(No Model.) 4 Sheets—Sheet 1.

J. J. HOOKER.

CAR STARTER AND BRAKE.

No. 411,594. Patented Sept. 24, 1889.

FIG. 1.

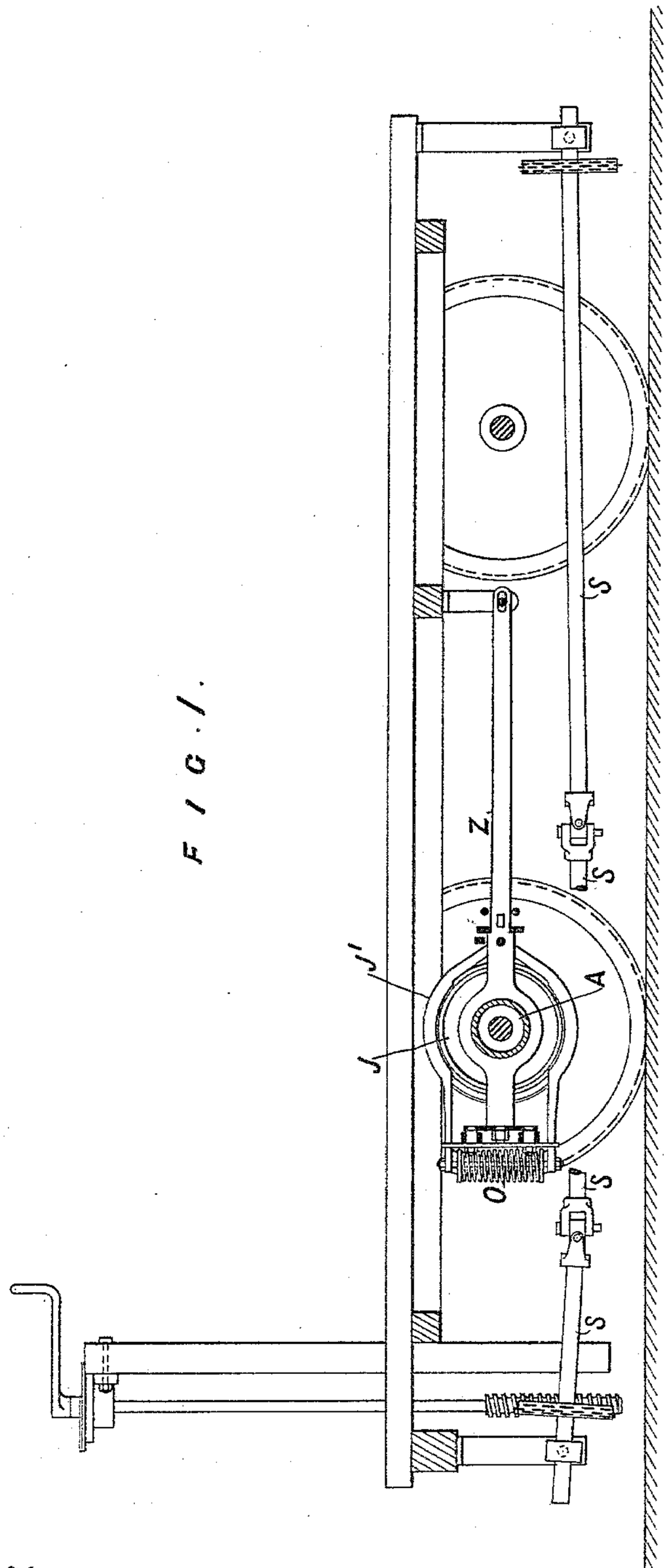

