No. 750,261. PATENTED JAN. 26, 1904.

W. H. COOLEY.

BRAKE FOR VEHICLES.

APPLICATION FILED DEC. 9, 1902.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1.

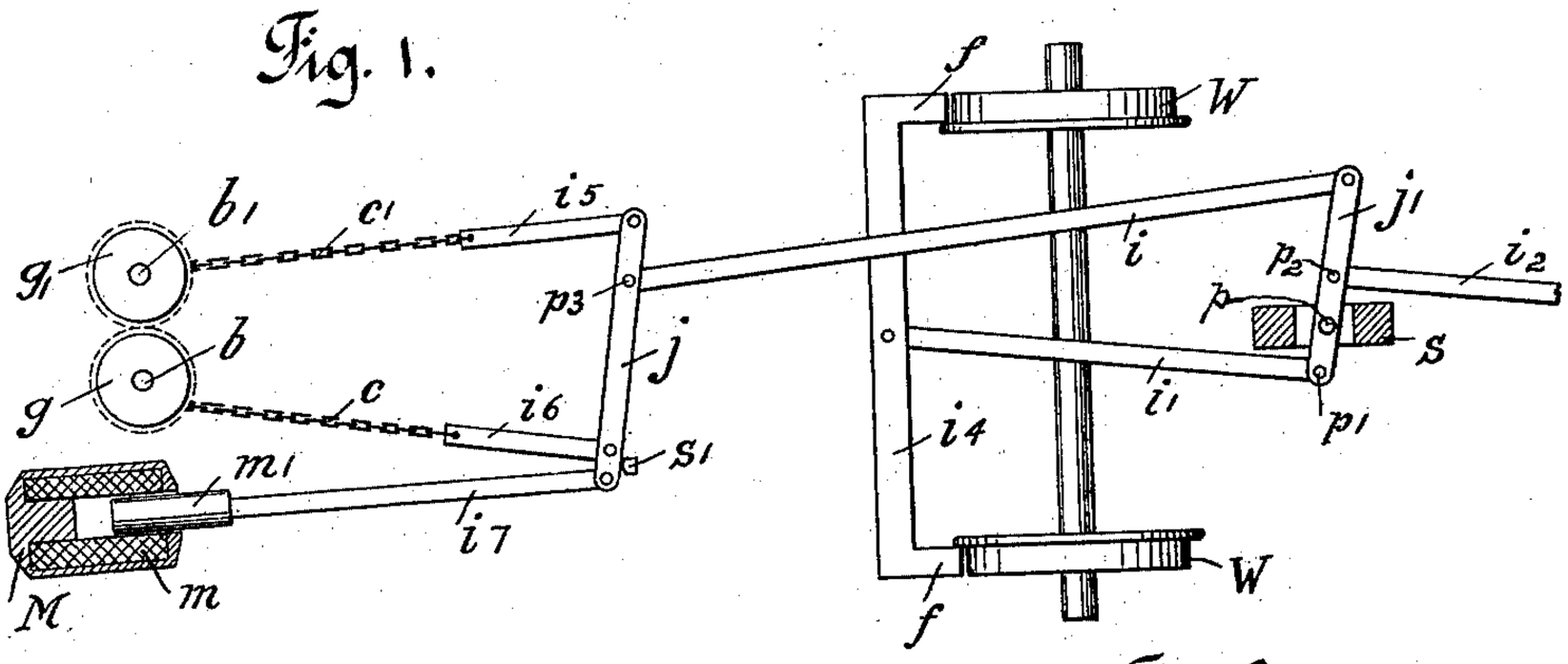


Fig. 2

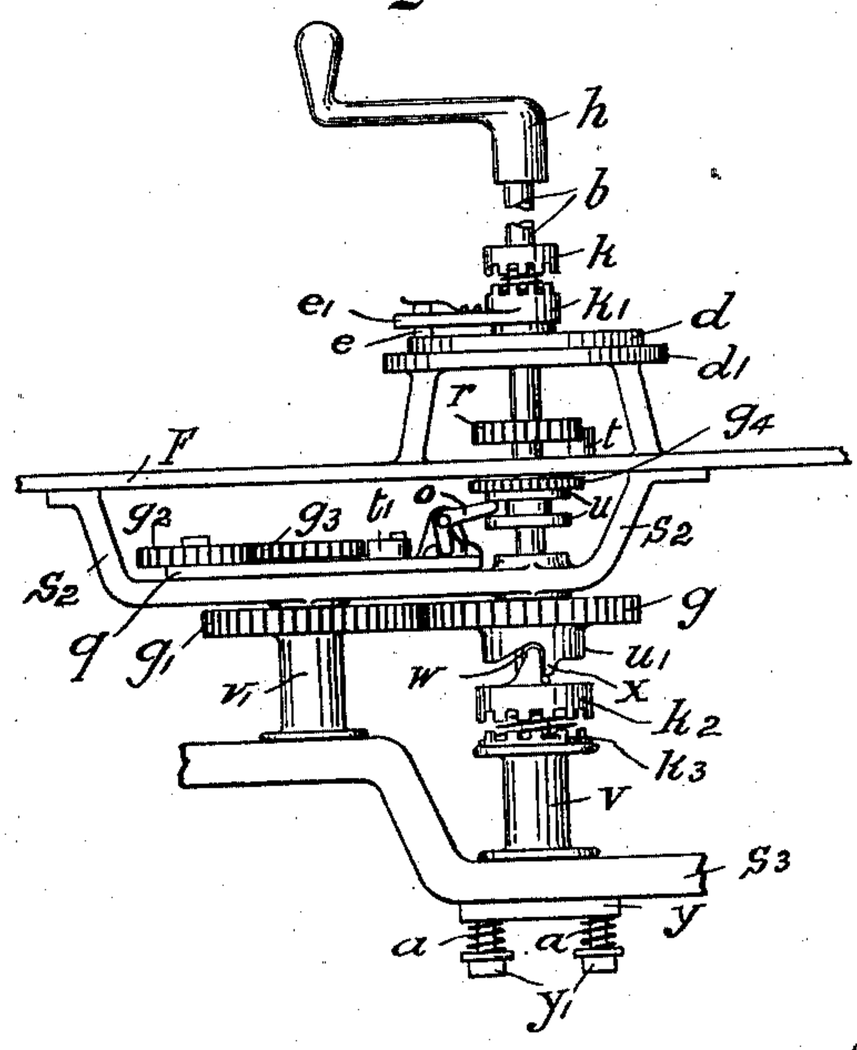


Fig. 3.

