(No Model.) 7 Sheets—Sheet 1.

F. L. CLARK.

HYDRAULIC BRAKE.

No. 574,663. Patented Jan. 5, 1897.

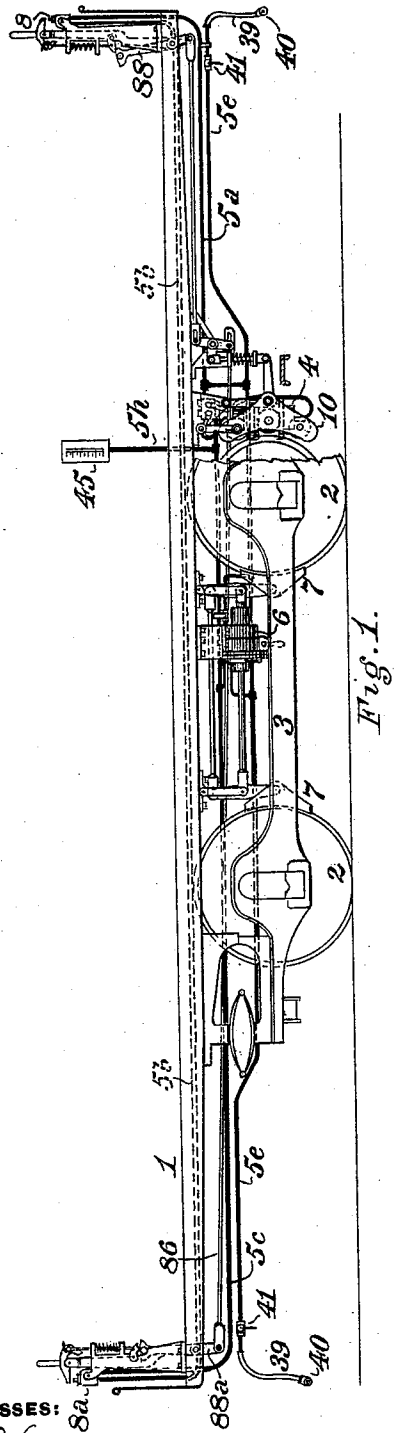

Fig. 1.

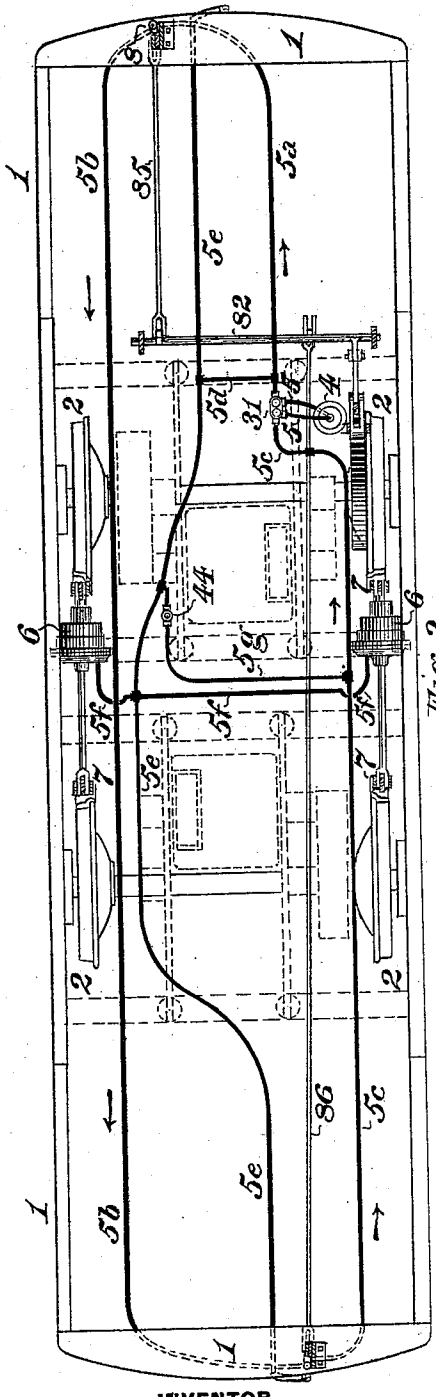

Fig. 2.

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No. 574,663. Patented Jan. 5, 1897.

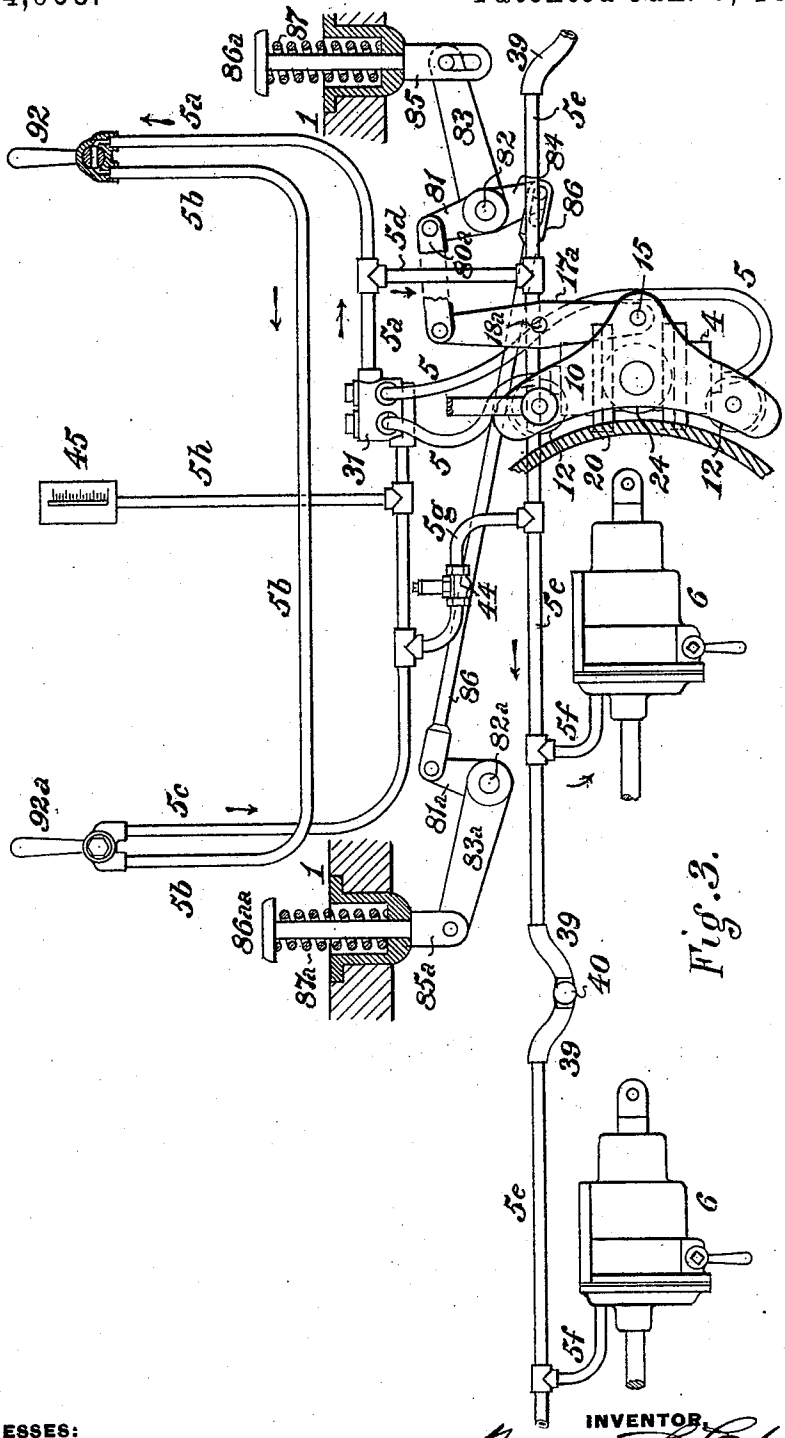

Fig. 3.