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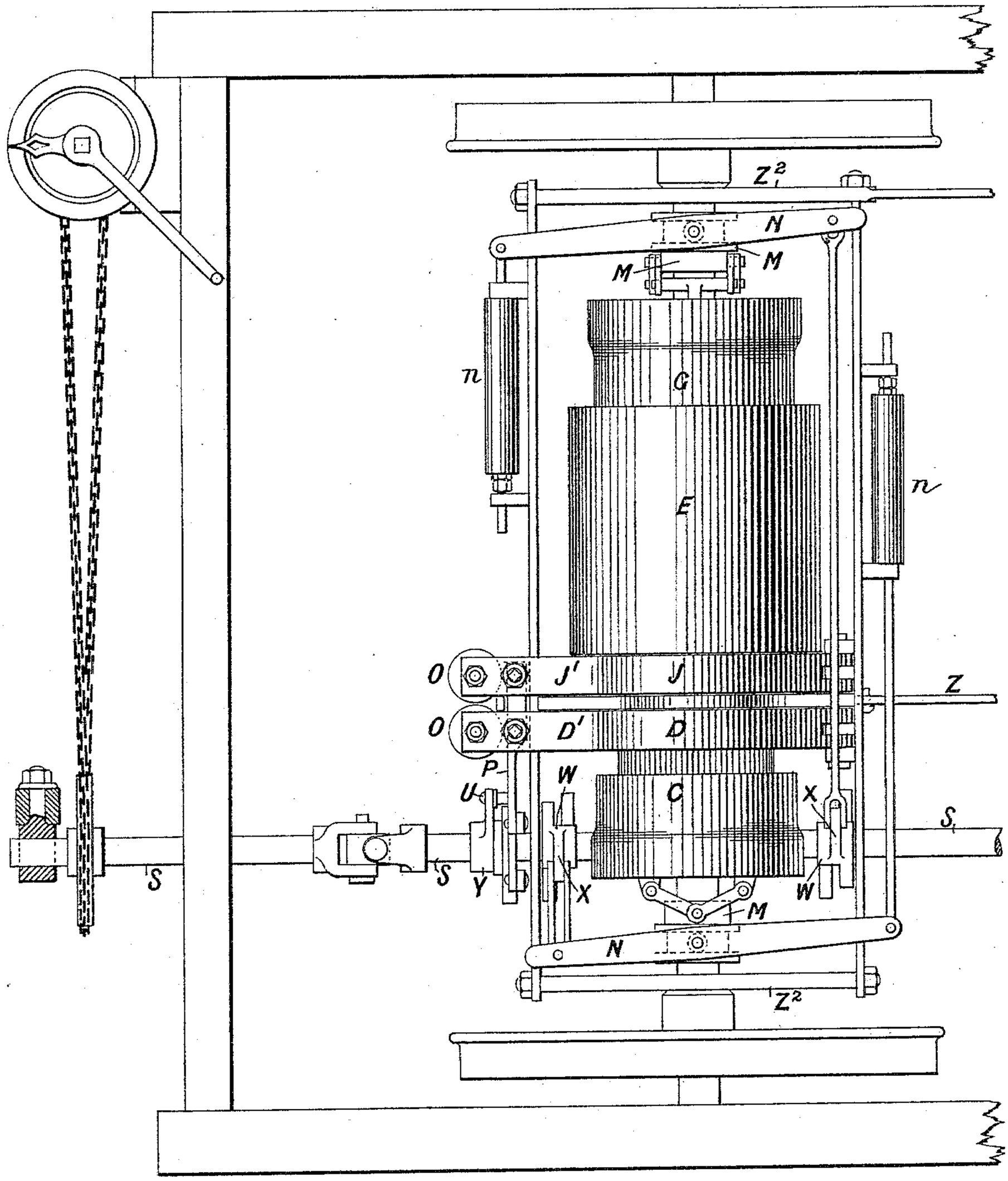
FIG. 2.



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4 Sheets—Sheet 3.

