 of Fig. 6.

First referring to the construction shown in Fig. 1 as illustrating one application of my motor to work, A designates an elevator shaft or well, *a* the several floors of the building within which said shaft is located, and B the elevator-car. C designates the car-hoisting cable, which is attached at one end to the car and at its other end to a traveling sheave D, located outside of the elevator-shaft, and C′ designates a guide-pulley which is located above the elevator-shaft and within the bight of the hoisting-rope C. C^2 designates a counterweight-rope, which is attached at one end to a traveling sheave D′ and at its other end to a counterweight C^3, and C^4 designates a guide-pulley which is located at the level of the pulley C′ and within the bight of the counterweight-rope C^2. E E′ designate positively-driven pulleys which are connected with and actuated by the electric motor constituting my invention. Said pulleys are attached to oppositely-moving parts of the motor and are rotated in opposite directions, as indicated by the arrows marked thereon, and are also adapted to be rotated at reciprocally differental speeds—that is say, they are so driven that when the speed of one is retarded the speed of the other is accelerated to a corresponding extent. F designates an endless cable which is trained around the driving-pulleys E E′ and the traveling sheaves D D′. Said cable is arranged in two loops having four bights $f\ f'\ f^2\ f^3$, which engage, respectively, the traveling sheaves D D′ and the driving-pulleys E E′. The direction of travel of each part of each loop of the cable is indicated by the arrows in Fig. 1. In the operation of a hoisting-gear thus arranged if the pulley E is driven faster than the pulley E′ the descending part of the cable leading downward from the sheave D will move faster than the ascending part of the cable leading from the pulley E′ to the said sheave D, and the latter will be drawn down, while at the same time the ascending part of the cable leading from the said pulley E to the sheave D′ will travel upwardly faster than the descending part of said cable leading from said sheave to the said pulley E′ moves downwardly, and said sheave D′ will rise at the same speed that the sheave D descends. Under these conditions the car will ascend and the counterweight descend. When the pulley E′ rotates faster than the pulley E, the action will be reversed and the car will descend and the counterweight ascend. Said mechanism is merely shown to make clear the application of my invention.

Next referring to the motor constituting my invention and shown as applied to operate an elevator-car, the same is made as follows: The driving-pulley E is attached rigidly to a shaft G, which, as herein shown, constitutes the armature-shaft of the electric motor, and the driving-pulley E′ is attached rigidly to a hollow sleeve or shaft G′, which surrounds the shaft G at the ends thereof and is connected rigidly between its ends with a casing G^8, which contains the field-magnets and cores and which surrounds the armature G^9, carried by the shaft G. The casing G^8 is made in two parts, being divided at g^a, which permits the parts of the casing to be separated and the parts of the motor contained within the casing to be removed therefrom. One end of the field-magnet shaft G′ is made integral with one part of the casing and the other end of said shaft is made integral with the other part thereof. The parts of the casing may be secured together by any convenient means. Within said casing and surrounding the armature are located the usual field-magnets G^{10} and field-magnet cores G^{11}. The armature G^9, with its connected shaft, and the field-magnets G^{10} and connecting-shaft rotate in opposite directions and when not doing work at equal speeds. The armature-shaft G has bearing in the tubular field-magnet shaft G′ at the ends of the motor, and said tubular shaft G′ is rotatively mounted in bearing-sleeves h h, which are attached to the upper end of standards H H. Said standards H are at their lower ends attached to or formed integral with a cast base-plate H′. G^{12} designates the commutator connected with the armature-shaft G. g^7 designates the usual armature-brushes, mounted on holders g^8, which latter are carried by the usual rocker g^b, mounted on an inwardly-extending annular flange connected with the field-magnet shaft G′. g^9 g^{10} designate collector-rings which surround and rotate with the field-magnet shaft laterally outside of the commutator. Said collector-rings are insulated from the field-magnet shaft and from each other, as clearly shown in Fig. 4 of the drawings, and are held laterally in place between an enlargement or shoulder g^{11} on the shaft and a ring or washer g^{12}, removably connected with the shaft G′ outside of said collector-rings and mounted on a reduced part of the shaft. g^{13} g^{14} designate collector-brushes carried by a holder g^{15}, which latter is attached to a vertical standard g^{16}, which is stationary with the bearing-sleeves h, in which said shaft rotates. The positive and negative wires g^{17} and g^{18} of the actuating-circuit are connected with said collector-brushes in the usual manner. The rocker-arms g^{19}, carrying the brush-holders, are connected by wires g^{20} g^{21} with the collector-rings g^9 g^{10}. The wire g^{20} leads through a lateral opening in the adjacent part of the field-magnet casing to the outer collector-ring g^{10}, while the wire g^{21} leads through a like opening to the inner collector-ring. Both of said wires are insulated from the field-magnet casing. Wires g^{22} g^{23} lead from the brush-holders to the field-magnets in the usual manner.

