(No Model.) 2 Sheets—Sheet 1.

C. BROWN & G. J. MELMS.

ELECTRIC LOCOMOTIVE.

No. 474,984. Patented May 17, 1892.

Fig 1.

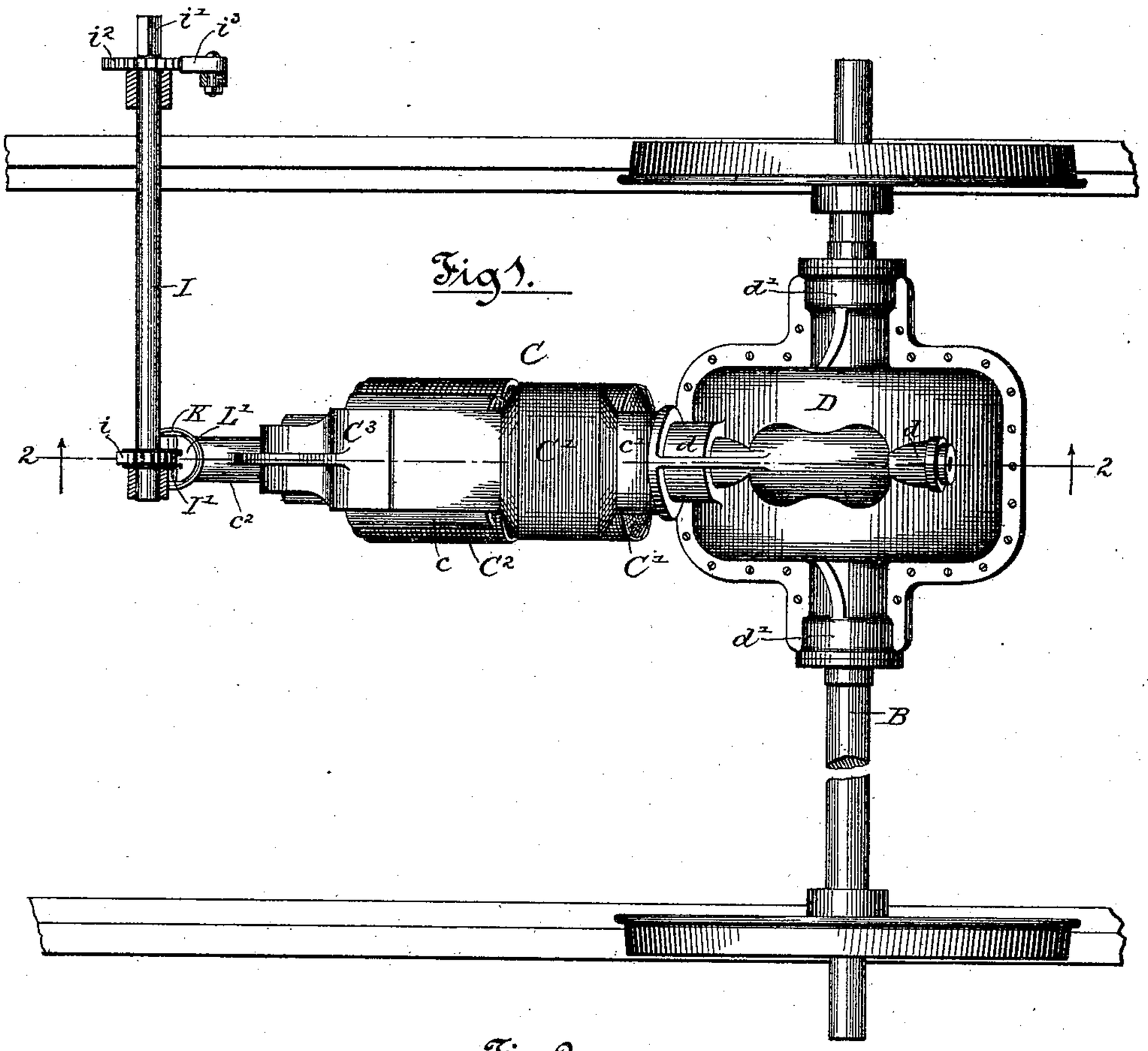
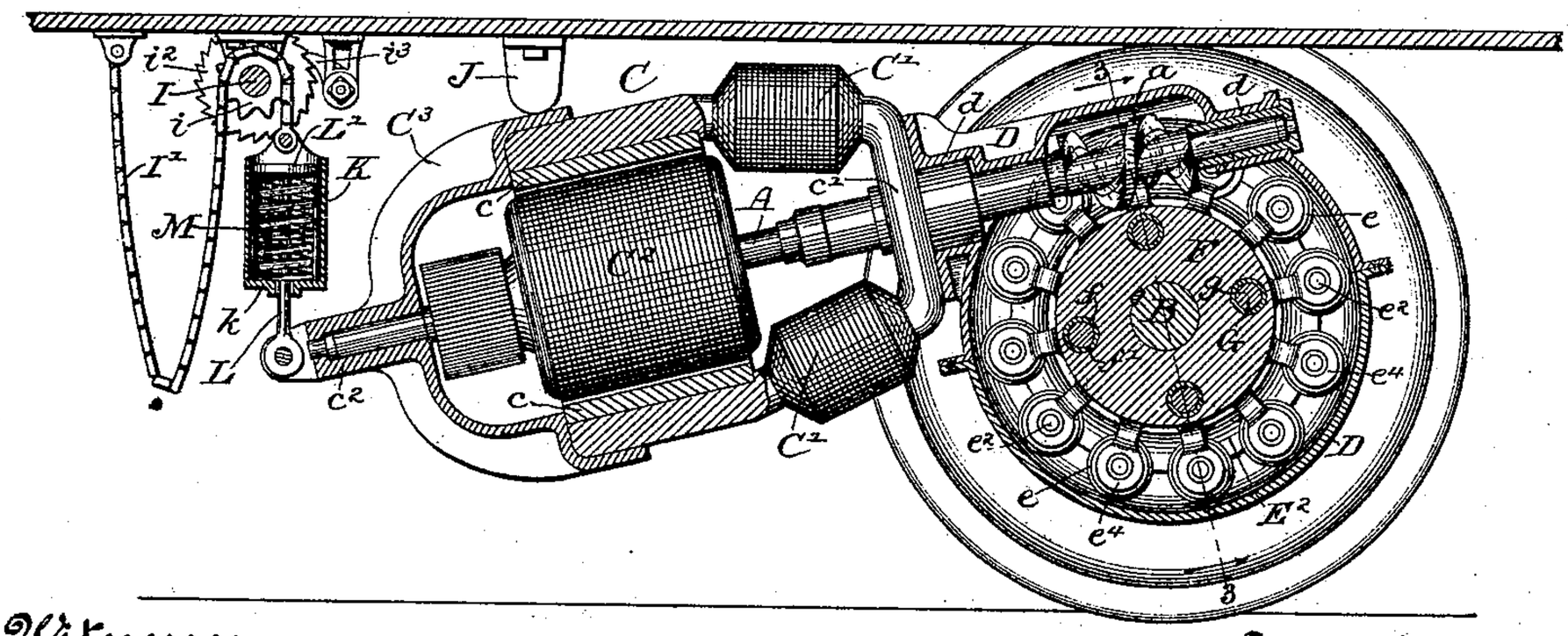