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(No Model.) 7 Sheets—Sheet 3.

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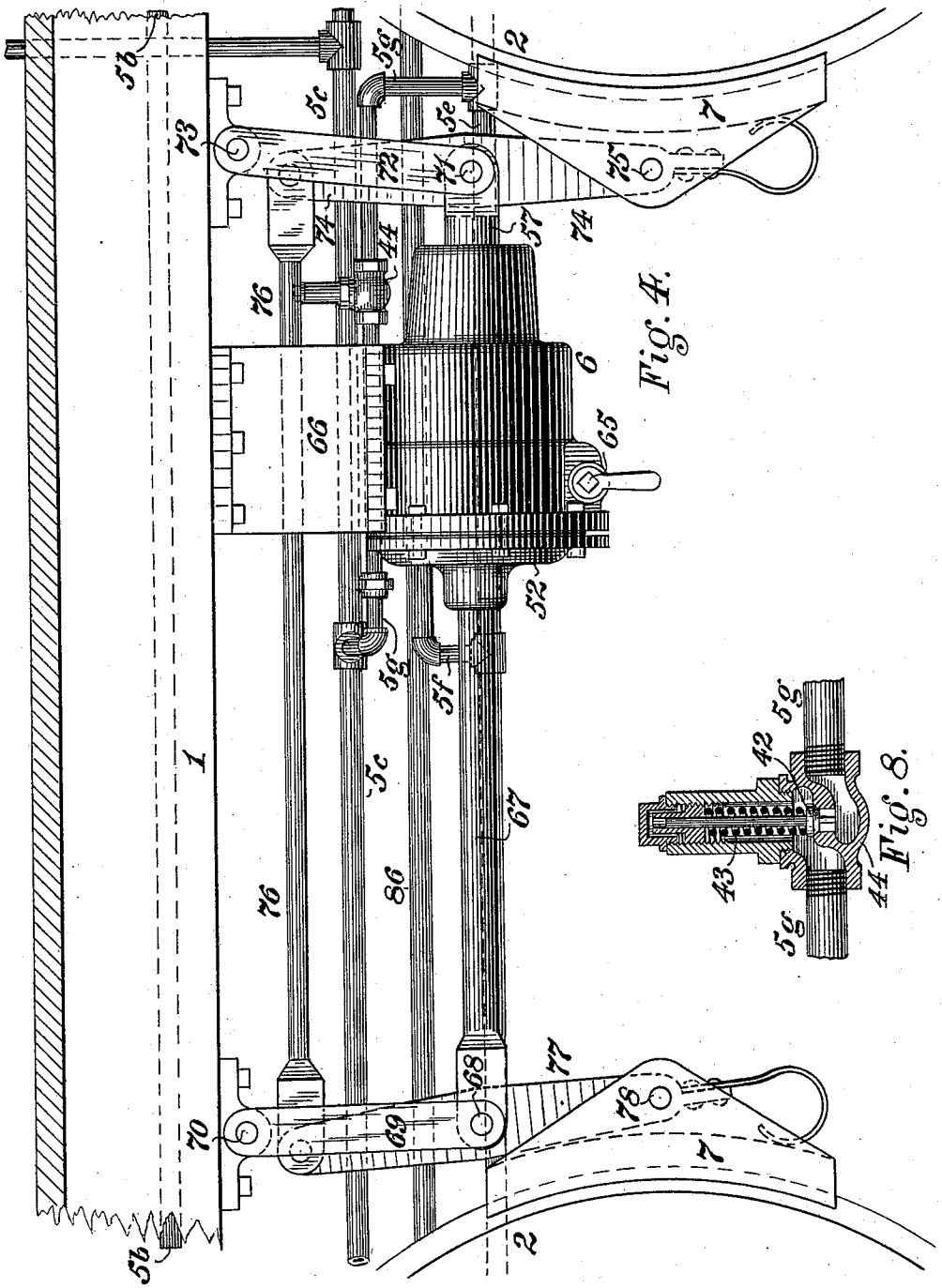

Fig. 4.

Fig. 8.

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(No Model.) 7 Sheets—Sheet 4.

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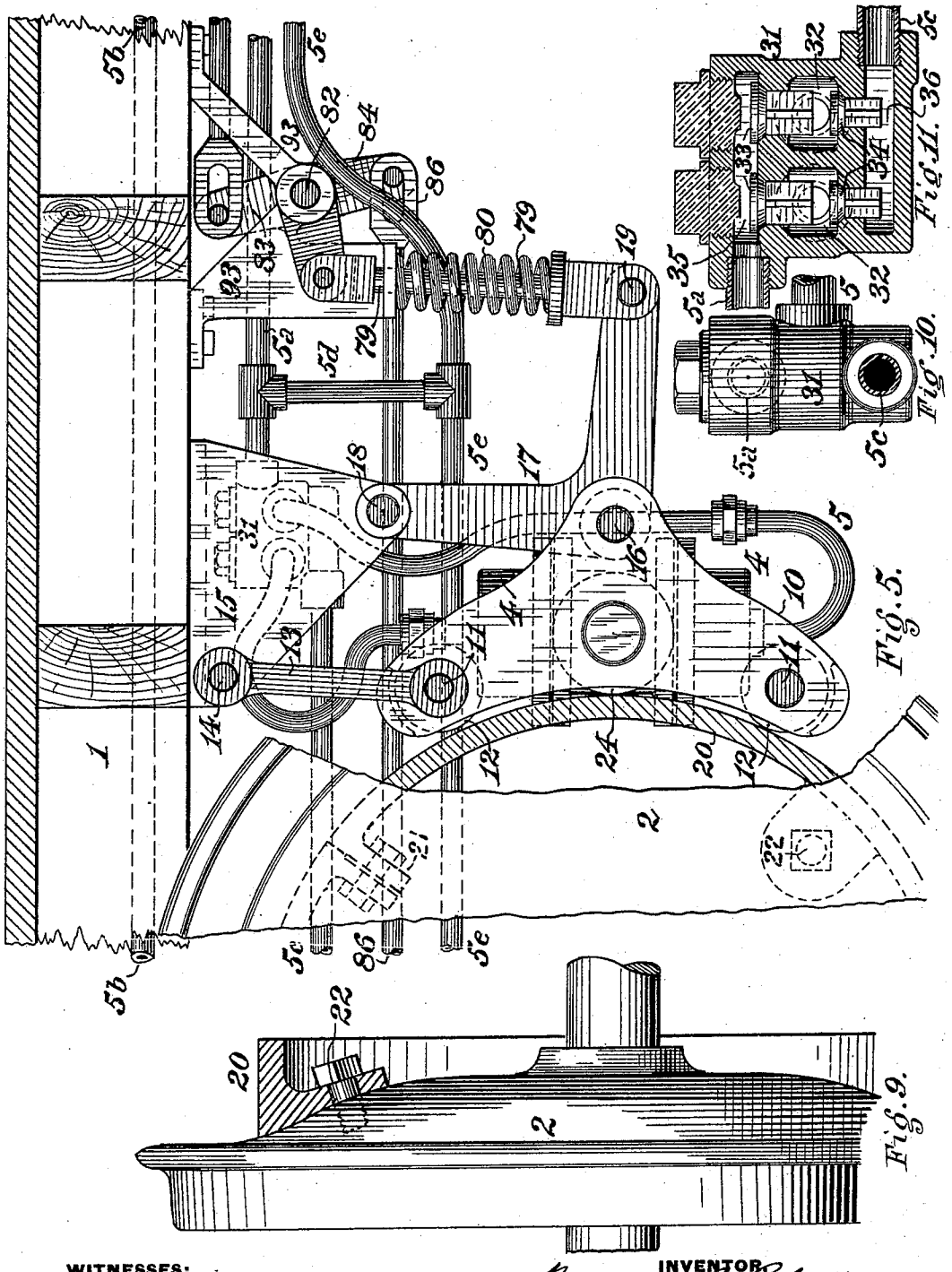

