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# W. H. WARD.

## STEAM RAILWAY BRAKE.

No. 246,924. Patented Sept. 13, 1881.

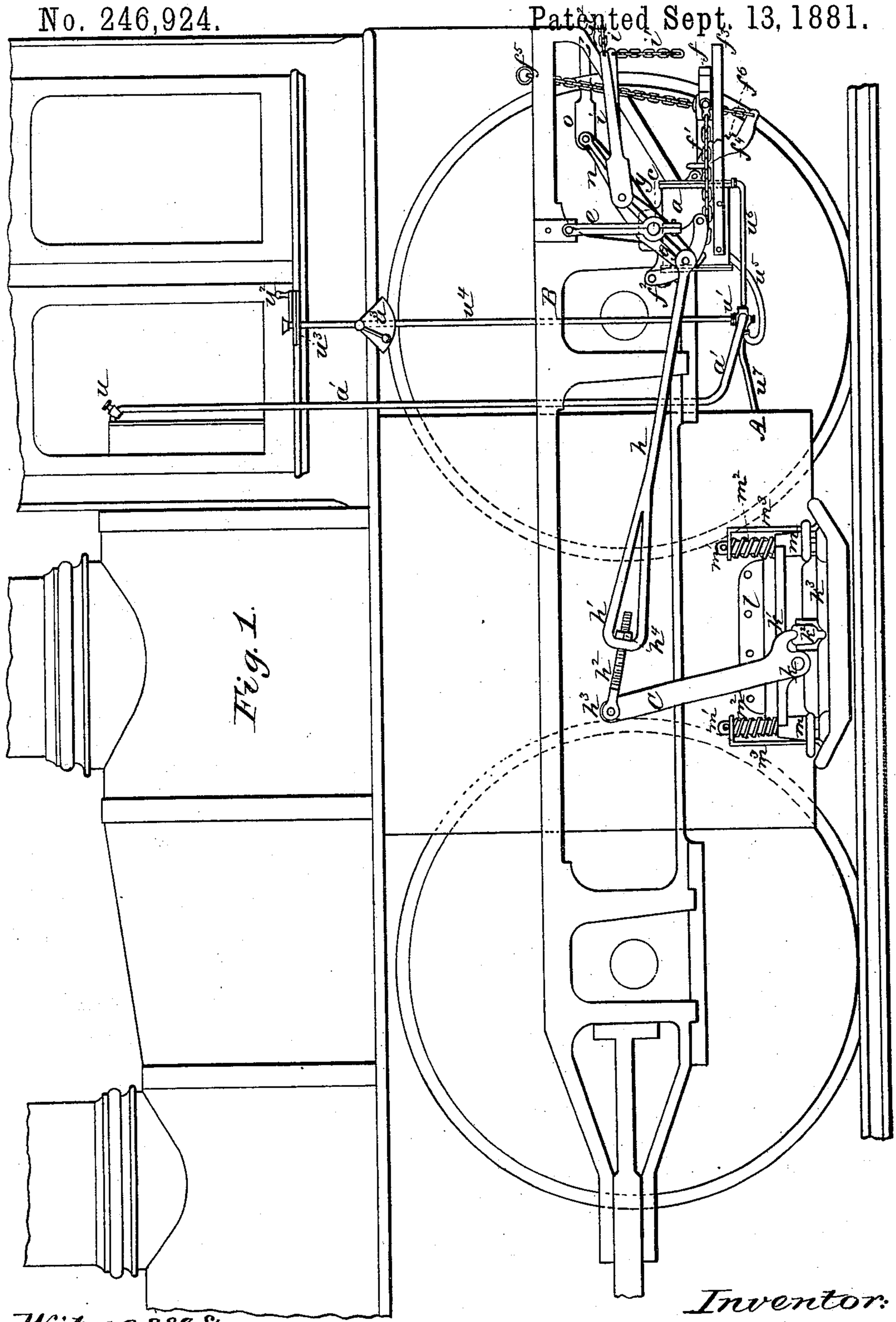


Fig. 1.