Fig 2.



Witnesses

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

(No Model.) 2 Sheets—Sheet 2.

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Fig 3.

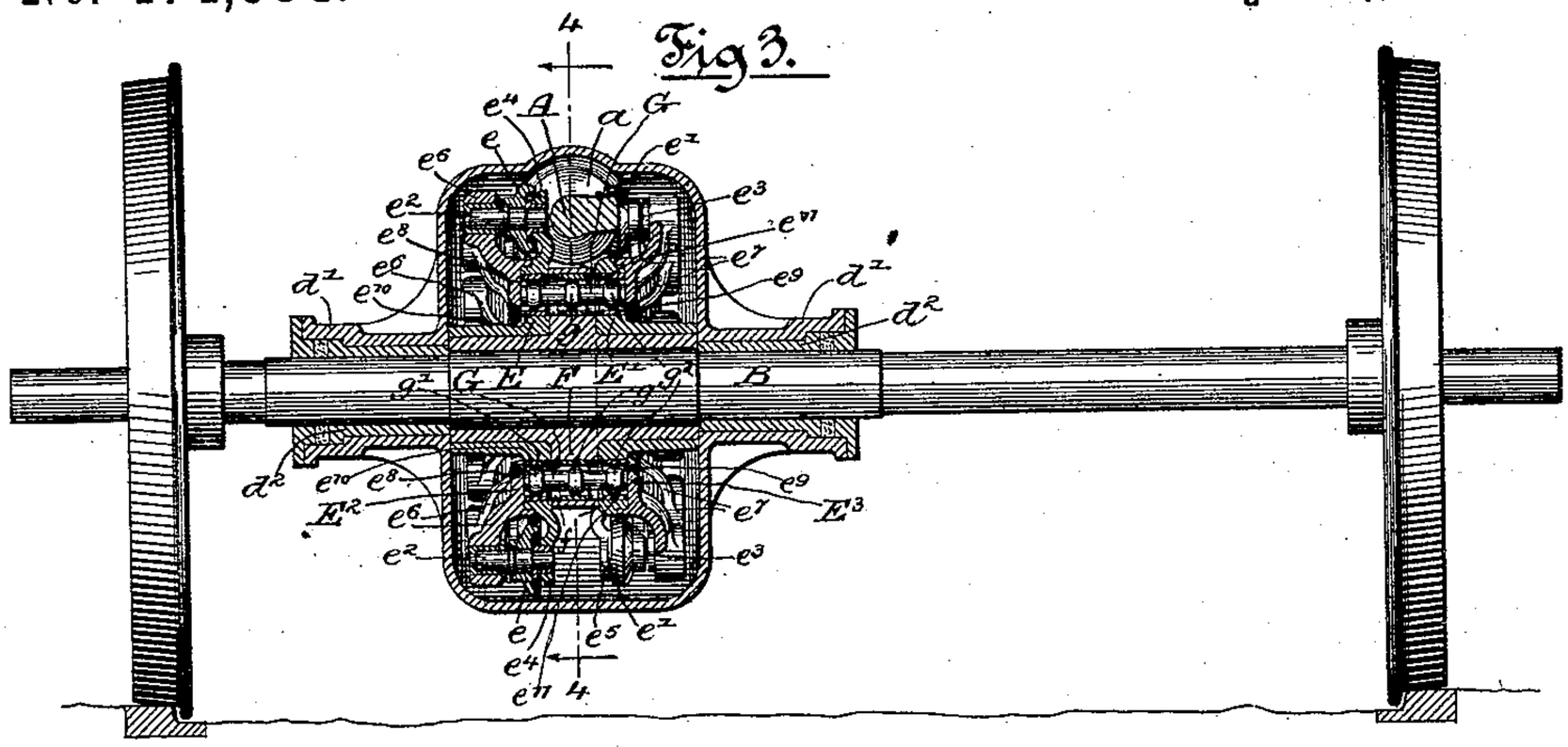


Fig 5.

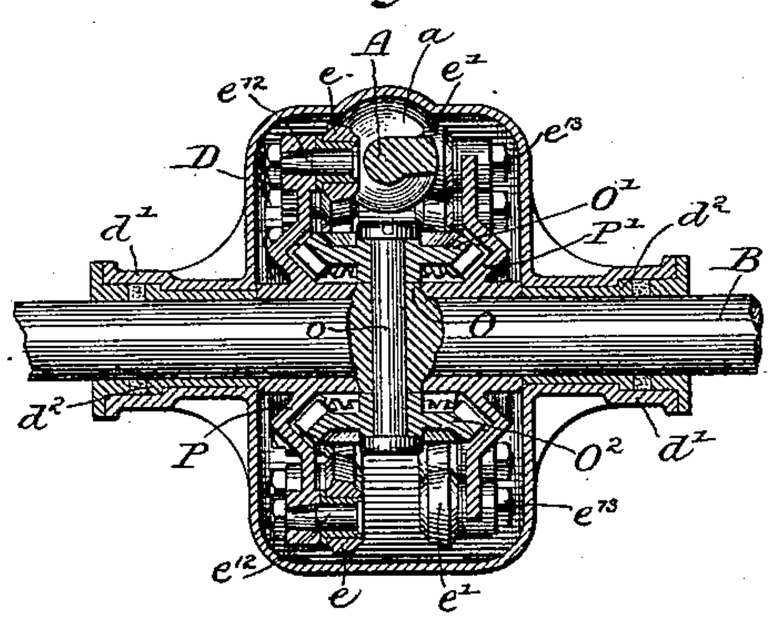


Fig 4.

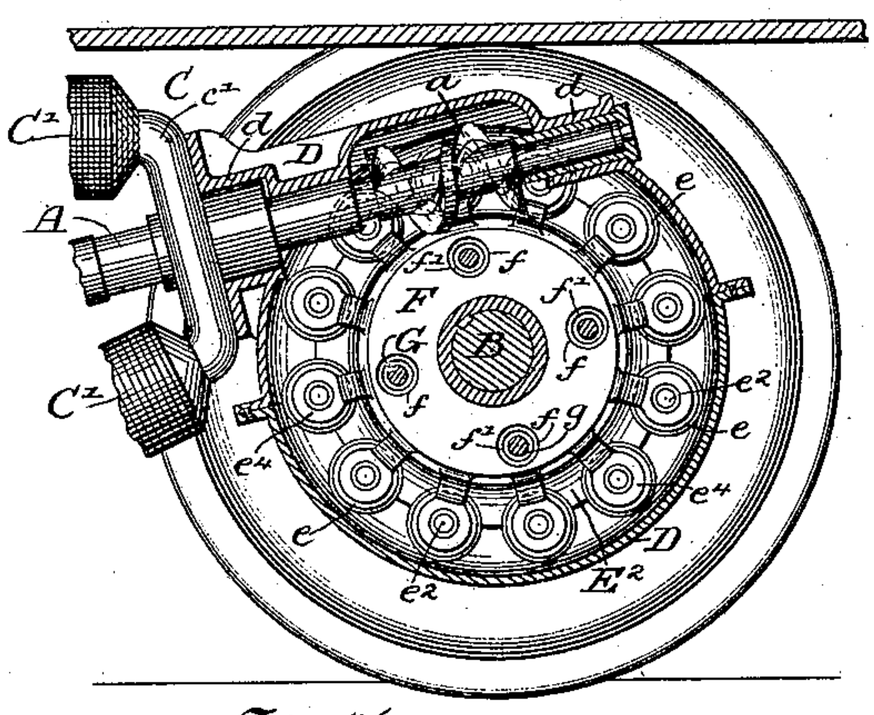


Fig 6.