I I′ designate friction-disks which are connected rigidly with the shafts G and G′, respectively, and rotate therewith. The hollow shaft G′ terminates flush with the outer face of the bearing h adjacent to the armature, and the disk I is mounted on the inner shaft G outside of said bearing and tubular shaft. Said disk is held from rotation of the shaft by means of a key, as shown in Fig. 4, but fits thereon in such manner that it may be moved endwise on the shaft. The disk I′ is keyed to shaft G′ on the side of the motor opposite to the disk I and is longitudinally immovable thereon. The said disks I I′ are provided on their adjacent faces, near the margins thereof, with opposing annular concave friction-surfaces i i', which conform in cross-sectional shape to the segments of the circle the center of which is located midway between the disks. Between said disks are located a plurality of oscillatory disks J J′ J^2, herein shown as three in number. The said disks are pivotally supported in such manner that each of them may turn, swing, or oscillate about an axis transverse to its axis of rotation and passing through the center of a circle the circumference of which coincides with the opposing concave annular surfaces of the disk I I′, whereby when said disks are rotated about their axis they will retain constant peripheral contact with the disks I I′. When each of the oscillatory disks is in such position that its axis of rotation is located at right angles to the axes of the shaft G G′, it will bear against the concave surfaces of the disks I I′ at points equidistant from the inner and outer margins of the annular concave surfaces thereof, so that both of said friction-disks will be rotated at equal speeds. When, however, the said oscillatory disk is turned about its transverse axis, its point of contact with one of the friction-disks will be moved inwardly or toward its center, while its point of contact with the other friction-disk will be moved outwardly or away from the center. This will result in the speed of one of the friction-disks being diminished, while the speed of the other disk will be to an equal extent increased. Said oscillatory disks are arranged to be simultaneously rotated about their axes. Obviously one disk will serve the purpose of transmitting motion from one friction-disk to the other; but three disks are herein shown which are so disposed about the centers of the friction-disks as to equalize the pressure on said disks and to equalize the pressure on the shafts supporting them. The form of support herein shown as employed for said oscillatory disks consists of yoke-pieces K K′ K^2, which are provided at their ends with journals k k', which have bearing in journal-apertures formed in a circular frame L, which surrounds the motor and is connected at its lower end with the base-piece H′ and in said base-piece. As herein shown, said base-piece and circular frame L are cast integral with each other. One of the bearing studs of each yoke-piece is made separate therefrom and has screw-threaded engagement therewith to afford means for readily inserting the same in place. The said yoke-pieces K K′ K^2 are provided adjacent to the uppermost bearing-journals with segmental gears K^3, which mesh with each other and whereby turning one of said yokes causes a like movement of the other yokes. One of said journals *k k′*—the one connected with the horizontal yoke, Fig. 3—is extended through the frame L to provide means for turning or moving said yokes through actuating means located outside of said frame. As shown in said Fig. 3^a, said journal has attached to its outer end a cross-bar K^4, which cross-bar has attached at its opposite ends ropes or cables K^5 K^6, the other ends of which are adapted to be extended to the car and are located within reach of the car conductor, whereby the oscillatory disks may be by him moved to either stop the car, reverse its direction, or change its speed, as desired. It will be understood that in the position of the disks shown in Figs. 3 and 3^a the driving-pulleys E E′ will rotate at equal speeds, and by reason of the arrangement and construction of the connections between said driving-pulleys and the elevator said elevator will at this time be stationary.