Witnesses:

W. B. Masson.

Floyd Norris.

Inventor:

per W. H. Ward

Johnson and Johnson

Attys

(No Model.) 5 Sheets—Sheet 2.

# W. H. WARD.

## STEAM RAILWAY BRAKE.

No. 246,924. Patented Sept. 13, 1881.

Fig. 2.

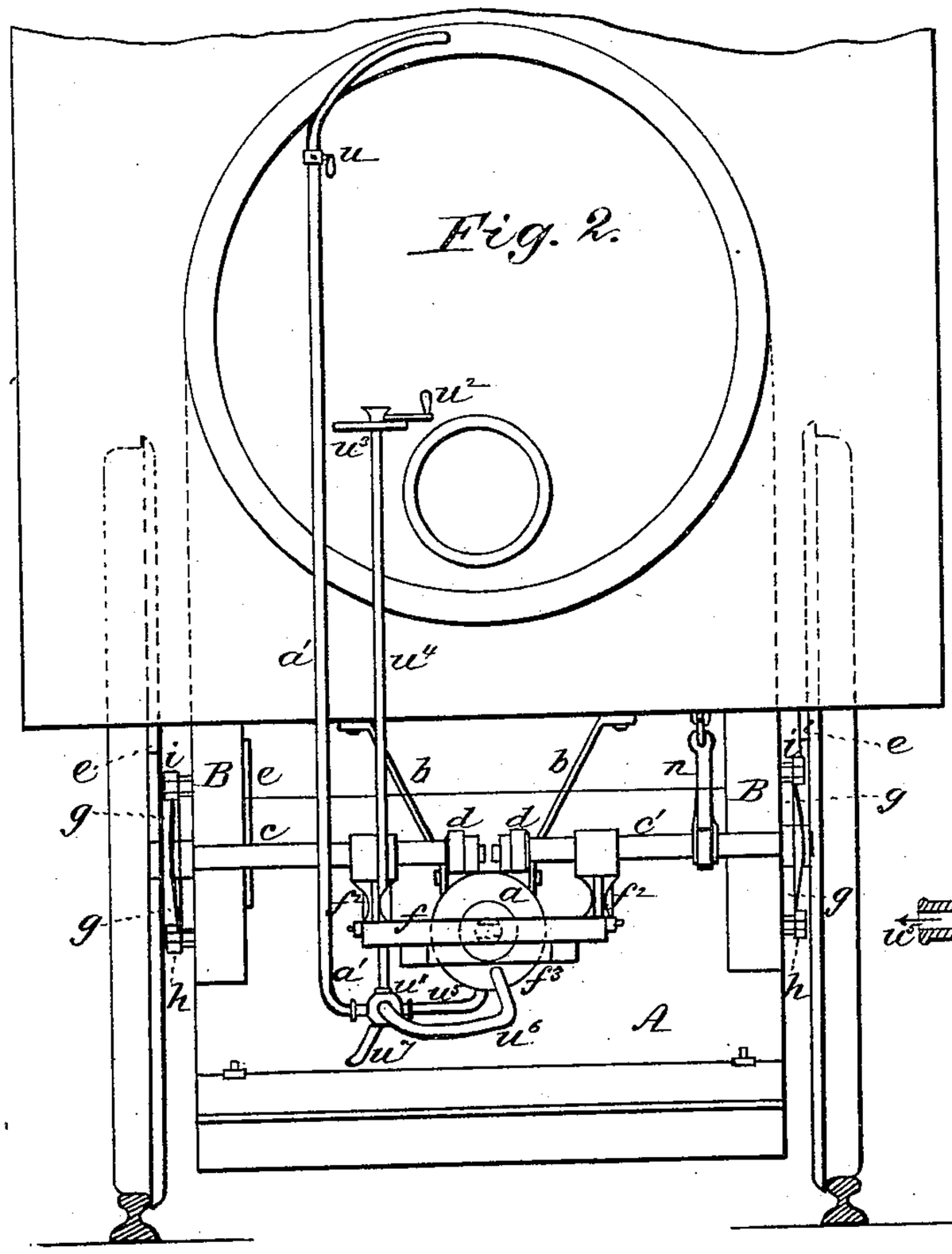



Fig. 2ª

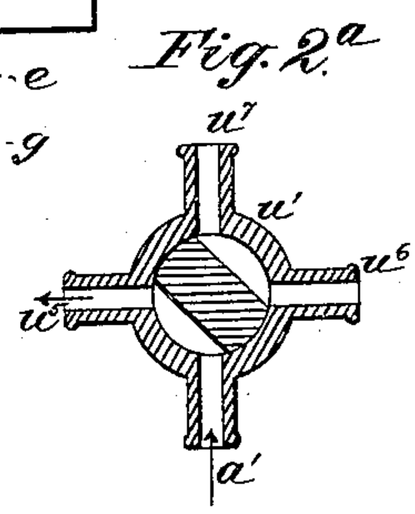
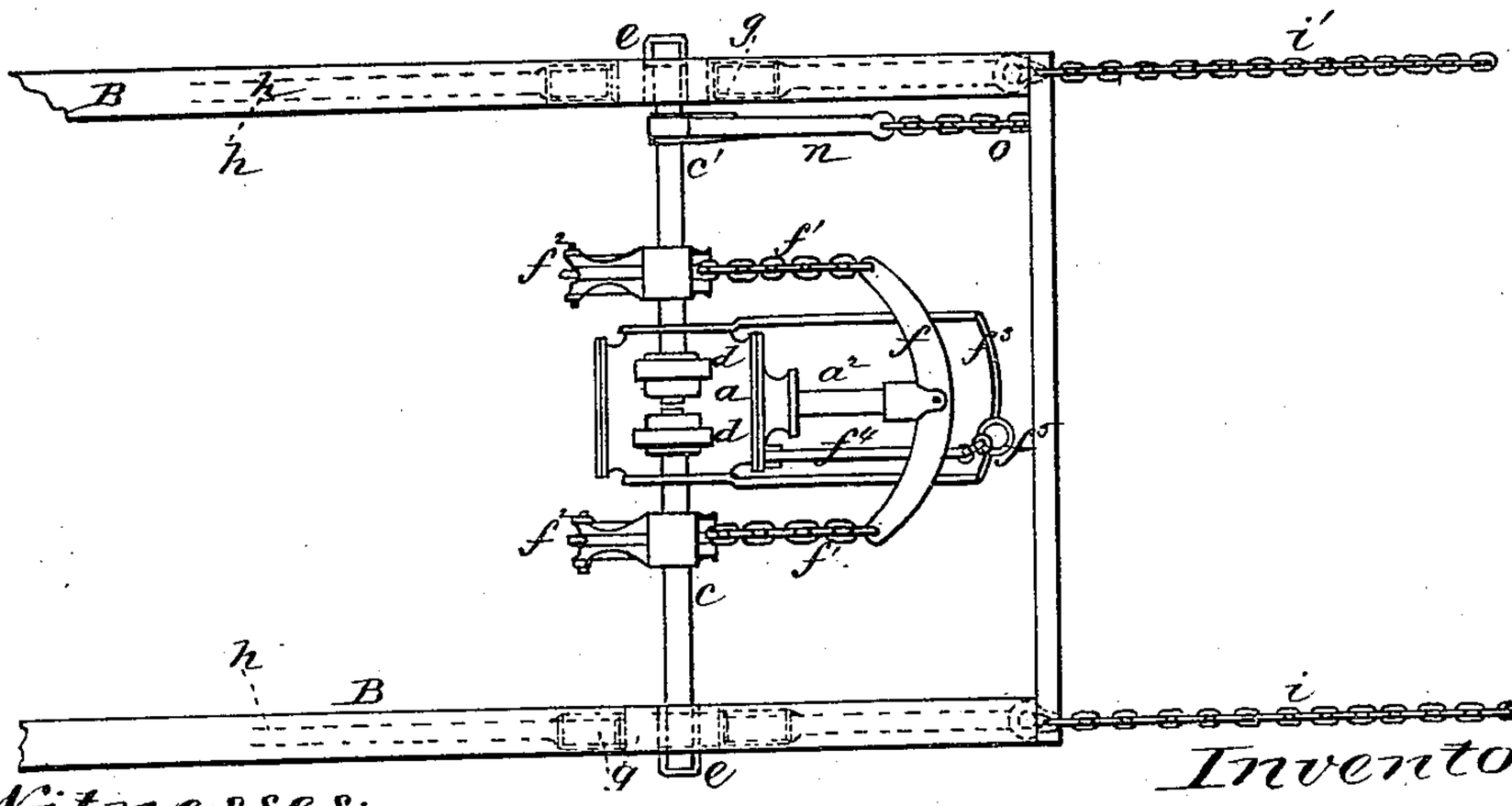