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(No Model.) 7 Sheets—Sheet 5.

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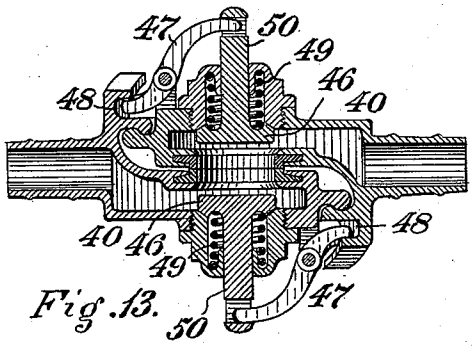

Fig. 13.

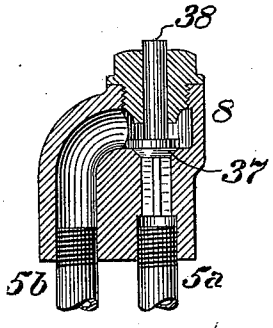

Fig. 12.

Fig. 7.

Fig. 6.

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(No Model.) 7 Sheets—Sheet 6.

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HYDRAULIC BRAKE.

No. 574,663. Patented Jan. 5, 1897.

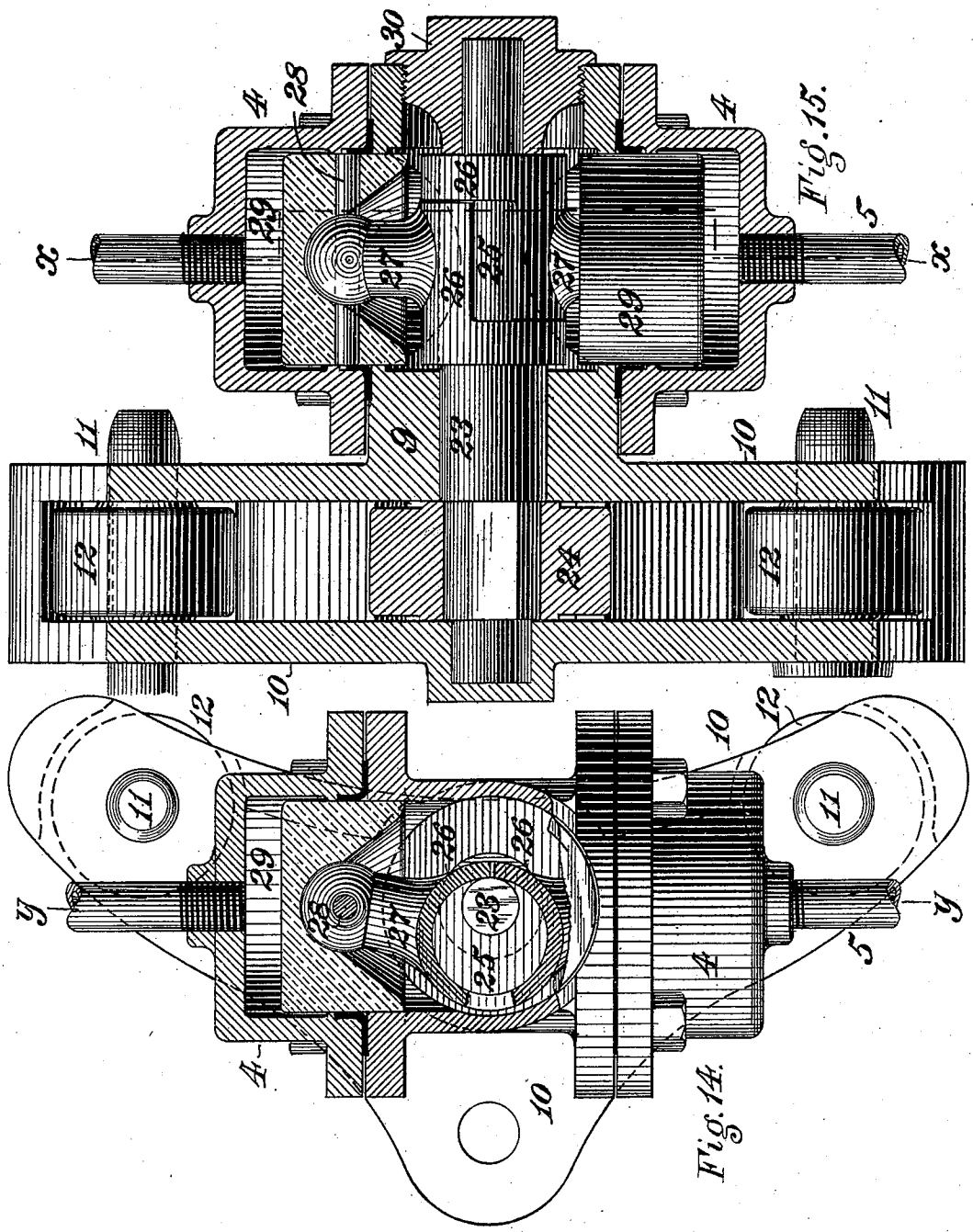

Fig. 15.

Fig. 14.

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(No Model.) 7 Sheets—Sheet 7.

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HYDRAULIC BRAKE.

No. 574,663. Patented Jan. 5, 1897.