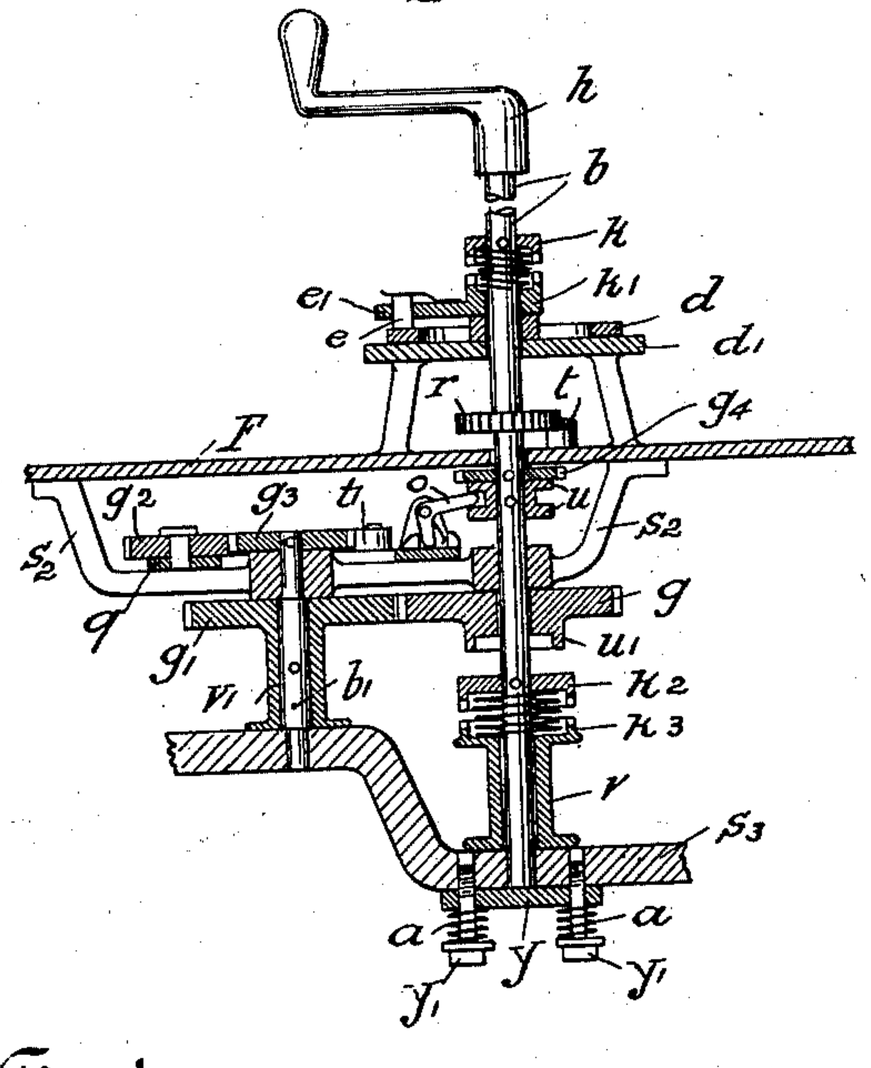
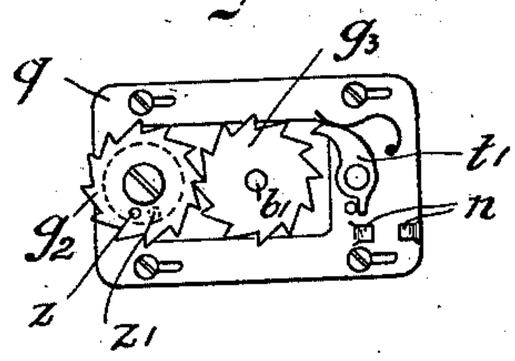


Fig. 4.



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BRAKE FOR VEHICLES.

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NO MODEL. 2 SHEETS—SHEET 2.

Fig. 5.

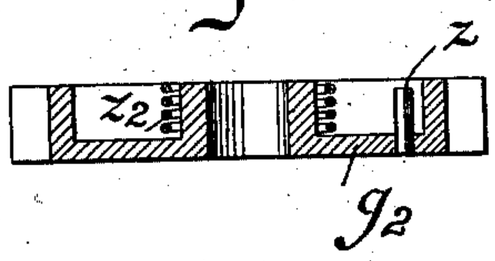


Fig. 6.