Fig. 3.




Witnesses:

W. B. Masson.

Floyd Norris.

Inventor:

pro W. H. Ward

Johnson and Johnson

Attys.

(No Model.) 5 Sheets—Sheet 3.

# W. H. WARD.

## STEAM RAILWAY BRAKE.

No. 246,924. Patented Sept. 13, 1881.

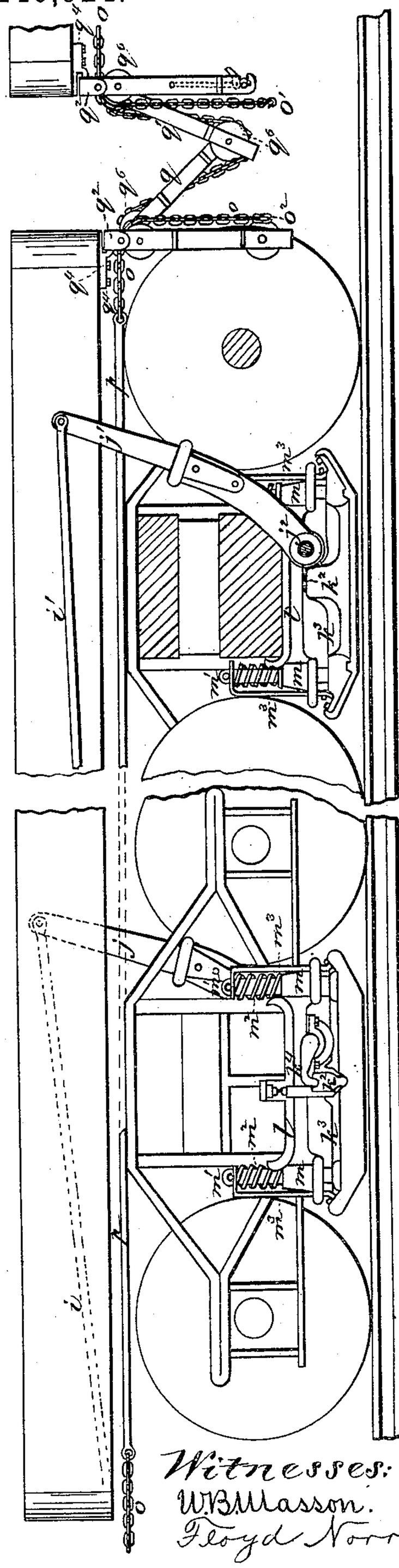


Fig. 4.