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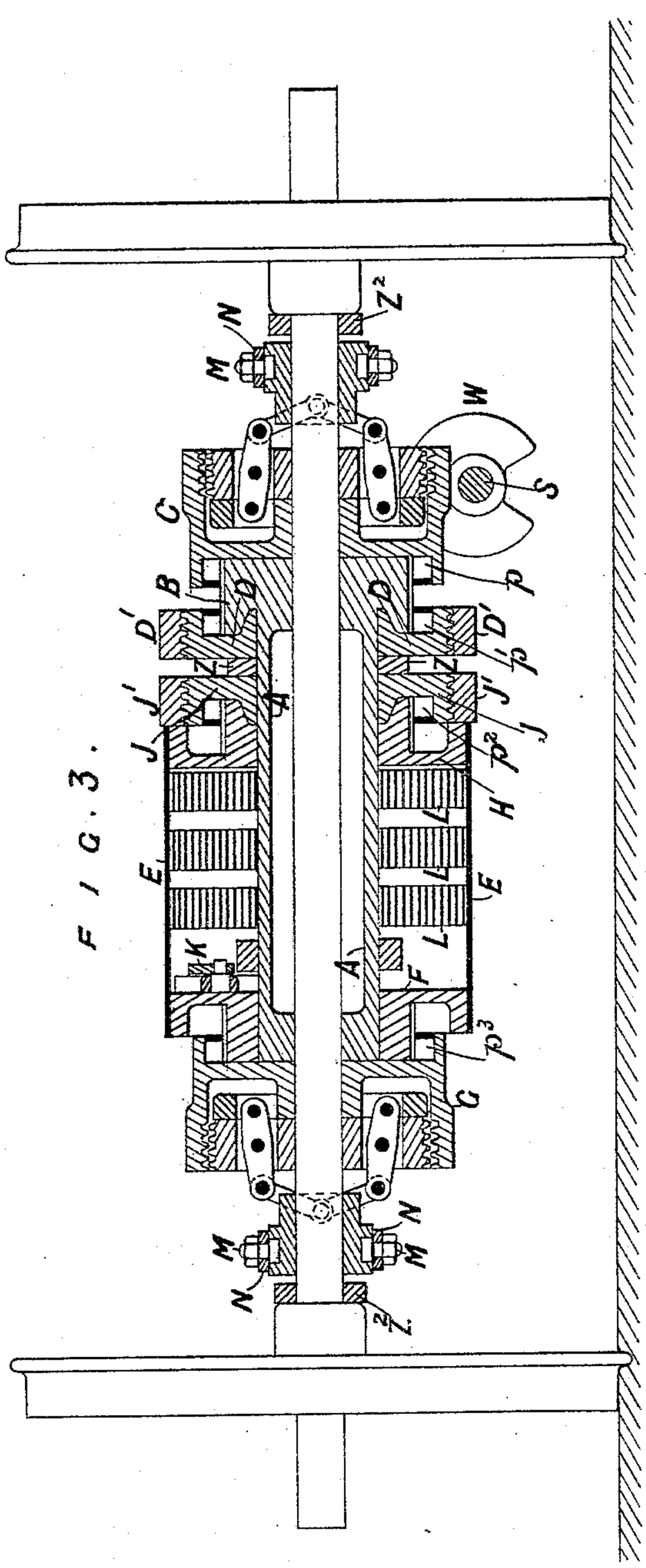

FIG. 3.