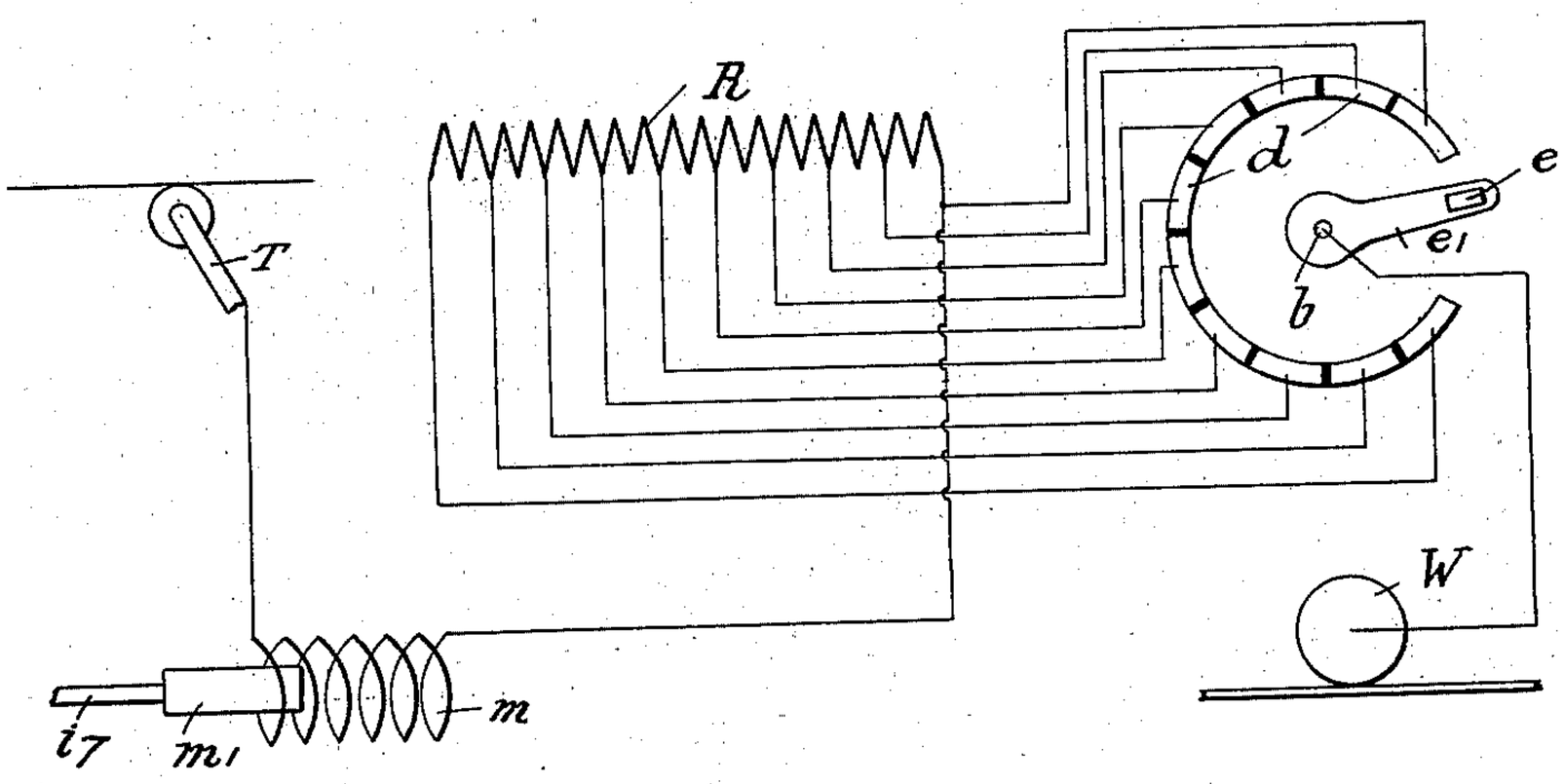
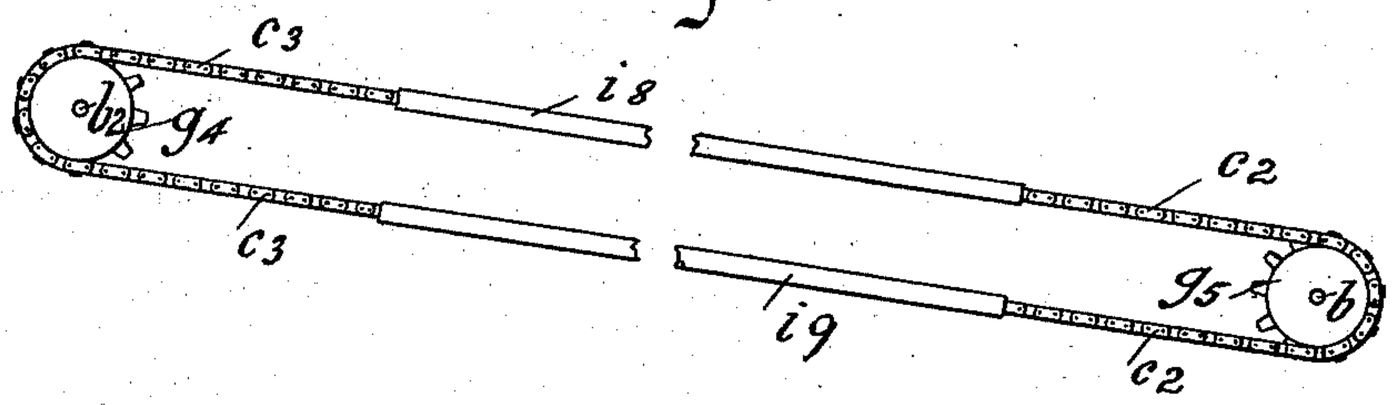


Fig. 7.



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No. 750,261. Patented January 26, 1904.

UNITED STATES PATENT OFFICE.

WILLIAM H. COOLEY, OF BROCKPORT, NEW YORK.

BRAKE FOR VEHICLES.

SPECIFICATION forming part of Letters Patent No. 750,261, dated January 26, 1904.

Application filed December 9, 1902. Serial No. 134,584. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM H. COOLEY, a citizen of the United States, residing at Brockport, in the county of Monroe and State of New York, have invented an Improvement in Brakes for Vehicles, of which the following is a specification.

The object of my invention is to provide a brake for a railway-car or other vehicle which may be applied by hand in substantially the usual way, and in addition thereto means whereby the operation of the ordinary brake-staff applies an electrically-actuated brake over a portion of the range of movement of such handle.

My invention contemplates also the limiting of the movement of the brake-staff in its return to the zero position in such a way that regardless of wear of the parts there shall be a practically uniform amount of slack to be taken up in the application of the brake at the next succeeding operation.

My invention also provides, further, for the taking up of the slack and securing a practically uniform pressure between the brake-shoes and the braking-surfaces just preceding the cutting in of the energizing-coils of the electric brake when the electric brake is cut in by the further movement of the brake-handle, such further movement serving only to take up the further slight additional slack of the shoe or equivalent mechanism which results from the more forcible application of the brake by the electrically-operating mechanism and in the usual springing of the parts under the greatly-increased pressure applied to the brake.

It is desirable that the electric brakes be applied over a small range of the movement of the brake-handle, because at the cutting in of the brake-coils into operative circuit the brake-shoes have been brought up firmly in contact with the wheels, and the further application of the brakes by the manually-applied mechanism should lag behind the electrically-applied braking effect to that extent that the application of the brakes by the electrically-operated mechanism by the movement of the handle does not call for the exercise of any great amount of effort on the part of the motorman. After that point in the movement of the handle where the maximum braking effort which can be applied by the electrically-operated mechanism has been reached then should the electrically-operated mechanism be inoperative the further application of the handle will only serve to apply the brakes in the usual way by hand.