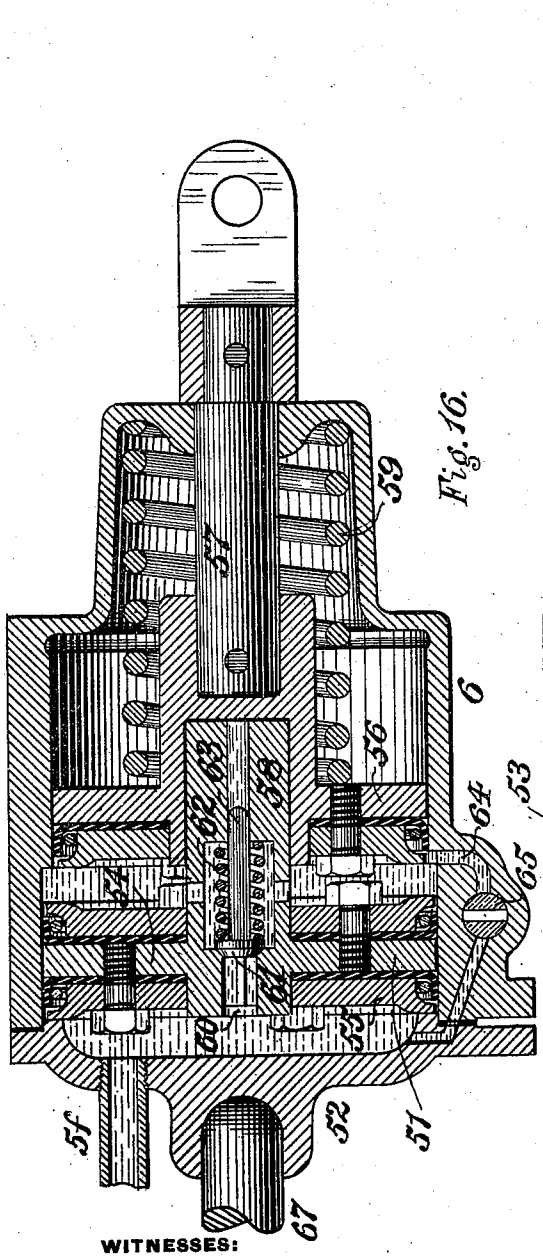

Fig. 16.

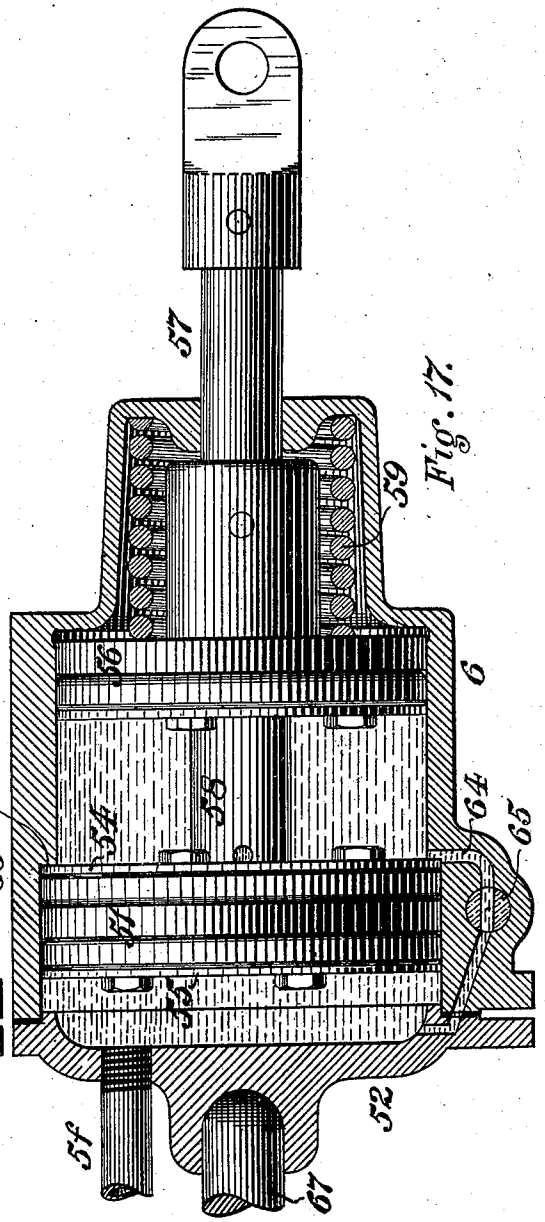

Fig. 17.

WITNESSES:

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INVENTOR,

Francis L. Clark

by Johnson Dewey & Bell,

Att'y.

UNITED STATES PATENT OFFICE.

FRANCIS L. CLARK, OF STEWART STATION, PENNSYLVANIA.

HYDRAULIC BRAKE.

SPECIFICATION forming part of Letters Patent No. 574,663, dated January 5, 1897.

Application filed January 15, 1896. Serial No. 575,548. (No model.)

To all whom it may concern:

Be it known that I, FRANCIS L. CLARK, a citizen of the United States, residing at Stewart Station, in the county of Westmoreland and State of Pennsylvania, have invented or discovered a certain new and useful Improvement in Hydraulic Brakes, of which improvement the following is a specification.

The object of my invention is to provide a brake apparatus designed more particularly for electric or cable railroad cars, in which, by mechanism readily and inexpensively applicable in connection with any of the ordinary constructions of car-framing and running-gear, braking power adequate to the maximum requirements of service, either normal or emergency, may be derived, as from time to time required, without the continuous operation of a pump or compressor, from an axle of the car and be transmitted to the wheels through an incompressible-fluid medium, as water or other liquid containing material of such character as will prevent freezing.

The improvement claimed is hereinafter fully set forth.

In the accompanying drawings, Figure 1 is a side view in elevation of a car-frame, running-gear, and brake apparatus, illustrating an application of my invention; Fig. 2, a plan or top view of the same; Fig. 3, a view, partly in elevation and partly in section, illustrating the general construction of a brake apparatus embodying my invention as applied to operate the brakes of two cars; Fig. 4, a side view in elevation and on an enlarged scale of a portion of a brake apparatus embodying my invention; Fig. 5, a similar view, but partly in section, of an adjoining portion; Fig. 6, a similar view, partly in section, of the remaining portion; Fig. 7, a view in elevation of the lever mechanism of Fig. 6 as seen from the left; Fig. 8, a vertical central section through the excess-pressure or safety valve; Fig. 9, a partial transverse section through the pump-driving ring connected to a car-wheel; Fig. 10, an end view of the pump-valve casing; Fig. 11, a vertical longitudinal central section through the same; Fig. 12, a vertical central section through the controlling-valve of the pipe system; Fig. 13, a longitudinal central section through a pair of hose-couplings; Fig. 14, a view, partly in elevation and partly in section at the line $x\,x$ of Fig. 15, of the pump and its supporting-frame; Fig. 15, a vertical section through the same at the line $y\,y$ of Fig. 14; Fig. 16, a longitudinal central section through the brake-cylinder and its pistons; and Fig. 17, a similar section through the brake-cylinder with the pistons shown in elevation and in the positions occupied when the maximum amount of wear of the braking-surfaces and slackness in the connection have been allowed.