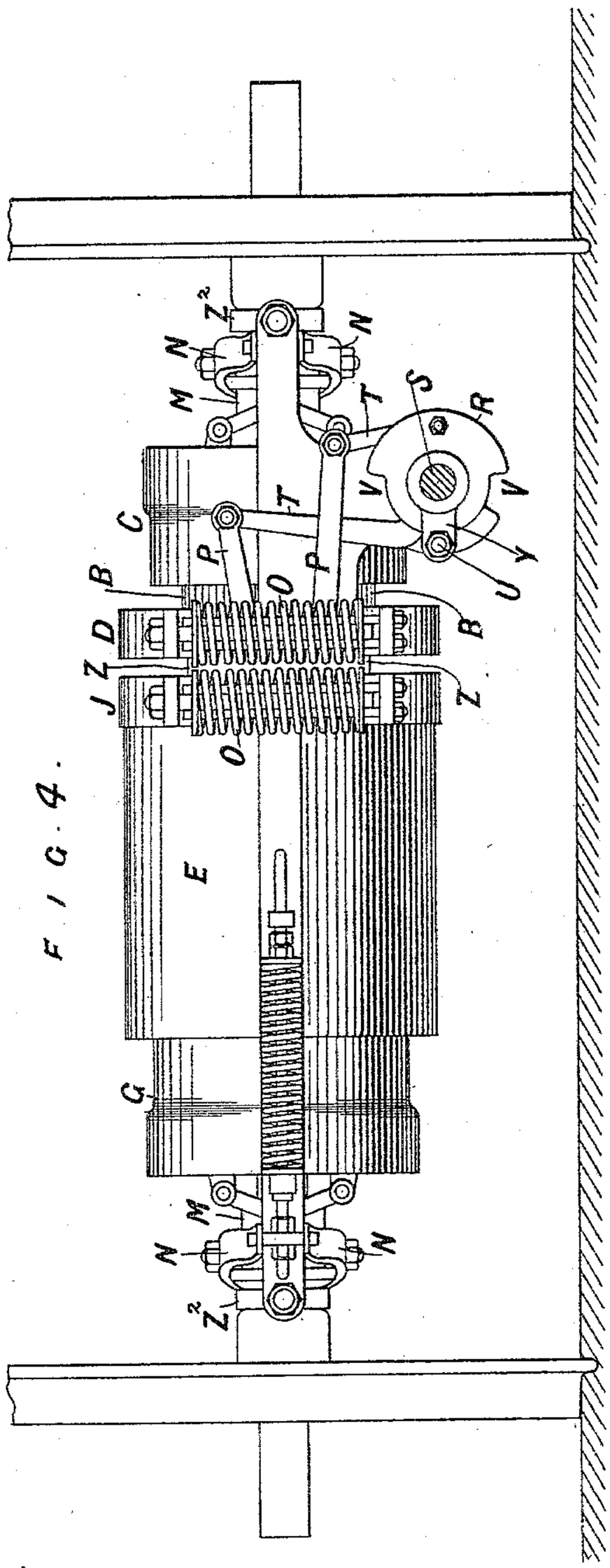

FIG. 4.

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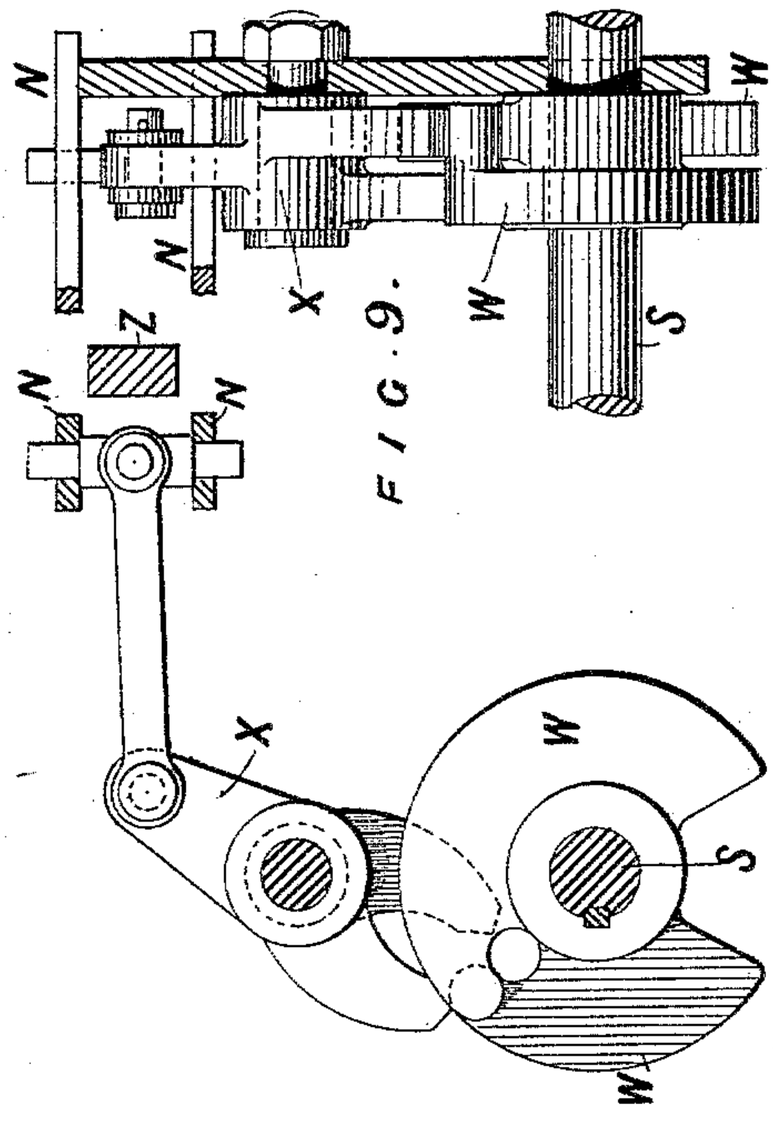