An important feature of my brake consists in means whereby the effective leverage of the brake-applying mechanism is increased immediately upon the taking up of the slack, which, as already indicated, is so regulated as to remain practically constant, so that but a practically uniform and small amount of motion of the brake-handle is required to take up such slack, and a practically uniform amount of movement of the handle from this point on is sufficient to apply the brakes.

By the use of my mechanism the necessary range over which the magnet of the electrically-operated braking mechanism must work is greatly reduced and a much greater efficiency of such electrically-operated mechanism may be secured.

A further advantage resulting from my invention consists in the fact that the brakes are applied electrically over practically a uniform movement of the brake-handle and a much greater uniformity of motion for each separate step in the sequence of braking effects is produced, whereby the motorman may determine with a much greater degree of certainty the character of the effect which is being produced for the different positions of the brake-handle.

The accompanying drawings, illustrating my invention, are as follows:

Figure 1 is a diagrammatic plan view of my braking system as applied to a car with all of the mechanism above the gears g and g' in Figs. 2 and 3 removed. Only one pair of wheels W W and the mechanism necessary to apply the brakes to the same are shown. Fig. 2 is an end view as seen from the left in Fig. 1 of the parts directly connected with the rods b and b'. Fig. 3 is a central vertical sectional view through the rods b and b' of the parts seen in Fig. 2. Fig. 4 is a detail view of the ratchet mechanism used to engage the ratchet-

wheel g^3. Fig. 5 is a detail view showing in central section the ratchet-wheel g^2 and parts carried thereby. Fig. 6 is a diagrammatic view of the electrical connections used. Fig. 7 is a top view of the connecting-rods i^8 and i^9, chains c^2 and c^3, and gears g^4 and g^5 used to connect brake-staffs b and b^2.

Similar letters refer to similar parts throughout the several views.

Referring to Fig. 1, W W are one pair of wheels of a car having brake-shoes $f\,f$, carried by a brake-beam i^4, from the middle point of which connection is made to the equalizing-bar j' at point p' by link i'. The equalizing-bar j' is pivoted at p to any suitable fixed support s, attached to the car, and is connected at its upper end by link i to lever j at a point p^3 somewhat above the middle of such lever j, as seen in Fig. 1. This lever j has connected to its upper end, as seen in Fig. 1, the link i^5, which in turn is connected to a chain c', arranged to be wound around a suitable drum v', rigidly secured to rod b', as seen in Figs. 2 and 3. Connected to the lower end of this lever j are seen links i^6 and i^7, which are connected, respectively, with chain c and core m' of magnet M. This chain c is arranged to be wound upon a suitable drum v, carried loosely upon rod b, as seen in Figs. 2 and 3. The rod b' is arranged to be driven from the rod b by means of gears g and g', as indicated, while link i^7 is arranged to be operated by core m' of magnet M whenever current is sent through coil m, as will be explained. The extreme right-hand position of the lower end of lever j is determined by any suitable fixed stop s'.

Referring to Figs. 2 and 3, h is the ordinary brake-handle of the car, rigidly attached to rod b, which has suitable bearings in the floor of the car F, and brackets s^2 and s^3, as indicated. k^2 and k^3 are the two members of a toothed clutch, member k^2 being rigidly secured to the rod b and member k^3 being rigidly secured to the drum v, such drum v and clutch member k^3 being so supported on rod b as to be freely rotatable when the parts k^2 and k^3 are held apart by a spring between them, as shown. Drum v is prevented from moving downward by bearing s^3, as indicated. The upper member k^2 carries by suitable upwardly-projecting arms a roller w, which is arranged to roll upon the cylindrical cam u', rigidly secured to the under side of gear g. This gear g is loosely supported on rod b and is prevented from moving upward by bearing s^2 and meshes with a similar gear g', rigidly secured to drum v' and also to rod b'. This rod b' is suitably supported by bearings s^2 and s^3, as indicated.

Refer to Figs. 2, 3, 4, and 5. To the upper end of rod b' is rigidly secured a ratchet-wheel g^3, arranged to engage either a spring-pawl t', carried by a sliding frame q, or a similar ratchet-wheel g^2, also supported by the frame q, according to whether such frame q is in its extreme left or right hand position. This frame q has formed therein slots, as shown, and is secured to the upper face of bearing-arm s^2 by screws passed through such slots, so as to permit the motion just referred to. When the frame q is in its right-hand position, the pawl t' is held out of engagement by a stop-pin on this frame q, as shown. As shown in Figs. 4 and 5, the ratchet-wheel g^2 carries a pin z, arranged to engage a similar pin z', carried by the frame q. As shown in Fig. 5, the ratchet-wheel g^2 is recessed on the under side and carries a spring z^2, secured to such wheel g^2 and the frame q, so as to tend to rotate such ratchet-wheel over to the right, as shown in Fig. 4, until pin z is brought against the pin z'. The spring z^2 is not strong enough, however, to move the ratchet-wheel g^3 and mechanism connected therewith, but only serves to keep the ratchet-wheel g^2 in proper mesh with ratchet-wheel g^3 when such wheel g^3 is rotated over to the left. The frame q carries two projections n, as seen in Figs. 2, 3, and 4, but not lettered in Figs. 2 and 3 to avoid confusion from too many letters in these figures, arranged to be engaged by the lower end of the bell-crank lever o, pivotally supported on a bracket extending upward from bearing-arm s^2. The right-hand end of this bell-crank lever o is engaged above and below by collars u, rigidly secured to rod b. This rod b also carries rigidly secured to it one of the members k of a toothed clutch, the other member k' of which is rigidly connected to the brush-arm e' and is freely rotatable on rod b. The brush-arm e' carries a brush e, which is arranged to bear upon contacts d, suitably supported and insulated from the base d', which in turn receives its support from the floor F of the car. The base d' permits the rod b to move freely therethrough, but by means of a loose collar on such rod b prevents brush-arm e' and clutch member k' from moving downward. The parts k and k' are normally kept apart by means of a spring between them, as indicated. A suitable ratchet-wheel r, rigidly secured to rod b, and a pawl t are provided for use as needed.