The oscillatory disks J J′ J^2 are provided on their peripheries with yielding bands or tires made of rubber or the like, whereby the necessary frictional engagement may be had of the same with the friction-disks I I′. In order to provide for the proper frictional contact of said friction-disks with the oscillatory disks, the disk I, as before stated, is fitted on the shaft G, so as to be movable longitudinally of said shaft. The said disk I when the machine is assembled will not bear against the shoulder formed by the bearing *h* adjacent thereto; but a space will be left between the same, as shown in Fig. 4, so as to permit slight inward movement of the said disk under the action of a suitable spring to provide for wear in the margins of the oscillatory disks. As herein shown, said shaft G is provided at its outer end with an extension g', which is surrounded by a spiral spring g^2, which spring bears at its inner end against a washer g^3 in contact with the disk, which is slipped over said extension and bears at its other end against a nut g^4, which has screw-threaded engagement with the end of said extension. The pulley E′ is mounted on a reduced part of the tubular field-shaft G′, whereby a shoulder g^{23} is formed on the shaft which limits the inward movement of the pulley on the shaft. Outward movement of said pulley is limited by engagement of the pulley with the bearing between the same and the other driving-pulley E. The pressure of said spring g^2 against the disk I acts to move the same into proper bearing-contact with the oscillatory disks, and the disk I′ is prevented from moving away from the disk I by reason of the fact that the spring acts through the armature-shaft and the driving-pulleys E E′, the latter of which is rigid with the field-shaft to hold said pulley I′, which is rigid with the field-shaft in bearing engagement with the oscillatory pulleys. The inner end of the hub of the driving-pulley E′ will desirably be separated by a space from the adjacent bearing-sleeve *h*, so as to prevent friction between the rotating parts and the lateral faces of the bearing and to also provide in connection with the space between the disk I and the other bearing-sleeve *h* ample room for adjusting the friction-disk to the oscillatory disks.

Desirably antifriction-bearings will be located between the pulleys E E′ on the shaft G to reduce to a minimum the friction between said oppositely-moving pulleys. As herein shown, said antifriction-bearings are made as follows: g^5 designates a hard-metal ring which is pressed into an annular groove in the inner face of the hub of the wheel E, and g^6 designates a similar ring which is pressed into a like groove formed in the adjacent face of the hub of the pulley E′. The inner face of said bearing-rings are made conical or inclined, the same being closer together near shaft than at the peripheries thereof, and between said inclined faces of the bearing-rings are interposed a plurality of conical rollers G^6. Said rollers are held in place by being inserted within suitably-shaped recesses or sockets in a caging-ring G^7, which is slipped over the shaft between said bearing members.

The operation of my invention in connection with the hoisting mechanism is as follows: As before stated, when the driving-pulleys E E′ are moved at equal speeds the traveling pulleys D D′ will remain stationary, so that both the car and the counterweight will be at a standstill. If, however, one of the driving-pulleys be moved faster than the other, it will cause movement of one of the traveling sheaves and the parts connected therewith. In order to move one of said driving-pulleys faster than the other, the several disks J J′ J^2 will be oscillated on axes transverse to their axes of rotation, so as to move the peripheries thereof inwardly and outwardly on the concave surfaces of the disks I I′, which will cause the speed of one of said disks and the driving-pulley connected therewith to be retarded to the same extent that the speed of the other disk and driving-pulley is increased, it being understood that the sum of the speeds of said driving-pulleys remain constant, notwithstanding the variation in speed of each driving-pulley.