My invention is in this instance illustrated as applied to a four-wheeled electric car, to which, as will be seen, it is readily applicable by reason of not involving the necessity for any change in or alteration of the construction or location of the electric motor or other members of the running-gear. It is not, however, limited in adaptability to this or any other specific construction of car, and may without essential variation of structural features or operative principle be utilized in street-railroad or other service for braking either a single car or a train of cars of any of the known forms.

In the practice of my invention as herein exemplified the brake apparatus is connected to and, except as to its operating-lever and controlling-valve mechanism, supported below the frame 1 of a car, which is carried upon four wheels 2, the axles of which are journaled in suitable bearings in side frames 3.

The essential elements of the apparatus, which, with their accessories, will be hereinafter fully and in detail described, are a pump 4, which is suspended from the car-frame in such manner that it may be moved into and out of position for actuation by the rotation of an axle of the car; a system of piping 5 5^a, &c., through which a suitable liquid, as water containing some antifreezing material, may be circulated by the pump; a brake-cylinder 6, one or more of which may be employed, two being shown in this instance, each having a piston which is by preference specially constructed to provide for automatically taking up slackness and wear and which is connected to one or more brake-shoes 7; a valve device 8 or 8^a, which controls the circulation of liquid through the pipe system 5 5^a, &c.; and an operating-lever mechanism

for moving the pump into and out of position for actuation and for effecting the opening and closure of the controlling-valve device 8 or 8^a.

The controlling-valve and operating-lever are shown as duplicated in order to enable the brake apparatus to be operated from either end of the car; but it will be obvious that when these members at one end of the car are operated the corresponding members at the opposite end remain inactive.

The pump 4, the specific construction of which is not an essential of my present invention, is in this instance shown as of the single-acting reciprocating-piston type and as provided with two cylinders and pistons. The pump-cylinders 4 4 (see Figs. 14 and 15) are secured removably to a sleeve or tubular extension 9, which projects centrally from one side of a supporting-frame 10, near the ends of which are fitted pins 11, on each of which is journaled a friction-roller 12. The frame 10 is suspended from the car-frame by links or hangers 13, the upper ends of which are journaled on a pin 14, fitting in a casting 15, secured to the car-frame, and the lower ends are journaled on the pin 11 which is nearest to the upper end of the frame 10. The frame 10 is also coupled by a pin 16, located in or near the horizontal axial plane of the tubular extension 9, to the middle or body portion of a bell-crank lever 17, the upper arm of which is pivoted by a pin 18 to the casting 15 and which has its lower arm coupled by a pin 19 to a lever system, to be presently described, by which the frame 10 and the members connected thereto are moved toward and from a driving ring or pulley 20, which is formed in two halves or sections, connected by bolts 21 and secured by tap-bolts 22 to the inside of one of the car-wheels 2.

The driving-ring 20 may, if preferred, be made integral with the wheel 2 in the manufacture thereof.

A pump-shaft 23, which is fitted to rotate in the tubular extension 9 of the frame 10, carries upon a squared portion of its length located between the sides of the frame a driving-roller 24, the periphery of which projects beyond the frame, so that when the latter is moved sufficiently close to the driving-ring 20, as shown in Fig. 5, the driving-roller 24 and one of the friction-rolls 12 are brought into frictional contact with the driving-ring, rotation being thereby imparted to the driving-roller 24 and pump-shaft 23.

An eccentric 25 is formed or fixed upon the pump-shaft at the portion thereof which is located between the pump-cylinders 4, and two eccentric-straps 26 26 are fitted around it, each strap being provided with a short arm or rod 27, which is coupled by a pin 28 to a piston 29, fitting the adjacent pump-cylinder 4. Each of the eccentric-straps 26 is cut away for the major portion of its width, so as, through said portion, to only surround about one-half of the periphery of the eccentric. The remaining minor portion of the width of each eccentric-strap completely encircles the eccentric, and the complete and cut-away portions are located at alternately opposite ends of the respective straps, as seen in Fig. 15. By this construction a large bearing-surface for the eccentric-straps is provided during the forcing-strokes of the pistons and the bearing of the pistons on the eccentric is made more nearly central than would otherwise be the case. The end of the tubular projection 9 farthest from the frame 10 is closed by a screw-cap 30, which serves as an end bearing for the pump-shaft 23.

The outer ends of the pump-cylinders 4 are connected with a system of pipes 5 5^a, &c., through which a suitable non-freezing liquid, as, for example, water containing some anti-freezing ingredient or mixture, is caused to circulate when the pump is actuated by the rotation of the pump-shaft 23. The pipe-sections 5, which connect directly with the pump-cylinders, lead therefrom into chambers 32 in a valve-casing 31, (shown in section in Fig. 11,) supported below the car-frame, said chambers having openings in their upper and lower sides controlled, respectively, by upwardly-opening puppet-valves 33 and 34 and leading, respectively, to an upper outlet-chamber 35 and to a lower inlet-chamber 36. A pipe 5^a leads from the outlet-chamber 35 to a controlling-valve device 8, located adjacent to one end of the car in position to be conveniently operated by the motorman or other person directing the movement of the car, and a pipe 5^b leads from the valve device 8 to a similar valve device 8^a, located in corresponding position near the opposite end of the car. A pipe 5^c leads from the valve device 8^a to the inlet-chamber 36 of the valve-casing 31. The controlling-valve device 8 or 8^a may be either a simple plug-cock, as shown in Fig. 3, or an upwardly-opening puppet-valve 37, working in a casing 8, to which the pipes 5^a and 5^b are connected, and having an outwardly-projecting stem 38 for closing it by a hand-actuated lever, as shown in Fig. 12.

The pipe 5^a, which leads from the outlet-chamber 35 of the valve-casing 31, is connected by a branch pipe 5^d with what may be termed a "train-pipe" 5^e, having a flexible hose-section 39 and coupling-section 40 at each of its ends for connection to a corresponding pipe on another car, and provided with cocks 41 41, by which it may be closed at either or both of its ends, as required. Branch pipes 5^f 5^f lead from the train-pipe 5^e to each of the brake-cylinders 6 of the car, there being two brake-cylinders in the instance shown. A by-pass pipe 5^g leads from the pipe 5^c to the train-pipe 5^e, and an excess-pressure or safety valve 42, which is held normally seated by a spring 43 or by a weight, is seated on a passage in a valve-casing 44, interposed between two sections of the by-pass pipe 5^g. A vertical pipe 5^h leads from the pipe 5^c into a chamber 45, having a suit-

able glass gage on its side through which the height of the liquid may be observed, in order that any undue amount of leakage thereof may be compensated by a renewed supply.

With the above construction a circulation of liquid is maintained, when the pump is operated and both the controlling-valve devices 8 and 8^a are open, through the pipes 5, 5^a, 5^b, and 5^c in the direction indicated by the arrows in Figs. 2 and 3, and liquid is also supplied to the train-pipe and brake-cylinders, the liquid in the latter, as well as that in the several pipes of the system, not then being under pressure. When, however, either of the controlling-valve devices 8 or 8^a is closed, the circulation of liquid in the pipe system is stopped and the continued action of the pump imposes a pressure upon the liquid by which the pistons of the brake-cylinders are forced outwardly therein and the connected brake-shoes applied to the wheels of the car. If the pressure should become unduly high, the excess-pressure valve 42 is thereby unseated and the circulation is reinstated to such degree and for such period as will relieve the excess.