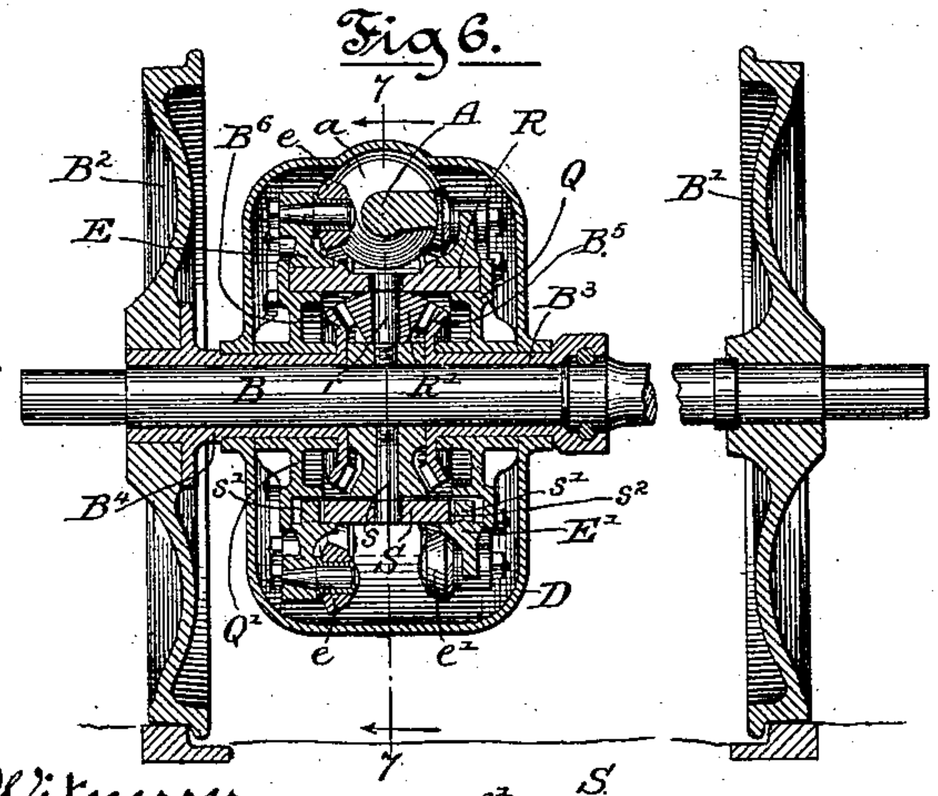


Fig 7.

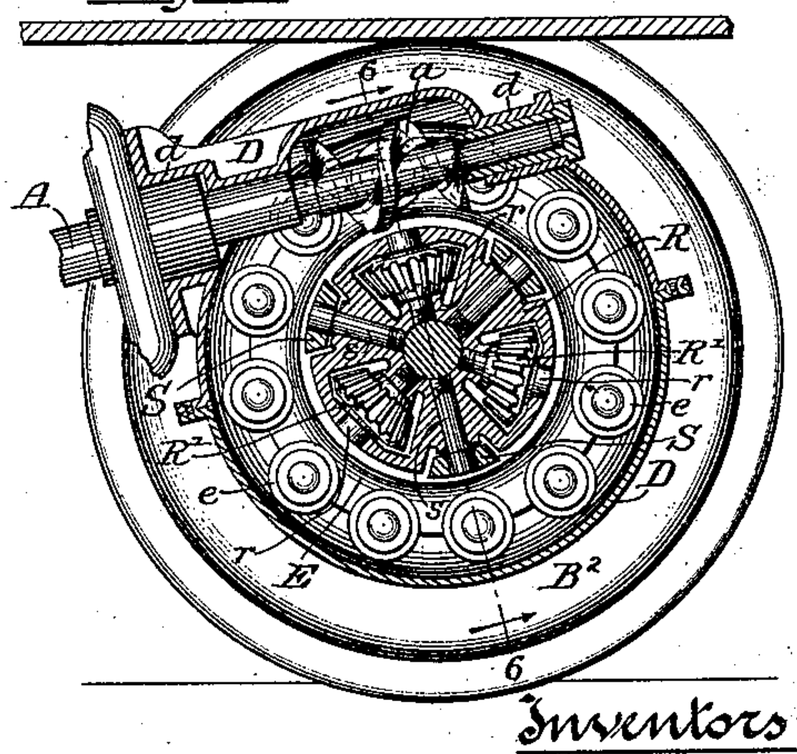
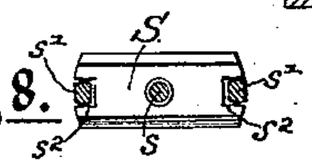


Fig 8.