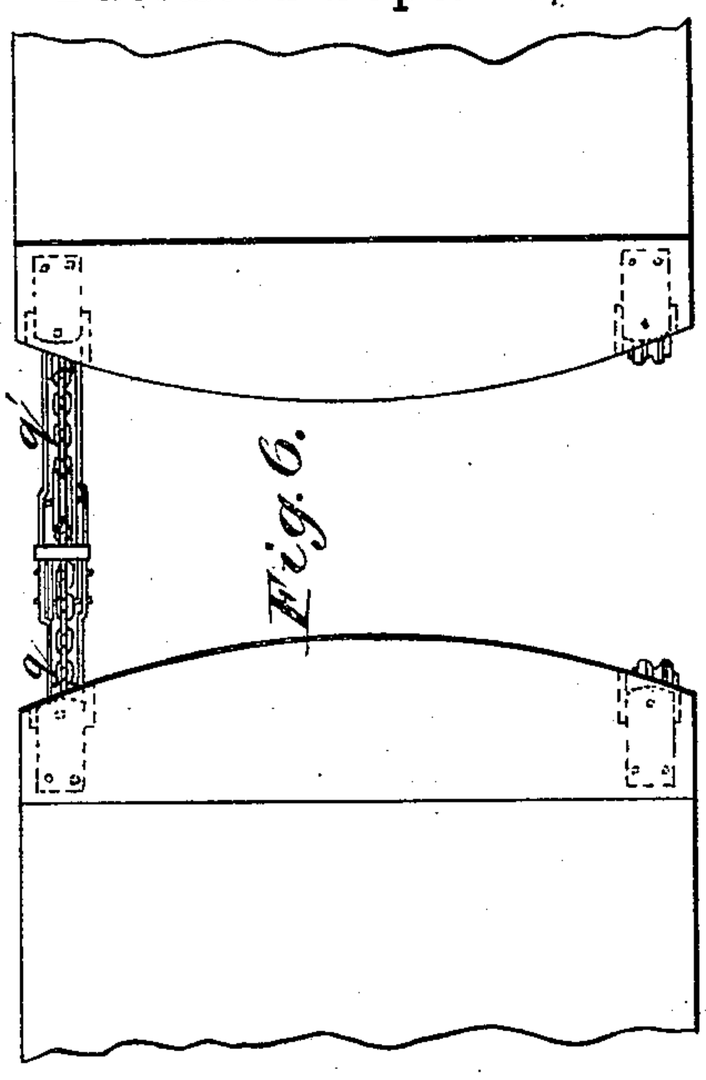


Fig. 6.