Referring now more particularly to Fig. 1, it will be assumed that the driving-pulleys E E′ are driven at the same rate of speed, and the elevator-car and counterweight are therefore stationary. If, however, the pulley E, which is connected with the armature-shaft, be driven at a greater speed than the pulley E′, it will be seen that the cable F will be paid out from the pulley E toward the sheave D′ more rapidly than it will be taken up by the driving-pulley E′ and also that said cable will be paid out from the opposite side of the pulley E′ less rapidly than it is taken up by the receiving side of the pulley E. The pulleys D D′ are free to rotate as rapidly as conditions may require and are also free to travel upwardly and downwardly. The result will be that the sheave D′ will be moved upwardly by reason of the upward pull given thereto to the counterweight to take up the slack in the cable on the paying-out side of the pulley E, and said pulley E will by reason of the friction between the cable and the pulley take in the cable on the receiving side thereof more rapidly than it is paid out on the discharging side of the pulley E′, which will cause the sheave D to be moved downwardly and the car to be moved upwardly at a speed proportionate to the difference between the speed of the parts of the cable on the opposite sides of the traveling pulley D. The car will therefore move upwardly at a uniform speed so long as the relative speeds of the driving-pulleys are maintained and the counterweight moved downwardly in the usual manner.

The speed of the car may be varied by moving the peripheries of the oscillatory disks toward or from the centers of the friction-disks; but the motion of the car will not be entirely arrested until the said oscillatory disks are again moved into such position that they have peripheral contact with the concave surfaces of said friction-disks at points equidistant from the margins thereof.

When the direction of movement of the car is to be reversed, the oscillatory pulleys will be oscillated to bring those parts of the peripheries thereof which were before between the intermediate positions of the oscillatory disks and the center of the disk outside of said intermediate position of the oscillatory disks and between the same and the outer margins of said concave surfaces.

The change of position of the oscillatory disks results in giving to the driving-pulley E′ a peripheral speed greater than that of the pulley E. When this occurs, the cable F will be paid out from the delivery side of the pulley E′ more rapidly than it is received by the pulley E and will also be received upon the pulley E′ more rapidly than it is paid out from the pulley E. The result of this arrangement is that a slack occurs in the cable on the receiving side of the traveling sheave D, and by reason of the fact that the said pulley is movable and the weight of the elevator tends at all times to move the same upwardly such slack will be taken up by the upward movement of said sheave and the downward movement of the elevator-car. Further, the fact that the cable is received more rapidly upon the pulley E′ than it is paid out from the pulley E the traveling sheave D′ will be moved upwardly, thereby carrying the counterweight upwardly in a direction the reverse of that to the elevator-car and to a like distance. In this direction, also, the speed of the car will be correlative to the difference between the speeds of the driving-pulleys E E′, and the car will be brought to a stop by restoring the oscillatory disks to their intermediate positions.

The motor above described may be employed for driving other forms of frictional hoisting mechanism—such, for instance, as that shown in Fig. 8 of my pending application for United States Letters Patent Serial No. 739,068, filed December 4, 1899, of which this application is a division. In said construction the cables are so arranged that the driving-pulleys rotate in the same direction and in applying my invention to said hoisting mechanism it would be necessary to interpose between one of the pulleys and the shaft which drives it means for changing the direction of the pulley—as, for instance, a gear-wheel or crossed belt.

I claim as my invention—

1. The combination with a rotative armature and rotative field-magnet of two wheels or pulleys through the medium of which power is transmitted from the motor to the part or parts to be driven, one of said wheels or pulleys being driven by the field-magnet and the other by the armature and a change-speed mechanism between the rotative armature and field-magnet which is connected with said rotative parts in such manner that when the speed of one of said parts is retarded the speed of the other is correspondingly increased, and vice versa, and the available power of the motor remains constant.