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UNITED STATES PATENT OFFICE.

CHARLES BROWN, OF NAPLES, ITALY, AND GUSTAV JACOB MELMS, OF CHICAGO, ILLINOIS.

ELECTRIC LOCOMOTIVE.

SPECIFICATION forming part of Letters Patent No. 474,984, dated May 17, 1892.

Application filed March 7, 1890. Serial No. 343,016. (No model.)

To all whom it may concern:

Be it known that we, CHARLES BROWN, a resident of Naples, Italy, and GUSTAV JACOB MELMS, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Electric Car-Motors; and we 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 an improved power-transmitting device in the nature of a worm-gear which is more especially intended for use in transmitting motion from a rapidly-revolving electric-motor shaft to the axle of a railway-car or vehicle driven by such motor.

The invention consists in the matters hereinafter described, and pointed out in the appended claims.

In the accompanying drawings, illustrating our invention, Figure 1 is a plan view of a motor, a car-axle, and wheels thereon, the gearing connecting the said parts being concealed by the housing or casing which surrounds said gearing. Fig. 2 is a longitudinal vertical section taken upon line 2 2 of Fig. 1. Fig. 3 is a sectional view of the worm-gearing taken upon line 3 3 of Fig. 2, showing the car axle and wheels in side elevation. Fig. 4 is a sectional view similar to Fig. 2, taken through the worm-gear on the line 4 4 of Fig. 3. Fig. 5 is a section similar to Fig. 3, showing a modified construction in some of the parts. Fig. 6 is a section similar to Fig. 3, showing still another modification of the apparatus, the section being taken upon line 6 6 of Fig. 7. Fig. 7 is a section taken upon line 7 7 of Fig. 6. Fig. 8 is a detail sectional view taken upon line 8 8 of Fig. 6.

As illustrated in said drawings, A is the main shaft of an electric motor, and B a car-axle to be driven or turned therefrom. In the application of the invention to other purposes the said shaft A will represent the driving or power-transmitting shaft, and B a shaft which is to be driven by or from the shaft A.

In the particular construction herein shown C indicates as a whole an electric motor, of which *c c* are the field-magnets, C′ C′ the field-magnet coils, and C^2 the armature, secured upon the shaft A in the usual manner. The field-magnets *c c* are connected by a yoke-piece *c′*, which is attached to a casting D, provided with bearings *d d*, which support the shaft A at either side of the worm *a*. The outer ends of the field-magnets are connected by a yoke-piece C^3 of non-magnetic material and which is provided with a bearing c^2 for the outer end of the said shaft A. The motor and shaft A are held in a definite position with relation to the axle B by means of the casting D, which is supported on pivots concentric with the axle, so as to allow the motor and shaft to be swung about the said axle for the purpose of shifting the motor into position convenient of access for inspection and repairs, the said casting D for this purpose being herein shown as pivotally supported by engagement with the axle, as more particularly hereinafter described.

E E′ are two disks mounted to turn freely upon the car-axle B, with their outer edges or margins arranged at some distance apart, the shaft A being arranged midway between the outer margins of the said disks E E′ in the manner illustrated. Said disks carry at their outer edges a series of anti-friction rollers *e e e e′ e′ e′*, which are mounted upon bearing-pins e^2 e^2 e^2 e^3 e^3 e^3, mounted upon the said disks E E′, respectively, with their axes parallel with that of the axle B. The said anti-friction rollers are adapted to enter between and engage the screw-threads of the worm *a*, so that said rollers take the place of the spurs or projections employed to engage the worm in a worm-gearing as commonly constructed. In other words, the disks E E′ and anti-friction rollers *e e′* thereon take the place of or perform the same function as the spur-wheel of a worm-gear in transmitting power from the worm to the shaft, which is driven by the same. In order that the said rollers shall run in contact with the worm freely and without friction, said rollers are preferably made conical and bear upon out-

wardly-tapering or wedge-shaped surfaces of the screw-thread of the worm *a* in the manner illustrated. In order to sustain the said bearing-pins e^2 e^2 e^3 e^3 rigidly and strongly upon the disks, said pins are mounted at both ends in bearings upon the disks and the rollers are mounted upon or attached to the pins between said bearings. As herein shown, the bearings for the inner ends of the pins are formed in arms e^4 e^4 e^5 e^5, cast upon the disks E E′, while the outer ends of the pins have bearings in brackets e^6 e^6 e^7 e^7, bolted to said disks. By the employment of two disks E E′ and a double series of anti-friction rollers engaging opposite sides of the worm the strain and wear upon both sets of anti-friction rollers is decreased, while unequal strain on the driving-shaft is prevented.