The couplings 40, by which the train-pipe 5^c is connected to a train-pipe upon a trailer or other car coupled to that on which the brake apparatus is mounted, as indicated in Fig. 3, may be of any suitable known construction, and are preferably of the type provided with valves which close automatically when the coupling-sections are disconnected. A form suitable for the purpose is shown in Fig. 13, each of the coupling-sections being provided with a valve 46, adapted to close its fluid-passage, said valve being held unseated when the sections are coupled by a double-armed lever 47, pivoted to the coupling-section and having one of its arms fitting in a slot in the stem 50 of the valve 47 and the other adapted to engage a cam or inclined groove 48 in the section. When the lever 47 is released from the cam-groove, which is done in the act of uncoupling the sections, the valve 46 is seated by a spring 49 bearing on its back. The valve is correspondingly unseated by the engagement of the lever and cam-groove in coupling the sections.

Each of the brake-cylinders 6 is fitted with a properly-packed main piston 51, which is preferably, as shown in Figs. 16 and 17, adapted to impart applied pressure to its piston-rod 52 in such manner as to automatically and continuously take up wear and slackness or lost motion of the rubbing-surfaces in the operation of the apparatus. In the construction illustrated, which is desirably adapted to this end, the main piston 51, the traverse of which need only be comparatively short, is fitted in a counterbore at the end of the brake-cylinder to which liquid is admitted, which end is closed by a head or cover 52, to which the liquid-supply pipe 5^a is connected. The outward traverse of the main piston 51 in effecting an application of the brakes is limited by a shoulder 53 at the inner end of the counterbore, against which the adjacent follower-plate 54 abuts at the end of the stroke of the piston in that direction. On the backward movement of the piston the opposite follower-plate 55 abuts against the cylinder-head 52. A supplemental piston 56, to which the piston-rod 57 is secured, is fitted with suitable packing in the smaller bore of the cylinder beyond the shoulder 53 and is recessed or bored out centrally to receive a central stem 58, which projects from the inner side of the main piston 51. As originally fitted up, the end of the stem 58 abuts against the bottom of the recess in the supplemental piston 56, which is consequently moved directly by and with the main piston 51 throughout the traverse made by the latter in effecting an application of the brakes. A helical spring 59, which bears against the head of the brake-cylinder through which the piston-rod passes, returns both the main and the supplemental pistons to their normal positions upon the release of pressure from the main piston.

A passage 60 extends through the main piston 51 and is controlled by an inwardly-opening check-valve 61, which is held normally seated by a spring 62 and is guided by a central stem 63, fitting a corresponding bore in the stem 58 of the main piston. A by-pass or conduit 64, controlled by a cock 65, which is normally closed, leads from the larger bore of the brake-cylinder past the main piston 51 to the outer end thereof.

In operation the liquid from the supply-pipe 5^a raises the check-valve 61 and fills the space between the main and supplemental pistons, after which, the pressure in said space being equalized with that in the supply-pipe, the spring 62 seats the check-valve 61. As the surfaces of contact of the brake-shoes and the wheels become worn and lost motion or slackness is developed in the connections between the piston-rod and brake shoe or shoes the diminished resistance to the movement of the supplemental piston 56 which results therefrom permits the pressure of the liquid supplied through the pipe 5^f to raise the check-valve 61, thereby admitting a sufficient quantity of liquid to the space between the main and supplemental pistons to move the supplemental piston out of contact with the central stem of the main piston and outwardly for a sufficient distance to take up such wear or slackness, whereupon, the pressure being equalized on opposite sides of the main piston, the check-valve is closed by its spring, and the main piston thereafter acts upon the supplemental piston in effecting the outward movement of the latter through the intermediation of the incompressible body of liquid interposed between the pistons. The admission of liquid is similarly effected coincidently and correspondingly with increase of wear or slackness or both, the supplemental piston being progressively moved away from the main piston until

it has advanced so far in the cylinder as to prevent it from making as great a stroke as that of the main piston. The cock 65 of the by-pass 64 is then opened and the liquid released from the space between the pistons until they are again brought into contact, as in Fig. 16, when the cock 65 is closed, and proper renewal or adjustment of the frictional surfaces and connections having been made, so as to take up the wear and slackness and bring the parts to normal condition, the further operation of the pistons is effected as above described. The intermediate mechanism through which the force applied to the piston 51 is transmitted to the brake shoe or shoes is not, in and of itself, an essential of my invention, and any suitable and preferred system of brake connections heretofore employed for the purpose may be adopted in the discretion of the constructor. The specific system illustrated, in which the piston of each brake-cylinder actuates the brake-shoes of two wheels, is, however, desirably applicable in point of simplicity and facility of application and is of the following construction.

Referring more particularly to Fig. 4, in which this portion of the apparatus is most clearly shown, the brake-cylinder 6 is supported below the frame 1 of the car and between two of its axles and is in this instance bolted to a casting 66, secured to the frame. A stout fulcrum rod or bar 67 is fitted freely by a rounded or spherical-faced end in a recess in the head 52 of the brake-cylinder, and its opposite end is coupled by a pin 68 to the lower end of a link or hanger 69, the upper end of which is coupled by a pin 70 to a block or bearing on the car-frame. The piston-rod 57 is coupled by a pin 71 to the lower end of a similar link 72, the upper end of which is coupled by a pin 73 to a block or bearing on the car-frame. The piston-rod is also coupled by the pin 71 to a double-armed brake-lever 74, the lower end of which is coupled by a pin 75 to the brake-shoe 7 of the adjacent car-wheel 2. The upper end of the brake-lever 74 is coupled by a rod 76 to the upper end of a corresponding brake-lever 77, the lower end of which is coupled by a pin 78 to the brake-shoe 7 of the car-wheel on the corresponding end of the next axle, that is, the axle toward which the fulcrum rod or bar 67 extends. The brake-lever 77 is also coupled by the pin 68 to the fulcrum rod or bar 67 and the link 69.

When the piston-rod 57 is forced outwardly to apply the brakes, its first action is to move the brake-lever 74 bodily in the same direction until the adjacent brake-shoe 7 is brought into and held in contact with the adjacent wheel 2. The further outward traverse of the piston-rod 57 then moves the brake-lever 74 upon the pin 75 as a fulcrum, the upper end of said brake-lever moving to the right in Fig. 4 and, through the connecting-rod 76, moving the brake-lever 77 in the same direction upon the pin 78 as a fulcrum, and thereby applying the connected brake-shoe 7 to the tread of the wheel adjacent to which it is suspended. Upon the release of pressure in the brake-cylinder, effected by opening whichever of the controlling-valve devices 8 or 8^a as has been closed for making an application of the brakes, the spring 59, surrounding the piston-rod, (shown in Figs. 16 and 17,) returns the parts to the release positions indicated in Fig. 4.