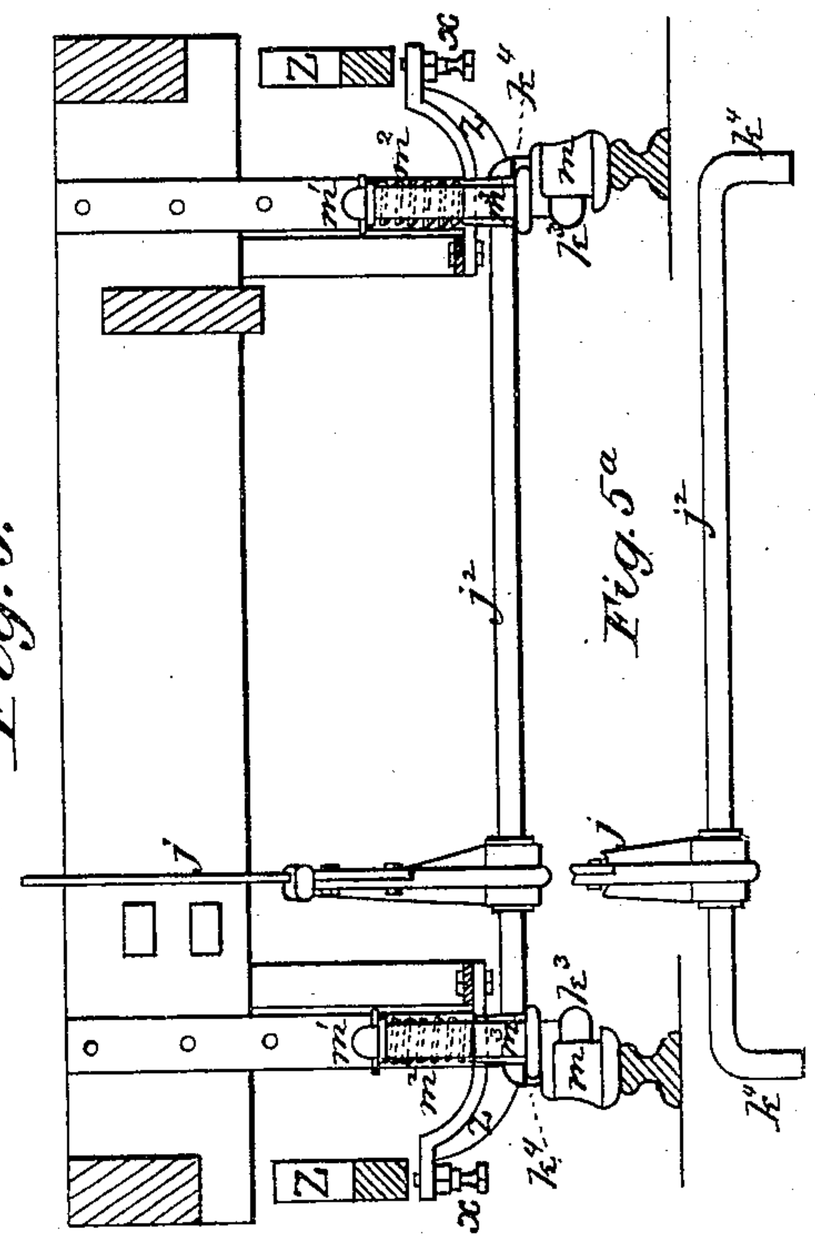


Fig. 5.



Fig. 5a

Witnesses:
W. B. Masson.
Floyd Norris.

Inventor:
pro W. H. Ward
Johnson and Johnson
Attys

(No Model.) 5 Sheets—Sheet 4.

# W. H. WARD.

## STEAM RAILWAY BRAKE.

No. 246,924. Patented Sept. 13, 1881.