FIG. 7.

FIG. 9.

FIG. 5.

FIG. 6.

FIG. 8.

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UNITED STATES PATENT OFFICE.

JOHN JOSEPH HOOKER, OF TIDESWELL, STOCKPORT, COUNTY OF DERBY, ENGLAND.

CAR STARTER AND BRAKE.

SPECIFICATION forming part of Letters Patent No. 411,594, dated September 24, 1889.

Application filed July 13, 1889. Serial No. 317,452. (No model.) Patented in France April 7, 1888, No. 189,829; in Belgium April 14, 1888, No. 81,381; in Italy June 30, 1888, XXII, 23,257, XLVI, 76; in Germany December 9, 1888, No. 47,983, and in Austria-Hungary March 5, 1889, No. 44,210 and No. 5,184.

To all whom it may concern:

Be it known that I, JOHN JOSEPH HOOKER, clerk in holy orders, of Tideswell, Stockport, in the county of Derby, England, have invented new and useful Improvements in Power-Storing Apparatus for Stopping and Starting Tram-Cars, (for which I have obtained Letters Patent in Italy by patent of addition to principal patent, dated June 30, 1888, Vols. XXII and XLVI, Nos. 23,257 and 76; in Belgium by patent of addition to principal patent, dated April 14, 1888, No. 81,381; in France by patent of addition to principal patent, dated April 7, 1888, No. 189,829; in Austria-Hungary, dated March 5, 1889, Nos. 44,210 and 5,184, and in Germany, dated December 9, 1888, No. 47,983,) of which the following is a full, clear, and exact descripton.

My invention relates to power-storing brake apparatus, whereby the energy of motion of a tram-car which is usually expended in friction in the operation of stopping the car may be utilized for restarting the vehicle.

The invention has for its principal object to provide simple and efficient apparatus which is reversible or double-acting—that is to say, which will store power in stopping the car, (whichever end of the latter be running foremost,) and which may be caused to apply the power so stored for the purpose of restarting the car either forward or backward without regard to the direction in which the car may have been running when the power was stored up.

Reference is to be had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a longitudinal section, and Fig. a plan, of the under framing of a car with my improved power-storing brake applied. Fig. 3 is a section of the spring-barrel and its appurtenances in the plane of the wheel-axle to which it is applied. Fig. 4 is an elevation of the same. Figs. 5, 6, 7, 8, and 9 are part sections showing details of certain parts on a larger scale.

The same letters of reference indicate like parts in all the figures.