As shown in Fig. 3, the operating-lever mechanism for moving the pump into and out of position for actuation is shown as adapted to be worked by the foot of the operator and the controlling-valve device as operated by hand, while in Figs. 1, 2, 5, 6, and 7 both the pump-moving mechanism and the controlling-valve device are operated by a hand-lever. Referring first to Fig. 3, the supporting-frame 10 of the pump 4 is coupled, by a pin 15, located in its middle portion and on the side farthest from the driving-ring 20, to the lower end of a double-armed lever 17^a, which is pivoted between its ends, by a pin 18^a, to a suitable support on the car-frame. The upper end of the lever 17^a is coupled by a link 80^a to the arm 81 on a rock-shaft 82, which is journaled in a suitable bearing on the car-frame and which is provided with an oppositely-extending arm 84 and an arm 83, substantially at right angles to the arms 81 and 84. The arm 83 is coupled to the lower end of a rod 85, having a treadle 86^a on its upper end and fitted to move vertically in a guide fixed to the car-frame 1. A spring 87, bearing against a shoulder on the rod 85, holds the latter normally in its highest position, in which, through the connections above described, the supporting-frame 10 of the pump is suspended in such relation to the adjacent car-wheel that the rollers 12 12 and 24 are out of contact with the driving-ring 20 and the pump is consequently inoperative.

By pressure upon the treadle the spring 87 is compressed and the downward movement of the rod 85, through its connections with the supporting-frame 10, moves the latter into such position that one or the other of the rollers 12 (according to the direction of movement of the car) and the roller 24 will be brought into frictional contact with the driving-ring 20, thereby effecting the actuation of the pump during such period as said contact is maintained by the continued depression of the rod 85. Upon the relief of pressure from the treadle 86^a the parts are returned to normal position by the spring 87.

The arm 81 of the rock-shaft 82 is coupled by a rod 86 to an arm 81^a on a corresponding rock-shaft similarly connected with a spring treadle-rod 86^{aa} near the opposite end of the car. The connecting-pins of the rod 86 and rock-shaft arm 84 and of the rock-shaft arm 83 and treadle-rod 85 fit in longitudinal slots, so as to prevent movement of the treadle-rod and connections at one end of the car when the treadle at the other end is operated.

The plug-cocks of the controlling-valve devices 8 8ª at opposite ends of the car are respectively operated, as required, by handles 92 9ª, fixed upon their stems.

In the operating-lever mechanism illustrated in Figs. 1, 2, 5, 6, and 7 the horizontal arm of the bell-crank lever 17, to which, as before stated, the pump-supporting frame 10 is coupled by a pin 16, is pivoted by a pin 19 to the lower end of a rod 79, the upper end of which is coupled to an arm 81 on a rock-shaft 82, journaled in a bracket or depending arm 93, fixed to the car-frame. The rock-shaft 82 carries substantially at right angles to the arm 81 two oppositely-extending arms 83 84, the upper of which is connected by a rod 85 with the lower end of a lever 88, which is pivoted by a pin 89 to the lower end of a vertical standard 90, fixed upon the car-frame near one end of the car, said standard also supporting on a lateral projection near its top the controlling-valve device 8. The lower arm 84 of the rock-shaft 82 is connected by a rod 86 with a lever 88ª, located at the opposite end of the car from the lever 88 and provided with accessions similar to those of the latter, as presently to be described, in order to admit of the manipulation of the pump starting and stopping mechanism and of a controlling-valve device from either end of the car, as required. The connections of the rock-shaft arm 83 and the rod 85 and of the rock-shaft arm 84 and the rod 86 are made by pins fitting in longitudinal slots, so as to prevent movement of the lever 88 or 88ª at one end of the car when the corresponding lever at the opposite end is operated.

A lever 94 is journaled on the pivot-pin 89 of the lever 88 and extends above the top of the standard 90. A hand-lever 95 is pivoted by a pin 96 to the top of the lever 94 and is provided with two arms 97 98, which project from it in opposite directions from the axis of its pivot. A dog or latch 99 is pivoted by a pin 100 to the standard 90 in such position that its free end may slide over the top of the lever 88, which is curved to a radius struck from the center of the pivot-pin 89 of said lever and is provided with two lateral projections 91 91, one of which abuts against the standard 90 and the other against one side of the lever 94 when the levers stand in the positions occupied during the operation of the pump, as shown in Fig. 6. An angular recess 101 is formed in the free end of the dog or latch 99, which is coupled to the lower end of a rod 102, the upper end of which is hooked or bent over to engage a pin 103 on the arm 98 of the hand-lever 95, which arm is downwardly prolonged beyond said pin to form a toe 106, which, when the hand-lever 95 is swung to the left on its pivot 96, abuts against the adjacent side of the lever 94.

A helical spring 104 surrounds the rod 102 and bears at one end against a projection on the standard 90 and at the other against a nut 105, which engages a thread on the rod, and may be adjusted longitudinally thereon to vary the tension of the spring 104, as may from time to time be required. The lower face of the arm 97 stands immediately above and slightly clear of the top of the stem 38 of the controlling-valve 37 in the periods of release of the brakes, the valve 37 being then free to be unseated by the fluid circulated through the pipe system during the operation of the pump.

When it is desired to make an application of the brakes, the pump is first put in operation by bringing the levers 95, 94, and 88 and their connections into the positions shown in Figs. 5, 6, and 7, which is done by simply raising the dog or latch 99 from engagement with the lever 88, which lever is then moved by the spring 80 into the position shown in Fig. 6 and the pump is moved into the position shown in Fig. 5. The hand-lever 95 is then moved to the right, thereby depressing the stem 38 of the controlling-valve 37 and closing said valve, which is held seated by the pressure of the operator on the hand-lever 95. The pressure generated in the pipe system by the actuation of the pump thereupon immediately applies the brakes, the application of braking force being continued, so long as the valve 37 is held closed, until the car is stopped. To release the brakes, the operator releases his pressure on the hand-lever 95, which is thereupon returned by the spring 104 to the position shown in Fig. 6, when the valve 37 is unseated by the pressure of the liquid beneath it, the free circulation of liquid in the pipe system is reinstated, and, the pressure on the brake-cylinder pistons being thereby released, the springs 59, acting in the opposite direction thereon, withdraw the brake-shoes from contact with the wheels.

To stop the operation of the pump, the hand-lever 95 is moved to the left, which first brings the toe 106 to a bearing against the side of the lever 94 and thereafter moves the lever 94 coincidently with the lever 95. The lever 94, by its bearing on one of the projections 91 of the lever 88, throws the upper end of said lever to the left and the lower end to the right, and through the rod 85 and its connections raises the lower arm of the bell-crank lever 17 and moves the supporting-frame 10 of the pump away from the wheel, thereby removing the rollers from contact with the driving-ring and stopping the operation of the pump. When the upper end of the lever 88 has been moved to the left of the dog or latch 99, the spring 104 throws the angular recess 101 of the dog or latch into engagement with the right-hand side of the upper end of the lever 88, holding said lever in the inclined position shown at the right of Fig. 1 and holding the supporting-frame 10 away from the wheel. The levers 94 and 95 may then be returned to the position shown in Fig. 6, leaving the lever 88 locked in position by the dog or latch. To renew the operation of the pump, it is only necessary to raise the dog or latch 99 out of en-

gagement with the lever 88, when the spring 80, Fig. 5, returns the lever 88, the supporting-frame 10, and the intermediate connections to the positions shown in Figs. 5 and 6.