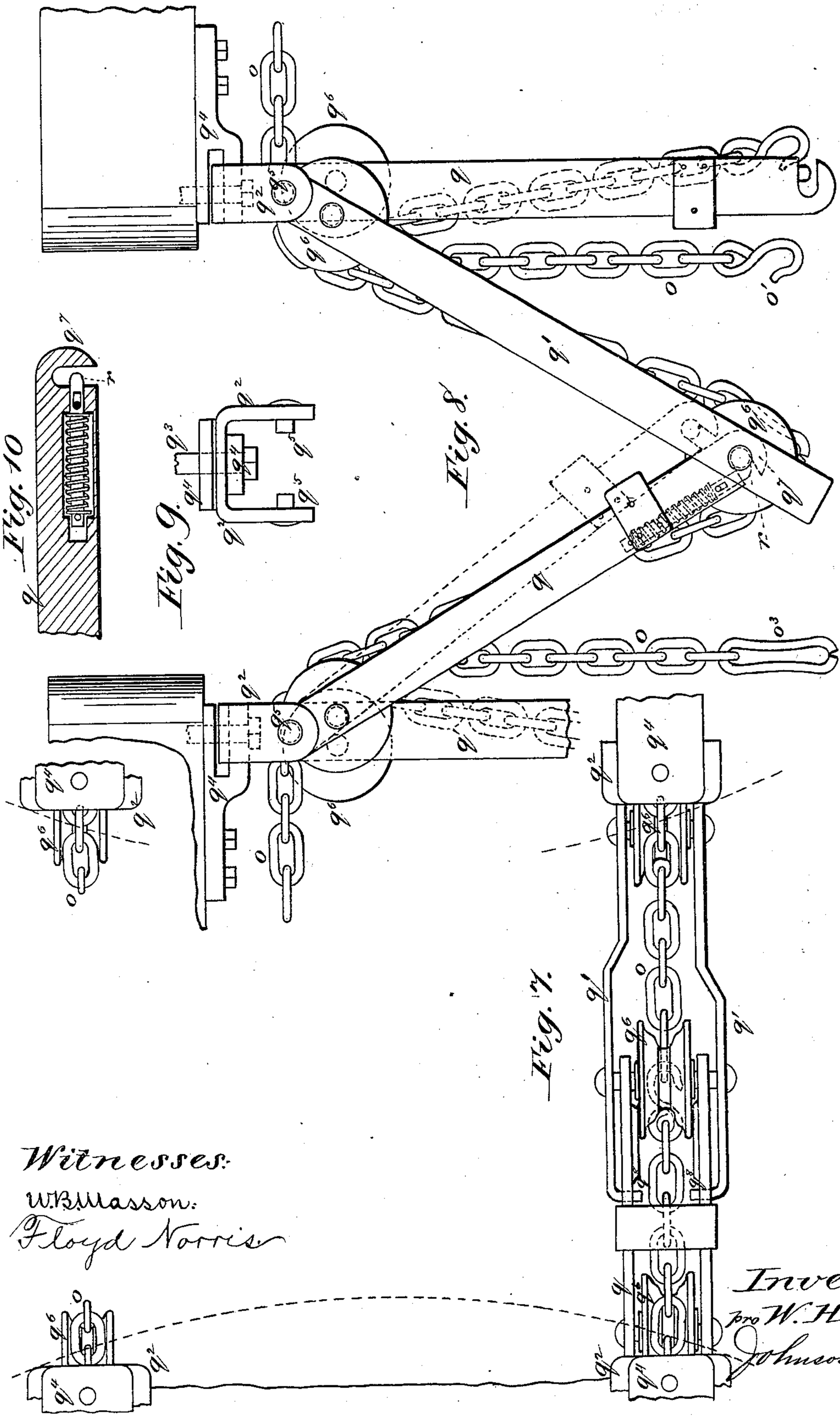


Fig. 8.



Fig. 9.



Fig. 10



Fig. 11.

Witnesses:
W. B. Masson.
Floyd Norris

Inventor:
per W. H. Ward
Johnson and Johnson
Attys

(No Model.) 5 Sheets—Sheet 5.

# W. H. WARD.

## STEAM RAILWAY BRAKE.

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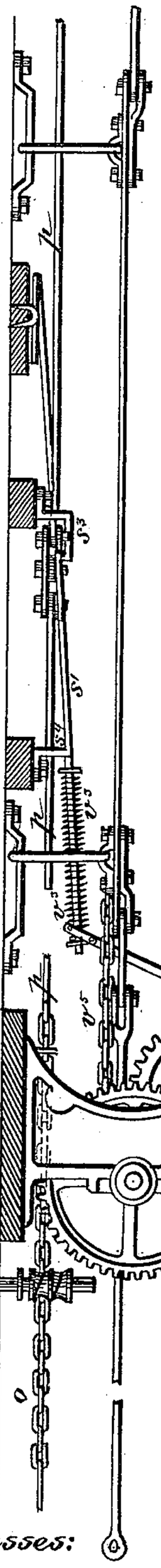

Fig. 11.