In Fig. 6 the circuit connections for electromagnet M are shown, as well as the manner in which the action of such magnet is regulated. The trolley T is connected to one terminal of coil m of magnet M, and the other terminal of such coil m is connected to a suitable resistance R, the different sections of which are connected, as indicated, to the contacts d. The brush-arm e', carried upon rod b and arranged to engage by means of brush e the contacts d successively as the arm e' is rotated, is electrically connected to the wheel W. The core m' of the magnet M, as well as the link i^7, connected to such core m', are also shown in Fig. 6.

In Fig. 7 the mechanism is shown for connecting the brake-staff b^2 at the other end of

the car with the brake-staff b at the end of the car shown in the drawings. These brake-staffs b^2 and b have rigidly secured to them sprocket-wheels g^5 and g^4, engaging chains c^3 and c^2, respectively, and the ends of chain c^3 are connected to the ends of chains c^2 by means of rods i^8 and i^9. Thus by operating either brake-staff b^2 or b the braking mechanism above described is operated in just the same manner, only one of such mechanisms and one magnet being required on a car. Brake-staff b^2 is provided with the ordinary pawl and ratchet and carries no other mechanism, except sprocket-wheel g^5, as indicated. The location of sprocket-wheel g^4 on brake-staff b is indicated in Figs. 2 and 3. A link i^2, secured to equalizing-bar j', as shown in Fig. 1, extends to the other end of the car and performs the same function for the other pair of wheels that link i' does for the pair of wheels shown.

The operation is as follows: When the brakes are to be set, all of the slack of chain c' and most of the slack of the mechanical connections between such chain c' and the brake-shoes f is taken up by winding the chain c' upon drum v'. From this point on the drum v' is not driven from the rod b, but is retained in the position to which it has been carried, and at the same time the drum v and brush-arm e' are engaged by rod b, and the remaining slack of the chain c, if any, and the mechanical connections to the brakes are taken up, at which time the brush e is moved upon the first contact d and the magnet M begins to pull upon link i^7, and thus to set the brakes. The amount of braking secured of course depends upon how much the brush-arm e' is moved over contacts d, and thus upon the amount of resistance left in circuit with the coil m. The coil m of magnet M should be so proportioned that with no resistance in circuit with such coil the maximum braking effort will be secured for the lowest potential existing upon the line, and the resistance R should be so taken that for the highest potential on the line and with all of such resistance R in circuit the minimum desired braking effort is secured. To brake the car, the handle h is rotated to the right, as usual, and turns rod b and clutch member k^2, connected therewith. Pawl t may be used at this time, if desired. The roller w on clutch member k^2 is also carried around at this time, and owing to the conformation of the cam u', upon which it operates, this cam u' and the gear g, connected therewith, are also rotated, by which means the gear g', drum v', rod b', and ratchet-wheel g^3, connected therewith, are rotated in the opposite direction. This action pulls chain c', link i^5, and the top of lever j, as seen in Fig. 1, over to the left, the fixed stop s' acting at this time as a fulcrum for lever j. As lever j is moved over to the left links i and the top of equalizing-bar j', as seen in Fig. 1, are moved to the left, and then link i', brake-beam i^4, and brake-shoes $f\,f$ are moved to the right until the shoes $f\,f$ touch the wheels W W. When the desired amount of tension is exerted upon chain c', the rod b and clutch members k and k^2 are forced downward by the action of the roller w on cam u' against the springs between the clutch members k and k' and k^2 and k^3 and the springs $a\,a$, operating against the plate y. Thus the rod b is forced downward until the roller w reaches the flat or delay surface on cam u', from which time the clutch member k^2 may continue to rotate without moving gear g until roller w strikes the downward-projecting stop x (seen in Fig. 2) on such cam u'. In practice, however, the apparatus is so designed that this extreme position is never reached. As the rod b is forced downward by the action of the cam u' the clutch members k and k^2 engage the clutch members k' and k^3, respectively, so that continued rotation of rod b in the same direction rotates brush-arm e' and drum v, which first begins to wind chain c on drum v, taking up any slack that may have been left in the brake levers and links, and at the same time the brush e is brought upon the first contact d, thus energizing magnet M. As the handle h is further rotated the action of magnet M is increased by cutting out successive portions of resistance R in the usual way, and the drum v winds up the slack resulting from the action of such magnet. The drum v and magnet M should be so designed that the magnet M is always a little ahead of the action of the drum v in pulling on lever j. As the lower end of lever j is moved to the left by the pull from magnet M on link i^7 its fulcrum is changed to its upper end, as seen in Fig. 1, and link i is moved to the left and sets the brake-shoes $f\,f$ firmly up against the wheels W W by means of the train of mechanism already described. It will be noticed that since the connection p^3 is somewhat above the center of lever j the chain c' has little leverage in taking up the slack of the apparatus, while the link i^7 has a correspondingly-increased leverage in setting the brakes. It will also be noticed that the slack of chain c is almost entirely taken up at all times, so if for any reason the electrically-operated mechanism should fail to work properly at any time the chain c will at once become taut and the braking effect continued by the further movement in the same direction of the handle h. When the rod b begins to rotate to the right, the rod b' is rotated to the left and ratchet-wheel g^3 is rotated to the left permitting ratchet-wheel g^2 to rotate to the right under the action of spring z^2, contained therein, until pin z strikes pin z'. If rod b' is rotated farther to the left, the whole frame q is moved to the left, the ratchet-wheel g^2 acting as a pawl upon ratchet-wheel g^3 until such left-handed rotation of the rod b' and ratchet-wheel g^3 ceases as a result of the gear