A leading and characteristic feature of advantage of my improvement is the fact that the momentum of the car is utilized as the braking force, which is consequently provided without the expenditure of any power whatever over and above that required for the propulsion of the car. A further advantage is presented in the material reduction of wear of the pump and its actuating mechanism as compared with prior constructions, in which a pump which is operated continuously during the movement of the car is employed. No perceptible time is required for the generation or accumulation of braking power, as the brake apparatus is ready for operation as soon as the pump is started, and the exertion of braking power to the full or to a partial extent, as may be required, is effected instantaneously by the total or partial closure of the controlling-valve device, as the case may be.

It will further be seen by reference to Fig. 2, in which the motor mechanism of an electric car is indicated by dotted lines, that my improvement is readily applicable to cars of this class, and that no modification of or interference with the motor mechanism ordinarily employed is involved in such application.

I claim as my invention and desire to secure by Letters Patent—

1. In a brake apparatus, the combination, substantially as set forth, of a pump-supporting frame, a suspension-link connecting said frame to the frame of a railroad-car adjacent to a wheel thereof, a driving ring or pulley formed or fixed on said wheel, a pump-cylinder connected to the supporting-frame, a piston working in said cylinder, a pump-shaft journaled in the supporting-frame, connections for reciprocating the piston from said shaft, a driving-roller fixed upon the pump-shaft and a friction-roller journaled in the supporting-frame, each in position to bear against the wheel-driving ring, mechanism for moving the supporting-frame into and out of position for the driving and friction rollers to make contact with the wheel-driving ring, a pipe system through which liquid may be circulated by the pump, and a brake-applying mechanism actuated by pressure imparted to liquid in the pipe system by the pump.

2. In a brake apparatus, the combination, substantially as set forth, of a pump adapted to be intermittently operated from a car-axle, a pipe system through which liquid may be circulated by the pump, a brake-applying mechanism actuated by pressure imparted to liquid in the pipe system by the pump, mechanism for transferring the pump into and out of position for actuation, lever mechanism located adjacent to each end of the car, for actuating the pump-transferring mechanism, and connections between said lever mechanisms for enabling either to be operated independently of the other.

3. In a brake apparatus, the combination, substantially as set forth, of a pump adapted to be operated from a car-axle, a pipe leading from said pump to a casing provided with a receiving and a delivery valve, a pipe leading from the delivery-valve chamber to a controlling-valve, a pipe leading from the controlling-valve to the receiving-valve chamber, a pipe leading from one of said pipes to a brake-cylinder, a piston fitting said brake-cylinder, a brake-shoe connected to said piston, and mechanism operative independently of variation in the pressure of the liquid in the system for instituting and discontinuing the operation of the pump and actuating the controlling-valve.

4. In a brake apparatus, the combination, substantially as set forth, of a pump adapted to be operated from a car-axle, a pipe leading from said pump to a casing provided with a receiving and delivery valve, a pipe leading from the delivery-valve chamber to a controlling-valve, a pipe leading from the controlling-valve to the receiving-valve chamber, a by-pass pipe establishing a circulation from the receiving to the delivery valve chamber, independently of the controlling-valve, an excess-pressure or safety valve governing said by-pass pipe, a pipe leading from one of said pipes to a brake-cylinder, a piston fitting said brake-cylinder, a brake-shoe connected to said piston, and mechanism operative independently of variation in the pressure of the liquid in the system for instituting and discontinuing the operation of the pump and actuating the controlling-valve.

5. In a brake apparatus, the combination, substantially as set forth, of a pump adapted to be operated from a car-axle, a pipe leading from said pump to a casing provided with a receiving and a delivery valve, a pipe leading from the delivery-valve chamber to a controlling-valve, a pipe leading from the controlling-valve to the receiving-valve chamber, a train-pipe connected with one of said pipes and provided with an end coupling and cock, a pipe leading from one of the before-recited pipes to a brake-cylinder, a piston fitting said brake-cylinder, and a brake-shoe connected to said piston.

6. In a brake apparatus, the combination, substantially as set forth, of a brake-cylinder connected to a car-frame between wheels of two axles of a car, a fluid-supply pipe leading into said cylinder, a piston fitting said cylinder, a piston-rod fixed to said piston, a double-armed brake-lever coupled to said piston-rod and to a suspension-link, a brake-shoe pivoted to one end of said brake-lever, a fulcrum rod or bar fitting freely in the head of the cylinder and extending therefrom in opposite direction to the piston-rod, a double-armed brake-lever coupled to the fulcrum rod or bar and to a suspension-link, a brake-shoe pivoted to one

end of said brake-lever, and a rod or link coupled to the opposite end of said brake-lever, and to the corresponding end of the brake-lever which is directly connected to the piston-rod.

7. In a brake apparatus, the combination, substantially as set forth, of a brake-cylinder, a fluid-supply pipe leading thereinto, a piston fitted in a counterbore at the supply end of said cylinder, a piston fitted to traverse in a smaller bore extending from the counterbore toward the opposite end of the cylinder, a piston-rod fixed to the smaller piston, a retracting-spring bearing on said smaller piston, a tubular projection on the larger piston which enters a recess in the smaller piston, and initially bears thereon, and a spring-seated valve controlling the passage of fluid through the larger piston to the space between the two pistons.

8. In a brake apparatus, the combination, substantially as set forth, of a brake-cylinder, a fluid-supply pipe leading thereinto, a piston fitted in a counterbore at the supply end of said cylinder, a piston fitted to traverse in a smaller bore extending from the counterbore toward the opposite end of the cylinder, a piston-rod fixed to the smaller piston, a retracting-spring bearing on said smaller piston, a tubular projection on the larger piston which enters a recess in the smaller piston and initially bears thereon, a spring-seated valve controlling the passage of fluid through the larger piston to the space between the two pistons and a by-pass or conduit controlled by a cock or valve and leading from the space between the two pistons to the supply side of the larger piston.

9. In a brake apparatus, the combination, substantially as set forth, of a pump adapted to be intermittently operated from a car-axle, a brake-cylinder having a piston connected to a brake-shoe, a pipe system through which liquid may be circulated by the pump, a valve controlling the traverse of liquid in the pipe system, a pivoted lever and connections for transferring the pump into and out of position for operation, a dog or latch for holding said lever in adjusted position, and a pivoted hand-lever having connections for moving the transferring-lever and releasing the dog or latch, and for closing and releasing the controlling-valve without changing the position of the transferring-lever.

In testimony whereof I have hereunto set my hand.

FRANCIS L. CLARK.

Witnesses:
J. SNOWDEN BELL,
F. E. GAITHER.