This improved apparatus comprises a spring-barrel E, carried upon a sleeve A, mounted loose upon the wheel-axle, the springs L being coiled about and attached at one end to the sleeve A and at the other end to the barrel E, a stop K, similar or equivalent to a "Geneva" stop, being provided in the barrel to limit the relative motion of the barrel and sleeve, and so prevent excessive winding or unwinding of the springs. It further comprises friction-clutches C G, respectively adapted to gear, the one the sleeve A and the other the barrel E, with the said axle for the purpose of storing or applying the power, as the case may be. It also comprises a pair of strap-brakes D D′ J J′, by which rotation of the sleeve A or the barrel E is prevented or permitted at required times, the connections of the sleeve and of the barrel with their respective clutches and brakes being made through oppositely-acting sets of pawl-and-ratchet gear p^3 F, p^2 H, and p' B p B, and the arrangement being such that both brakes cannot be released at the same time, the one always remaining applied to act as an abutment or point of resistance for the springs when the other is released, and neither brake can be released until after the corresponding clutch has geared the part (barrel or sleeve, as the case may be) of which the brake is to be released with the axle.

The brakes and clutches are operated by the same shaft S indifferently from either end of the car, and the motion of the handing-levers is similar at both ends of the car, the clutch to be geared and the corresponding brake to be released being operated by a single motion of the said shaft.

I will now describe these parts more in detail.

The sleeve A has a ratchet-boss B keyed on it at one end, with which gear two sets of pawls p p', mounted the one set within the rim of the sleeve clutch-drum C and the other set within the rim of the sleeve brake-wheel D, which is mounted loose upon the sleeve. Fast on the one end of the barrel E is a ratchet-boss H, with which gears a set of pawls p^2,

mounted within the rim of the barrel brake-wheel J, which, like D, is loose on the sleeve. Fast on the other end of the barrel is another ratchet-boss F, with which engages a set of pawls p^3, mounted within the rim of the barrel clutch-drum G. The ratchet-bosses F and H, connecting the barrel with its clutch and brake, have their teeth inclined in the same direction and may be considered as one, although situated at opposite ends of the barrel, while the boss B, connecting the sleeve with its clutch and brake, has its teeth inclined in the opposite direction to F and H. The clutch-drums C and G are loose on the shaft; but the bosses in which are fitted the radially-sliding dogs forming the inner members of the clutch are fast on the axle.

It will be seen from the foregoing that when the springs are wound up they tend to rotate the sleeve and barrel in opposite directions, and that either may be connected to the axle while the other is held stationary, so that the springs may be wound up whichever way the car may be running, and the car can be propelled in either direction by the force of the springs, (whichever way it may have previously been running,) as it is impossible to let the springs unwind except by first connecting the barrel or the sleeve (according to the direction in which it is desired to travel) with the axle, while the part not so connected is held fast by its brake.

The wrought-iron brake-straps D′ J′ are made in halves, hinged together, and are pressed on their corresponding brake-wheels D J by means of springs O, which are overcome, when the one or other brake is to be released, through the agency of levers P P, connected by links T with crank-pins on a disk R, the same levers releasing the one or other set of brakes, according to the direction in which they are oscillated. The action of these levers is illustrated in Figs. 5 and 6, by which it will be seen that both sets of brakes cannot be released at one time.

The shaft S, which I term the "reversing-shaft," extends longitudinally beneath the car, and is provided with universal joints at points in its length between the power-storing gear and the ends of the car to permit of the vertical play due to the action of the carrier-springs of the car. The crank-disk R is loose on the shaft S, which I term the "reversing-shaft," and remains stationary while the shaft makes a partial revolution for the purpose of first actuating the one or other set of clutch-gear, as hereinafter described, an arm Y, keyed on the shaft, acting as a carrier to move the disk R around with the shaft after the latter has rotated sufficiently to operate the clutch-gear. The drawings represent this part of the apparatus in what may be termed the "mid-gear position," the shaft S being free to make a quarter-revolution in either direction before the stud U on arm Y strikes against a shoulder V of the crank-disk R, and consequently before either brake is released.