g being released from the rod b by the downward motion of the latter. This downward motion of rod b by means of collars u carried thereby moves the right-hand end of bell-crank lever o downward and the lower end of such lever to the left, which engaging the projections n on frame q moves such frame to the left, causing pawl t' to engage ratchet-wheel g^3 and prevent it from backward rotation when the heavy braking effort is put on the lower end, as seen in Fig. 1, of lever j. If at this time the ratchet-wheel g^2 has not been rotated by its spring z^2 until pin z strikes pin z' when the frame q is moved to the left and ratchet-wheels g^2 and g^3 are disengaged from each other, spring z^2 rotates ratchet-wheel g^2 freely until pin z does strike pin z'. When it is desired to release the brakes, the pawl t, if used, is first disengaged from ratchet-wheel r, then the handle h is moved over to the left, chain c is slackened, and magnet M is gradually cut out of circuit. When this is done, roller w has been brought opposite the depression in cam u' and the rod b forced upward by the springs acting thereon. It will be noticed that the rod b cannot be further rotated to the left without carrying the cam u' with it. As the handle h is moved upward it is disengaged from brush-arm e' and drum v and the right-hand end of bell-crank lever o is moved upward and the lower end of such bell-crank lever is moved to the right, thus moving frame q to the right, disengaging pawl t' from ratchet-wheel g^3 and engaging ratchet-wheels g^2 and g^3. As handle h is further rotated to the left rod b', drum v', and ratchet-wheel g^3 are rotated to the right, chain c' is slackened, and the brake-shoes $f\,f$ are drawn away from the wheels W W by the usual springs for that purpose. (Not shown in the drawings.) At this same time the ratchet-wheel g^2 is rotated positively to the left by the ratchet-wheel g^3 against the action of the spring z^2 in the ratchet-wheel g^2 until the pin z is brought against the pin z', as shown in Fig. 4, at which time further backward or left-handed rotation of the handle h is prevented. While the spring seen on the right-hand side of the lower end of the bell-crank lever o serves to hold the frame q as far to the right as the position of the lever o permits, the frame q may be at any time moved to the left by the action of the ratchet-wheels g^2 and g^3 engaging each other when it is necessary to rotate the ratchet-wheel g^3 farther to the left in taking up the slack of the chain c' than the limit of motion of ratchet-wheel g^2 permits. Thus it will be seen that the frame q and parts carried thereby constitute a lock for securely holding rod b' in any position to which it may have been rotated and also an automatic device for always providing a practically uniform amount of slack in chain c' when the brakes are wholly released by taking up and retaining any additional slack occurring from wear of the chain, pivots, or brake-shoes.

It is desirable at times to adjust the relation between the springs tending to retain the rod b in its upper position and the effort to be exerted upon the chain c' at the time that the slack is taken up. For this purpose I make use of a flat bar y, sliding upon bolts y', secured in the under side of the arm s^3. The upward pressure exerted upon this plate by means of the springs a may be varied by adjusting the nuts seen on the lower ends of the bolts y'.

What I claim is—

1. In a combined electrical and hand brake, an operating-handle and means, controlled by the tension applied to the braking apparatus, whereby, when such handle has reached a point in its course where a predetermined braking effort is applied by the hand-operated mechanism, a braking effort is also applied by the electrically-operated mechanism.

2. In a combined electrical and hand brake, an operating-handle and means, controlled by the tension and adjustable to operate at different tensions applied to the braking apparatus, whereby, when such handle has reached a point in its course where a predetermined braking effort is applied by the hand-operated mechanism, a braking effort is also applied by the electrically-operated mechanism.

3. In a combined electrical and hand brake, an operating-handle and means, controlled by the tension applied to the braking apparatus, whereby, when such handle has reached a point in its course where a predetermined braking effort is applied by the hand-operated mechanism, a braking effort is also applied by the electrically-operated mechanism and means whereby the further movement of such handle applies an increased effort from such electrically-operated mechanism.

4. In a combined electrical and hand brake, an operating-handle and means, controlled by the tension and adjustable to operate at different tensions applied to the braking apparatus, whereby, when such handle has reached a point in its course where a predetermined braking effort is applied by the hand-operated mechanism, a braking effort is also applied by the electrically-operated mechanism and means whereby the further movement of such handle applies an increased effort from such electrically-operated mechanism.

5. In a combined electrical and hand brake, an operating-handle and means, controlled by the tension applied to the braking apparatus, whereby, when such handle has reached a point in its course where a predetermined braking effort is applied by the hand-operated mechanism, a braking effort is also applied by the electrically-operated mechanism, means whereby the further movement of such handle applies an increased effort from such electrically-operated mechanism and means whereby

the motion of the handle for applying the series of increasing braking efforts from the electrically-operated mechanism only takes up the slack created by the increased braking effort from the electrically-operated mechanism.

6. In a combined electrical and hand brake, an operating-handle and means controlled by the tension and adjustable to operate at different tensions applied to the braking apparatus, whereby, when such handle has reached a point in its course where a predetermined braking effort is applied by the hand-operated mechanism, a braking effort is also applied by the electrically-operated mechanism, means whereby the further movement of such handle applies an increased effort from such electrically-operated mechanism and means whereby the motion of the handle for applying the series of increasing braking efforts from the electrically-operated mechanism only takes up the slack created by the increased braking effort from the electrically-operated mechanism.

7. In a combined electrical and hand brake, an operating-handle and means, controlled by the tension applied to the braking apparatus, whereby, when such handle has reached a point in its course where a predetermined braking effort is applied by the hand-operated mechanism, a braking effort is also applied by the electrically-operated mechanism, means whereby the further movement of such handle applies an increased effort from such electrically-operated mechanism, means whereby, during that portion of the further movement of the handle throughout which the action of the electrically-operated mechanism is increased, the handle is operable to apply the full force of the electrically-operated brake without applying any further braking effort through the hand-operated mechanism other than the taking up of the slack caused by the increased force with which the brakes are electrically applied and means whereby, during this same movement, the handle applies the hand-operated brake, should the electrical brake become inoperative.

8. In a combined electrical and hand brake, an operating-handle and means, controlled by the tension and adjustable to operate at different tensions applied to the braking apparatus, whereby, when such handle has reached a point in its course where a predetermined braking effort is applied to the braking apparatus by the hand-operated mechanism, a braking effort is also applied by the electrically-operated mechanism, means whereby the further movement of such handle applies an increased effort from such electrically-operated mechanism, means whereby, during that portion of the further movement of the handle throughout which the action of the electrically-operated mechanism is increased, the handle is operable to apply the full force of the electrically-operated brake without applying any further braking effort through the hand-operated mechanism other than the taking up of the slack caused by the increased force with which the brakes are electrically applied, and means whereby during this same movement, the handle applies the hand-operated brake, should the electrical brake become inoperative.