2. The combination of a motor comprising a rotative armature and rotative field which turn in opposite directions, shafts connected with and driven by said armature and field, friction-disks connected respectively with said armature and field shafts which rotate about a common axis, an oscillatory disk which has opposite peripheral contact with the opposing surfaces of said friction-disks and oscillates on an axis transverse to its axis of rotation, and means giving oscillatory motion to said oscillatory disk and means for adjusting said friction-disk with respect to the oscillatory disk.

3. The combination of a motor comprising a rotative armature and rotative field, which turn in opposite directions, shafts connected

with and driven by said armature and field, disks attached to said shafts which rotate about a common axis, an oscillatory disk which has opposite peripheral contact with the opposing faces of the disks, a frame carrying said oscillatory disk which oscillates on an axis transverse to the axis of rotation of the disk, means for giving said frame and disk oscillatory movement about its transverse axis, a shaft attached to said frame, a cross-piece on said shaft, and actuating-cables connected with the opposite ends of said cross-piece.

4. A differential rope hoisting mechanism for elevators comprising an electric motor embracing a rotative armature and a rotative field-magnet, change-speed mechanism between the armature and field-magnet which is connected with said rotative parts in such manner, that when the speed of one of said parts is retarded, the speed of the other is correspondingly increased and vice versa and the available power of the motor remains constant, two driving-pulleys one connected with the armature and the other with the field-magnet, two traveling sheaves, and endless cable trained about said sheaves and driving-pulleys.

5. The combination of a motor having armature and field capable of opposite rotation, a driving-pulley associated with the armature, a driving-pulley associated with the field, and a mechanical change-speed device coacting with said pulleys and operating to maintain different speed ratios of said pulleys while retaining constant the available power of the motor.

6. The combination of a motor having armature and field capable of opposite rotation, a driving-pulley associated with the armature, a driving-pulley associated with the field, and a mechanical change-speed device coacting with the armature and field for maintaining different speed ratios of said armature and field, and constructed to retain constant the available power of the motor.

7. The combination of a motor having armature and field capable of opposite rotation, shafts connected with and driven by said armature and field, respectively, friction-disks connected respectively with the armature and field shafts, one on each side of the motor, and a disk extending between and having opposite frictional contact with opposing surfaces on the friction-disks and oscillating on an axis transverse to its axis of rotation.

8. The combination of a motor comprising a rotative armature and rotative field which turn in opposite directions, shafts connected with and driven by said armature and field, one of which is tubular and surrounds the other, friction-disks connected severally with said shafts, one on each side of the motor, and an oscillatory disk extending between and having opposite peripheral contact with the opposing faces of said friction-disks and oscillating about an axis transverse to its action of rotation.

9. The combination of a motor comprising a rotative armature and rotative field which turn in opposite directions, shafts connected with and driven by said armature and field, friction-disks connected respectively with said shafts and rotating therewith, one on each side of the motor, a plurality of oscillatory disks having opposite peripheral engagement with the opposing faces of the friction-disks, and rotating on axes transverse to their axes of oscillation, said oscillatory disks surrounding said field and armature.

10. The combination of a motor comprising a rotative armature and rotative field which turn in opposite directions, shafts connected with and driven by said armature and field, friction-disks connected with said shafts respectively, one located on each side of the motor, a plurality of disks which have opposite frictional contact with the opposing faces of the friction-disks, a frame for each of said latter disks, each capable of oscillating about an axis transverse to the axis of rotation of its associated disk, and gears connecting said frames whereby they may be oscillated simultaneously to oscillate the disks carried thereby in a manner to move the contacting faces of said disks toward the center of one friction-disk and toward the periphery of the other friction-disk and vice versa.

In testimony that I claim the foregoing as my invention I affix my signature, in presence of two witnesses, this 18th day of January, A. D. 1900.

THADDEUS W. HEERMANS.

Witnesses:
C. W. Hills,
William L. Hall.