In the use of a double series of anti-friction rollers, if the disks supporting said rollers were rigidly attached to the shaft or were rigidly connected with each other, great difficulty would be experienced in adjusting the rollers of both disks to bear equally on the worm, and in fact it would be a practical impossibility to maintain the said rollers in equal and uniform bearing against the worm even if it were possible to so adjust them. In order, therefore, to insure an equality of strain on the two sets of anti-friction rollers, we mount the disks E E′ upon the axle, so that they will turn freely thereon and connect them with the axle by means of a device, allowing said disks to shift or oscillate independently of each other on the shaft, so that an equilibrium of pressure is maintained between the disks, while at the same time the shaft is caused to turn with the disks. One simple and convenient means of so connecting the disks with the shaft is herein shown in Figs. 1 to 4, the same consisting, essentially, in one or more levers arranged lengthwise of the shaft, pivoted at a point midway of their ends to the shaft, and engaged at their opposite ends with the said disks, so that the strain or pull of the disks acts upon the ends of said levers and is transmitted to the shaft by the pivotal connection of the levers with the same, the levers thus acting in the same manner as the doubletree of a wagon to give an equal strain on the two sets of rollers and the disks, notwithstanding any slight relative backward or forward movement of the same under the action of the worm on the two sets of anti-friction rollers.

As shown in said Figs. 1 to 4, the devices for the purposes above described are made as follows: F is a metal ring or flange located upon the axle B between the disks E E′ and rigidly attached to the axle. Said ring is provided with a plurality of holes or openings *f*, Fig. 4, preferably provided with bushings *f′*. The disks E E′ are provided, respectively, with a series of holes e^8 e^9, arranged opposite the holes *f* in the ring F, and also preferably provided with bushings e^{10} e^{11}. G G G are a series of straight bars or levers inserted through the holes *f* of the ring F and through the holes e^8 e^9 of the disks E E′. For convenience of constructing, the said levers G G are made of cylindric form and are provided with enlargements *g g′* g^2, having the form of spherical segments and fitting closely within the holes *f* e^8 e^9. Said spherical enlargements *g g* constitute in effect pivotal connections between the levers G and the ring F, allowing the said levers to swing or oscillate to a limited extent with relation to the said ring. The similar spherical enlargements *g′* g^2 allow the outer ends of the levers G to turn or swing in the disks E E′ when the levers assume an angular position, while at the same time the cylindric form of the said holes e^8 e^9 allows the said ends of the levers to slide in the disks to the slight extent made necessary by the oscillatory movement or turning of the levers. The said levers G, when made in the form of cylindric rods in the manner described, are conveniently held in place by means of rings E^2 E^3, upon which the brackets e^6 e^7 are cast, and which are secured to the outer faces of the disks E E′ over the holes e^8 e^9.

In the operation of the parts described it is entirely obvious that the disks E E′ are connected with the axle B, so as to transmit rotary motion to the same solely through the medium of the levers G G, said disks acting with a lateral pressure on the outer ends of the levers, and the latter acting at their central parts upon the ring F in transmitting rotary motion to the axle. The said levers G stand normally or naturally parallel with the wheel-axle; but by reason of slight variation in the sizes or forms of the parts the disks E E′ will shift slightly with reference to each other as the worm passes from one roller to another in the revolution of the disks, and as the disks are so moved or shifted the levers will assume an angular position, so as to preserve an equality of strain or pressure upon the disks.

The casting D is herein shown as constructed to not only sustain the shaft A and motor-frame in proper position relatively to the axle B, but to afford a casing or housing surrounding the several parts of the worm-gear, so as to protect the same from dust and dirt. Said casing or housing is provided with sleeves *d′ d′*, which surround the axle B, and within which are formed bearings d^2 d^2 for said axle. The said casing or housing D is extended over and incloses the worm *a* on said shaft in the manner illustrated. The yoke-piece *c′* of the motor C being attached directly to the casting D, the said casting constitutes in effect a part of the frame of the motor and the main support of the same.

For convenience in construction the housing D is divided centrally into two parts, which are secured together by bolts or rivets passing through flanges at the meeting edges of the parts in the manner illustrated. Said

housing will preferably contain a quantity of oil or other lubricant, through which the edges of the disk and the rollers thereon pass in the operation of the device, thereby effecting a thorough distribution of the lubricant throughout all of the bearing-surfaces of the operative parts.