9. In a combined electrical and hand brake, an operating-handle and means, controlled by the tension applied to the braking apparatus, whereby, when such handle has reached a point in its course where a predetermined braking effort is applied by the hand-operated mechanism, a braking effort is also applied by the electrically-operated mechanism through a leverage increased above that through which the hand-operated brake is applied.

10. In a combined electrical and hand brake, an operating-handle and means, controlled by the tension and adjustable to operate at different tensions, applied to the braking apparatus, whereby, when such handle has reached a point in its course where a predetermined braking effort is applied by the hand-operated mechanism, a braking effort is also applied by the electrically-operated mechanism through a leverage increased above that through which the hand-operated brake is applied.

11. In a braking system, a movable body connected to the brakes, means whereby such movable body may be operated to take up the slack of the apparatus and then locked in that position during the further application of the brakes and means for releasing such movable body upon the release of the brakes.

12. In a braking system, a movable body connected to the brakes, means whereby such movable body may be operated to take up the slack of the apparatus and then locked in that position during the further application of the brakes, means for releasing such movable body upon the release of the brakes and means whereby to such movable body there may be imparted an additional movement corresponding to a predetermined amount of additional slack when such predetermined amount thereof has accumulated.

13. In a braking system, a movable body connected to the brakes, means whereby such movable body may be operated to take up the slack of the apparatus and then locked in that position during the further application of the brakes, means for releasing such movable body upon the release of the brakes, means whereby to such movable body there may be imparted an additional movement corresponding to a predetermined amount of additional slack when such predetermined amount thereof has accumulated, and means for preventing the complete return of such movable body, after each additional movement thereof, to its last initial position, by an amount corresponding to each such additional movement.

14. In a braking system, a drum connected to the brakes, means whereby such drum may be operated to take up the slack of the apparatus and then locked in that position during the further application of the brakes and means for releasing such drum upon the release of the brakes.

15. In a braking system, a drum connected to the brakes, means whereby such drum may be operated to take up the slack of the apparatus and then locked in that position during the further application of the brakes, means for releasing such drum upon the release of the brakes and means whereby to such drum there may be imparted an additional movement corresponding to a predetermined amount of additional slack when such predetermined amount thereof has accumulated.

16. In a braking system, a drum connected to the brakes, means whereby such drum may be operated to take up the slack of the apparatus and then locked in that position during the further application of the brakes, means for releasing such drum upon the release of the brakes, means whereby to such drum there may be imparted an additional movement corresponding to a predetermined amount of additional slack when such predetermined amount thereof has accumulated and means for preventing the complete return of such drum, after each additional movement thereof to its last initial position, by an amount corresponding to each such additional movement.

17. In a braking system, in combination with means for applying the brakes by the operation of a brake-staff, means for maintaining a practically uniform slack of the apparatus, comprising a movable body connected to the brakes and connections between such movable body and such brake-staff for operating such movable body to take up any additional slack when a predetermined amount thereof has accumulated.

18. In a braking system, in combination with means for applying the brakes by the operation of a brake-staff, means for maintaining a practically uniform slack of the apparatus comprising a drum and a chain connected thereto and to the brakes and connections between such drum and such brake-staff for operating such drum and such chain to take up any additional slack therein when a predetermined amount of such additional slack has accumulated.

19. In a braking system, in combination with means for applying the brakes by means of a brake-staff, a drum operable from such brake-staff and connected by a chain to the brakes for the purpose of taking up the slack of the apparatus, means under the control of such brake-staff, for maintaining a practically uniform slack of the apparatus and for maintaining a practically uniform angular motion of the brake-staff in the return of the drum to give such practically uniform slack, such means independent of the amount of angular motion which must at any time be imparted to such drum relative to a first zero-point therefor before any wear of the parts has occurred.

20. In a braking system, in combination with means for applying the brakes by means of a brake-staff, a movable body operable from such brake-staff and connected to the brakes for the purpose of taking up the slack of the apparatus, means under the control of such brake-staff for maintaining a practically uniform slack of the apparatus and for maintaining a practically uniform motion of the brake-staff in the return of such movable body to give such practically uniform slack, such means independent of the amount of motion which must at any time be imparted to such movable body relative to a first zero-point therefor before any wear of the parts has occurred.

21. In a braking system, two movable bodies connected to the brakes, a handle, means whereby by the operation of such handle such first body is moved to take up the slack of the apparatus and means whereby by the further operation of the handle such first movable body is released and locked against backward motion in the position to which it has been driven and such second movable body is moved and the brakes further applied by the movement thereof.

22. In a braking system, two movable bodies connected to the brakes, a handle, means whereby by the operation of such handle such first body is moved to take up the slack of the apparatus until a predetermined tension is applied to the braking apparatus and means whereby by the further operation of the handle such first movable body is released and locked against backward motion in the position to which it has been driven and such second movable body is moved and the brakes further applied by the movement thereof.

23. In a braking system, two movable bodies connected to the brakes, a handle, means whereby by the operation of such handle such first body is moved to take up the slack of the apparatus until a predetermined tension is applied to the braking apparatus, means whereby by the further operation of the handle such first movable body is released and locked against backward motion in the position to which it has been driven and such second movable body is moved and the brakes further applied by the movement thereof and means for adjusting such predetermined tension.

24. In a braking system, two drums connected to the brakes, a handle, means whereby by the movement of such handle the first drum is operated to take up the slack of the apparatus and means whereby by the further movement of such handle the first drum is released and locked against backward motion in the

position to which it has been driven and the second drum is engaged and the brakes further applied by the operation thereof.

25. In a braking system, two drums connected to the brakes, a handle, means whereby by the movement of such handle the first drum is operated to take up the slack of the apparatus until a predetermined tension is applied to the braking apparatus and means whereby by the further movement of such handle the first drum is released and locked against backward motion in the position to which it has been driven and the second drum is engaged and the brakes further applied by the operation thereof.

26. In a braking system, two drums connected to the brakes, a handle, means whereby by the movement of such handle the first drum is operated to take up the slack of the apparatus until a predetermined tension is applied to the braking apparatus, means whereby by the further movement of such handle the first drum is released and locked against backward motion in the position to which it has been driven and the second drum is engaged and the brakes further applied by the operation thereof and means for adjusting such predetermined tension.