The levers N, by which the sliding clutch collars M are actuated for throwing the clutches into gear, have their fulcra connected to springs n, whereby after the one or other clutch has been thrown into gear further motion of the parts will be permitted to enable the reversing-shaft S to act upon the crank-disk R and operate the brake-gear, as above described. The said fulcrum-springs n thus insure a certain but limited amount of pressure for the clutches, so preventing overstraining of the parts while insuring a sufficiency of pressure for the required purpose and taking up lost motion due to wear.

Each clutch-lever is operated from a cam W, keyed on the reversing-shaft S, said cam being adapted to throw the lever into the required position, and also to hold it in that position whichever way it may have been moved. For this purpose it is preferred that the cam should be in the form of two segments of a disk lying in different planes, as clearly shown in Figs. 7, 8, and 9, the adjacent ends of the two segments overlapping, as shown in Figs. 7 and 8, and together acting as a single-toothed pinion upon the forked member of a rock-lever X, connected at its other extremity to the brake-lever N, the limbs of the fork being in planes corresponding to the respective cam-segments, so that one or other will be struck by the corresponding segment, (according to the direction of rotation of the cam,) and so that after the lever has been so moved the limb struck will bear against the circumference of the segment, and be thereby locked in its new position. In the drawings the cam is shown in the position proper to mid-gear, and it will be seen that it could be revolved to the left without affecting the lever X, except to hold it in its present position; but if the cam is revolved to the right it will catch one of the limbs of the lever X and throw it over to the position proper to put the corresponding clutch into gear. Having done this, the cam can still turn a further portion of a revolution and lock the lever in its new position. While the cam W is moving idle through this further portion of a revolution the arm Y, which had previously turned idle, is carrying round the crank-disk R, so as to liberate the one or other brake.

Each clutch is operated by its own cam-gear, the two sets being similar and keyed on the same reversing-shaft S, but in different positions, so as to perform their functions each exactly at the proper moment with regard to the corresponding brake-gear.

To prevent the brake-gear revolving bodily with the axle, the brake-straps are attached to a frame held by a lever Z, encircling the sleeve A between the brake-disks and attached to the opposite sides of the frame, said lever extending longitudinally beneath the car, its end being anchored to the car-frame at a considerable distance from the power-storing apparatus, so as not to inter-

fere with the vertical play of the axle in the axle-boxes. The frame to which this lever is attached is supported by its cross-head Z^2 on the axle, and it serves to support the shaft S and the gear by which the clutches and brakes are operated, the fulcrum-springs *n* of the brake-levers being attached to this frame. One of the cross-heads Z^2 is extended and anchored to the body of the car similarly to lever Z, to steady the apparatus. The reversing-shaft S is worked by a hand-lever on a vertical shaft at the driver's platform through chain or other reducing-gear, the reversing-shaft being geared down in the ratio of about four to one. A dial-plate and index is provided to show the position of the mechanism, the index being geared down to correspond to the shaft S. The dial has words or signs on it to indicate the position of the gear to the driver and show him in which direction the handle must be moved to obtain the desired result.