Inasmuch as the housing D is supported solely by the axle, and is adapted to turn freely about the same, it is obviously necessary to attach the motor-frame to an adjacent stationary part—such, for instance, as the car frame or truck—in order that the motor-frame shall be held stationary when the parts are in operation; but it is desirable to so construct the parts that the motor may be swung downwardly away from the bottom of the car or truck into a space between the track-rails provided for the purpose, so that the motor may be inspected or repaired, and for this purpose we employ devices for supporting or holding in place that end of the motor-frame remote from the device as follows: I is a transverse shaft mounted upon the car or truck frame and provided with a sprocket-wheel *i*, arranged at a point over the outer end of the motor-frame. Said shaft I is provided with a squared end *i'* for the application of a hand-crank, and with a ratchet-wheel i^2, which is engaged by a pawl i^3 to hold the shaft from turning backward.

I' is a chain belt engaged with the sprocket-wheel *i* and connected with the yoke C^3 of the motor-frame. The end of said chain opposite to that connected with the frame is conveniently secured to the car frame or truck in the manner illustrated. The motor is raised or lowered at will by turning the shaft I, said motor when in condition for operation being sustained in its elevated position and held in this position by the pawl i^3, which holds the shaft I from turning. When it is desired to lower the motor, said shaft I is released and allowed to turn backwardly, when the motor may descend until all the slack has been taken out of the chain I'. During the operation of the motor the motor-frame will obviously tend to swing or turn about the axle with a pressure due to the power required to turn the axle, and said pressure is exerted in the direction of a downward pull on the connection between the motor-frame and the car body or truck or by an upward pressure of the said frame against a part or stop, as J, placed upon the frame to take such upward pressure. Commonly the motor will be arranged to act or pull downwardly when the car is being propelled forward, and in order to prevent shock or jar on the parts at the time of starting the motor and to prevent transmission of vibratory motion from the motor to the car we have provided an elastic or yielding connection between the motor-frame and the car frame or truck, such elastic or yielding connection being herein shown as inserted between the chain I' and the end of the motor-frame with which said chain is connected. The yielding connection in the form thereof herein illustrated consists of a cylinder K, provided with a centrally-apertured bottom *k* and a rod L, passing through the bottom of the cylinder and provided with a head or piston L', between which and the bottom *k* of the cylinder is placed a spiral spring M. The cylinder K is connected with the chain I', while the rod L is pivoted to the frame-yoke C^3 of the motor. In a construction of this kind the motor-frame is held from swinging or turning during the operation of the motor by means of the spring M, which will be held compressed to some extent during the operation of the motor and will allow the same to swing or yield bodily in case it is suddenly started or in case the car is suddenly stopped, thereby avoiding liability of breakage by sudden and violent strains at such times.

While we have herein described the driving-shaft of the worm-gear and the motor for actuating the same as being sustained on a frame or housing, which is supported by the engagement of said frame with a car-axle, it is entirely obvious that the same features of construction may be employed with advantage otherwise than in a car-motor, in which case the said frame will be similarly connected with the driven shaft or will be mounted concentrically therewith, and said frame will be connected with some adjacent stationary part or support instead of with a car truck or body, it being entirely obvious that the shifting or moving of a motor from its usual working position may be desirable elsewhere than in a car-motor—as, for instance, the motor may when in operation stand in a place inconvenient of access, but by pivotally supporting the motor-frame concentrically with the driven axle in the manner described it may be easily shifted into a desired position for inspection or repair.

In Fig. 5 of the accompanying drawings we have shown another construction, which may be employed to maintain an equilibrium of pressure on the two roller-carrying disks E E'. In this instance the axle B is provided with an annular collar or enlargement O, and through it is inserted a bearing-pin *o*, upon the ends of which are mounted gear-pinions O' O^2. Upon the inner or adjacent spaces of each of the disks is formed a circular rack or series of gear-teeth P P', intermeshing with the pinions O' O^2. In a construction of this kind power for turning the axle B is transmitted to the same through the medium of said gear-pinions O' O^2, which afford an equal strain or pressure on each of the disks, notwithstanding variations in the relative position of the disks, in the same manner as hereinbefore described, in connection with the mechanism illustrated in Figs. 1 to 4. As shown in said Fig. 5, the rollers *e e e' e'*, instead of being supported upon bearing-pins, as before de-

scribed, are mounted upon studs e^{12} e^{13}, secured in the disks E E'.