27. In a braking system, two movable bodies connected to the brakes, a handle, means whereby by the operation of such handle such first body is moved to take up the slack of the apparatus, means whereby by the further operation of the handle such first movable body is released and locked against backward motion in the position to which it has been driven and such second movable body is moved and the brakes further applied by the movement thereof and means whereby the movements of such first and second bodies apply braking efforts through lesser and greater leverages respectively.

28. In a braking system, two movable bodies connected to the brakes, a handle, means whereby by the operation of such handle such first body is moved to take up the slack of the apparatus until a predetermined tension is applied to the braking apparatus, means whereby by the further operation of the handle such first movable body is released and locked against backward motion in the position to which it has been driven and such second movable body is moved and the brakes further applied by the movement thereof and means whereby the movements of such first and second bodies apply braking efforts through lesser and greater leverages respectively.

29. In a braking system, two movable bodies connected to the brakes, a handle, means whereby by the operation of such handle such first body is moved to take up the slack of the apparatus until a predetermined tension is applied to the braking apparatus, means whereby, by the further operation of the handle such first movable body is released and locked against backward motion in the position to which it has been driven and such second movable body is moved and the brakes further applied by the movement thereof, means for adjusting such predetermined tension and means whereby the movements of such first and second bodies apply braking efforts through lesser and greater leverages respectively.

30. In a braking system, two drums connected to the brakes, a handle, means whereby by the movement of such handle the first drum is operated to take up the slack of the apparatus, means whereby by the further movement of such handle the first drum is released and locked against backward motion in the position to which it has been driven and the second drum is engaged and the brakes further applied by the operation thereof and means whereby the operations of such first and second drums apply braking efforts through lesser and greater leverages respectively.

31. In a braking system, two drums connected to the brakes, a handle, means whereby by the movement of such handle the first drum is operated to take up the slack of the apparatus until a predetermined tension is applied to the braking apparatus, means whereby by the further movement of such handle the first drum is released and locked against backward motion in the position to which it has been driven and the second drum is engaged and the brakes further applied by the operation thereof and means whereby the operations of such first and second drums apply braking efforts through lesser and greater leverages respectively.

32. In a braking system, two drums connected to the brakes, a handle, means whereby by the movement of such handle the first drum is operated to take up the slack of the apparatus until a predetermined tension is applied to the braking apparatus, means whereby by the further movement of such handle the first drum is released and locked against backward motion in the position to which it has been driven and the second drum is engaged and the brakes further applied by the operation thereof, means for adjusting such predetermined tension and means whereby the operations of such first and second drums apply braking efforts through lesser and greater leverages respectively.

33. In a braking system, means, controlled by the braking effort applied and adjustable to operate at different braking efforts, whereby by the application of any desired predetermined braking effort from one braking mechanism applies also a braking effort from a second braking mechanism.

34. In a braking system, means, controlled by the braking effort applied and adjustable to operate at different braking efforts, whereby by the application of any desired predeter-

mined braking effort from one brake-actuating mechanism applies also a braking effort from a second brake-actuating mechanism.

35. In a braking system, means, controlled by the braking effort applied and adjustable to operate at different braking efforts, whereby the application of any desired predetermined braking effort from one braking mechanism applies also a braking effort from a second braking mechanism through a leverage increased above that through which such first predetermined braking effort is applied.

36. In a braking system, means, controlled by the braking effort applied and adjustable to operate at different braking efforts, whereby the application of any desired predetermined braking effort from one brake-actuating mechanism applies also a braking effort from a second brake-actuating mechanism through a leverage increased above that through which such first predetermined braking effort is applied.

37. In a braking system, electrically-operated mechanism permanently connected to the brakes and means for applying a braking effort from such mechanism at a constant air-gap for the initial relative positions of the magnetic elements in such system.

38. In a braking system, electrically-operated mechanism permanently connected to the brakes and means whereby, upon the application of a predetermined and adjustable tension to the braking apparatus, a braking effort is applied by such electrically-operated mechanism and at a constant air-gap for the initial relative positions of the magnetic elements in such system.

39. In a combined hand and electric braking system, means for applying an effort from the electrically-operated mechanism at a constant air-gap for the initial relative positions of the magnetic elements in such system and at a leverage greater than that at which the brakes are applied by the hand-operated mechanism.

40. In an electric braking system, means whereby, upon the application of a predetermined and adjustable tension to the braking apparatus, a braking effort is applied by the electrically-operated mechanism at a constant air-gap for the initial relative positions of the magnetic elements in such system and at a leverage greater than that at which such predetermined and adjustable tension is applied.

41. In a combined electric and hand brake, means for applying a braking effort by the hand-operated mechanism until a predetermined and adjustable tension has been applied to the braking apparatus by the operation of the handle and means whereby, during the further operation of such handle, a maximum braking effort may be applied by the electrically-operated mechanism, by relative motion between magnetic elements in such system, such relative motion always contained between two constant extremes.

42. In a combined electric and hand brake, means for applying a braking effort by the hand-operated mechanism until a predetermined and adjustable tension has been applied to the braking apparatus by the operation of the handle and means whereby, during the further operation of such handle, a maximum braking effort may be applied by the electrically-operated mechanism, by relative motion between magnetic elements in such system, such relative motion always contained between two constant extremes and starting at one of them.

43. In a braking system, an electromagnetically-operated element connected to the brakes, a stop limiting the return of such element to its initial or starting position, means whereby there may be applied any desired initial braking effort before the movement of such magnetic element and means whereby, upon the movement of such magnetic element, a braking effort is applied at a leverage greater than that at which such initial braking effort is applied before the movement of such element.

44. In a braking system, in combination with an electromagnetically-operated element connected to the brakes, a stop for fixing the initial position of such element before the movement thereof and means for applying a predetermined and constant braking effort before such element is caused to move in the application of a braking effort.

45. In a braking system, an electrically-operated element permanently connected to the brakes and means for securing practically uniform relative positions of the magnetic elements in such system at the commencement of the relative movement of such elements.

WM. H. COOLEY.

Witnesses:
HERBERT LEARY,
ALBERT C. BELL.