When not in use, the axle revolves freely without acting on or being acted on by the power-storing apparatus, both clutches being out of gear and both brakes applied. This is the position represented in the drawings. To store power, the one or other clutch is thrown into gear by a partial revolution of the reversing-shaft, and the barrel or the sleeve (according as the car is running in the one or other direction) is thus geared with the axle, while the other brake holds the part (sleeve or barrel) not so geared with the axle stationary while the springs are being wound and to act as an abutment therefor. Suppose, for example, the car to be running to the right in Figs. 1 and 2 and the shaft S to be in mid-gear, as shown. The power-storing apparatus would be disconnected from the axle, because both clutches C G are out of gear. To wind up the springs, the shaft S makes a quarter-revolution, (to the right in Fig. 7,) thereby throwing lever X over to the left and drawing inward the lever N and collar M of the clutch C, thereby causing the toggle-gear of said clutch to expand the radial clutch-dogs, and so gear the axle with the clutch C, which drives the ratchet-wheel B fast on the sleeve A, with which the axle is therefore geared. Meanwhile the barrel E is prevented from revolving by its brake and ratchet-gear H. After the winding-up is accomplished the reversing-shaft S should be returned to its mid-position, and the springs will be kept wound up by the ratchet-gear and brakes until the stored power is required, whether for starting or for backing the car. This can be done equally well whether the car be stopped or whether it be desired to keep it running, as when advantage is taken of a descending gradient to coil the springs (by installments, for instance) without stopping the car. The gear would, however, generally be kept in position to wind up the springs until the car stops, the apparatus acting as a brake after the springs are fully coiled.

To apply the stored power, the appropriate clutch is put in gear and the corresponding brake is released by a further motion of the reversing-shaft in the direction in which it was moved to operate that clutch, the other brake remaining applied and acting as an abutment for the springs. Thus to start the car to the right in Fig. 1 the shaft S is revolved to the left in Fig. 7 to first throw the barrel-clutch G into gear and then liberate the barrel-brake J. The barrel being now free and coupled to the axle through the clutch G, the axle turns with it and the car is propelled, the sleeve being meanwhile held stationary by the brake D. To perform the same functions in the opposite direction, the same description applies if the driver or observer be supposed to be looking in the direction in which the car is traveling when coiling the springs, the indications on the dials being varied to suit the fact that when running in one direction the sleeve is the "leader" and the barrel the "follower," and when running in the opposite direction the barrel is the leader and the sleeve the follower.

The apparatus, although described and shown as applied upon one of the wheel-axles, may with advantage be mounted on a separate shaft hung in bearings beneath the car-frame midway between the two axles, the said shaft being geared with one or both the wheel-axles by a pitch-chain.

Having now particularly described and ascertained the nature of the said invention and in what manner the same is to be performed, I declare that what I claim is—

1. In a power-storing brake for facilitating the starting of tram-cars, the combination, with a drum, springs, and sleeve connected and arranged as described, and mounted loose on the wheel-axle or on a shaft geared therewith, of brakes independently controlling the rotation of the barrel and of the sleeve, respectively, and of friction-clutches adapted to connect the wheel axle or shaft with the barrel or with the sleeve, respectively, and of oppositely-acting sets of pawl-and-ratchet gear, respectively connecting the barrel and the sleeve with the corresponding brakes and clutches, the whole arranged for storing or giving out power indifferently by the drum or the sleeve, as may be required, substantially as specified.

2. In the apparatus herein specified, the combination, with the independently-acting spring-pressed brake-straps respectively controlling the rotation of the barrel and sleeve, of the lever and crank-gear, substantially as described, by which the brake-straps are separately operated, as specified.

3. In the apparatus herein specified, the combination, with the spring-pressed brake-straps, and with gear by which they are independently released, of the cam-gear, substantially as herein described, whereby the clutches are respectively operated, the con-

nection between the clutch and brake operating gears being such that the one or other of the former must necessarily be caused to gear the barrel or sleeve with the wheel axle or shaft before the corresponding brake can be relieved, as specified.

4. In the apparatus herein specified, the combination, with the clutches and clutch-levers and clutch operating and locking cam-gear, of spring or yielding fulcra for the clutch-levers, whereby the pressure of the clutches is limited and overstraining is prevented.

5. In the apparatus herein specified, the combination, with the one longitudinal shaft, of the two sets of clutch operating and locking cam-gear, the brake-operating crank-disk and lever-connections, and the carrier and abutments on the crank-disk, whereby independent motion of the said shaft and the clutch-operating gear is permitted within certain limits, as and for the purposes described.

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