In Figs. 6 and 7 I have shown still another construction in worm-gears of the character described, in which provision is made for driving by a single worm-gear two separate shafts—such, for instance, as the two parts of a divided car-axle—in such manner that the shafts will turn together where both shafts turn at the same speed when both are acting under the same conditions; but one may turn faster and the other slower in case one shaft is free to turn faster than the other. In the case of a divided car-axle, where one part of the axle is attached to one wheel and the other part to the other wheel, as shown in Figs. 6 and 7, an arrangement of the driving-gear of the character described allows one wheel to turn faster than the other in turning curves—a feature of great and obvious advantage. As illustrated in said Figs. 6 and 7, the axle B is secured to one wheel B' and has surrounding and rigidly attached to it a sleeve B^3, while the other wheel B^2 is attached to a sleeve B^4, which surrounds and turns on the axle. On the adjacent ends of said sleeves B^3 B^4 are located bevel gear-wheels B^5 B^6. Upon said sleeves B^3 B^4 are mounted two rings Q Q', adapted to turn on the said sleeves, said rings being bolted to the outer margins of an annular hub or casting R, which fits about the shaft B. The outer cylindric surface of the hub R forms bearings for the disks E E', which are adapted to shift or turn thereon in the same manner as hereinbefore described. The hub R is provided with radial bearing-pins *r r r*, upon which are mounted beveled gears R' R' R', which intermesh with the gear-wheels B^5 B^6 on the sleeves B^3 B^4. The said disks E E' are connected with the hub R by means of levers S S S, which are pivoted on pivot-pins *s s s* in the hub R and are engaged at their ends with the said disks E E' conveniently by means of lugs *s' s' s'* on the disks entering notches s^2 s^2 s^2 in the ends of said levers. The levers S S S serve to connect the disks E E' with the hub R, so that said parts will revolve together in the same manner that the levers G G (shown in Figs. 1 to 4) connect the disks E E' with the ring F. Motion is transmitted from the hub R to the sleeves B^3 B^4 by the bevel-gears R' R' R', which permit either of the said sleeves and the wheel attached thereto to turn slower or faster than the other sleeve and wheel, any retardation of one wheel, as in passing around a curve, producing a more rapid movement of the other wheel, owing to the fact that said bevel-gears are in mesh with the gear-wheels B^3 B^4 of both sleeves. In the construction shown in said Figs. 6 and 7, therefore, not only is the strain on the disks and disk-rollers equalized, but the strain on the two wheel-axle sections or other similar acting shafts is similarly equalized.

The devices above described for maintaining the said disks E E' in equilibrium as concerns the pressure upon said disks or the strain to which the same are subjected under the action of the worm are only two of the many devices which may be employed for this purpose, and inasmuch as a worm-gear of the character described, having two roller-carrying disks, which disks are connected by devices maintaining an equilibrium of pressure between them, may be constructed in a great variety of different ways, our invention as it relates to this feature is not restricted to the particular devices illustrated for maintaining such equilibrium of pressure between the disks. The particular construction illustrated in Figs. 1 to 4 is, however, in itself a simple and advantageous one, and the same being new is herein claimed as part of our invention.

Although we have herein shown and described an electric motor as a means of actuating the driving-shaft of the gear, it is entirely obvious that as far as improvements in the gear itself are concerned said shaft may be driven or actuated in any well-known or preferred manner, and as far as the improvements which relate to the means of supporting the driving-shaft and motor are concerned any other kind of motor may be used.

We claim as our invention—

1. A worm-gearing comprising a worm, a driven shaft provided with two disks, each having a plurality of anti-friction rollers engaging the worm, said disks being adapted to turn or oscillate upon the shaft, and means connecting the disks with the shaft, affording an equilibrium of strain upon the disks, substantially as described.

2. The combination, with the driven shaft and worm thereon, of a shaft or axle provided with a flange or ring, two disks mounted loosely upon the axle at either side of said disk or ring, said disks being provided each with a plurality of anti-friction rollers engaging the said worm, and one or more bars or levers engaging the said ring or flange of the shaft and the said disks, substantially as described.

3. The combination, with a driven and a driving shaft, of a suitable driving connection between said shafts, a motor actuating the driving-shaft, a frame supporting the motor and affording bearings for the driving-shaft, said frame being supported at the end adjacent to the driven shaft by means of bearings adapted to engage said driven shaft, the other end of said frame being supported by means of a connection with the car-body or other adjacent part, adapted to permit angular movement of said motor-frame, and means for securing said frame in any desired angular position relative to said shaft within determined limits, substantially as described.

4. The combination, with a car frame and axle, of a driving-shaft, a worm-gear connect-

ing the driving-shaft with the axle, a motor actuating the driving-shaft, a frame supporting the motor and affording bearings for the driving-shaft, said frame being supported on bearings concentric with said axle, and a connection between the motor-frame and a car-body, comprising a shaft provided with a sprocket-wheel, and a chain connected with the said frame and engaging the sprocket-wheel, substantially as described.

In testimony that we claim the foregoing as our invention we affix our signatures in presence of two witnesses.

CHARLES BROWN.
GUSTAV JACOB MELMS.

Witnesses to signature of Charles Brown:
EDWARD CAMPHAUSEN,
NESTOR CALVANO.

Witnesses to signature of Gustav Jacob Melms:
C. CLARENCE POOLE,
HARRY COBB KENNEDY.