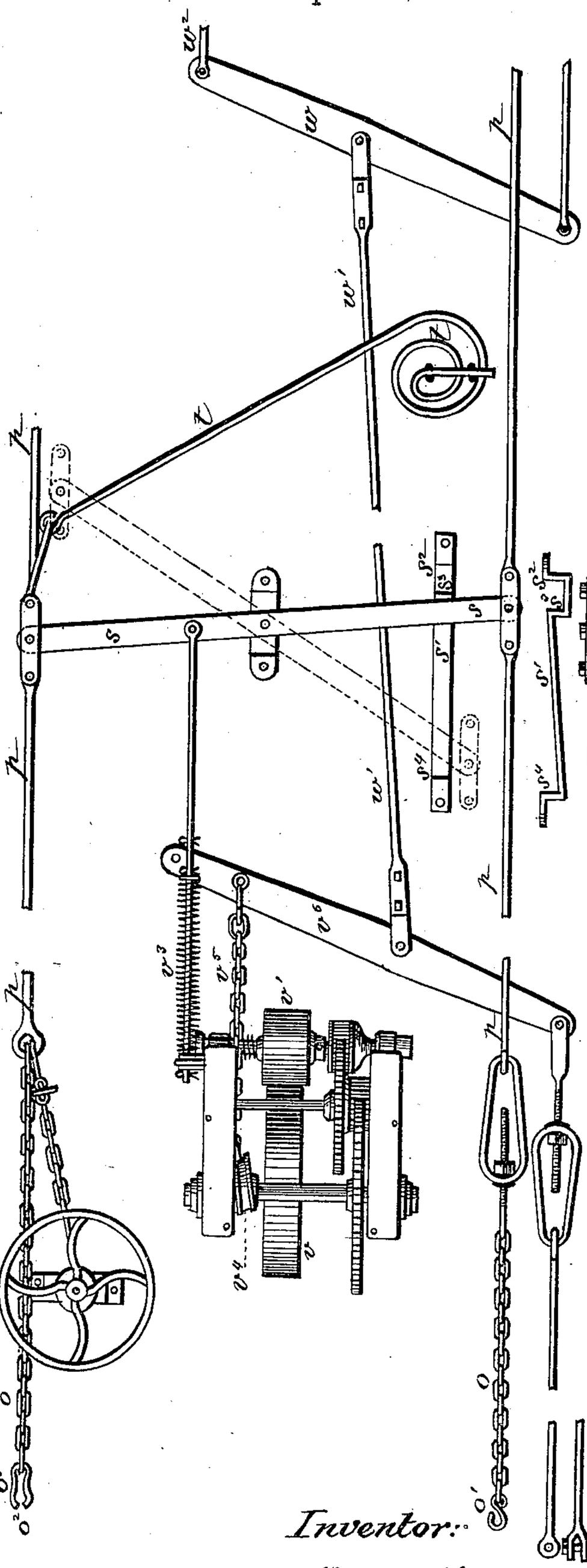

Fig. 12.

Witnesses:

W. B. Wasson

P. C. Dieterich

Inventor:

per W. H. Ward

Johnson & Johnson

Attys.

# UNITED STATES PATENT OFFICE.

WILLIAM H. WARD, OF PITTSBURG, PENNSYLVANIA.

## STEAM RAILWAY-BRAKE.

SPECIFICATION forming part of Letters Patent No. 246,924, dated September 13, 1881.

Application filed February 14, 1881. (No model.)

*To all whom it may concern:*

Be it known that I, WILLIAM HENRY WARD, a citizen of the United States, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented new and useful Improvements in Steam-Power Railway-Train Brakes, of which the following is a specification.

My invention is directed to improvements on steam-brakes for railway-cars.

The brakes of the locomotive, the tender, and of the train are connected with and operated by the piston of a steam-cylinder secured centrally beneath the foot-board of the locomotive-cab, and by which the engineer can apply and release the brakes at pleasure. The steam-brake cylinder is suspended in horizontal position by a fixed hanger or hangers, and its piston-rod is connected with and operates separate and independent cross-shafts of the locomotive, and whose outer ends are suspended by pivoted hangers and connected with the brake-operating devices in such manner as to allow of an accommodating action of the shafts and the brake-connections, so as to equalize or balance the brake force upon the shoes of the locomotive and tender in applying the brakes. The brake and piston-rod connections with said separate shafts are made by means of an evener-bar and chains connected with the piston, so that the action of said piston will correspondingly turn the said shafts equally and apply and release the brakes of the locomotive boiler and tender. The action of the evener-bar, co-operating with the accommodating function of the operating-shafts separately connected therewith, compensates for any unequal wear of the brake-shoes of the locomotive and tender and gives an accommodating action for track curvature or unevenness without strain to the engine or its work connections or the trucks of the tender.

From the piston-connections the brake action can be rendered effective with the brakes of the locomotive when the latter is detached from the tender; or the engineer can apply the brakes of the locomotive and tender simultaneously and with equal force and release such brake action at pleasure; or the engineer can apply and release all the brakes of the train; and this control of the locomotive, the locomotive and its tender, and of the entire train is effected by means of a four-way cock having suitable connections with the steam-chamber of the locomotive and with the brake-operating cylinder.

The brake-shoes of the locomotive are applied by independent lever-connections with the suspended ends of the separate operating cross-shafts, which are provided with double arms for such connections and for connections with the brake mechanism of the tender, while the brake-connections with said separate operating-shafts to the cars of the train is made by an arm attachment to one of said shafts, and these shafts, being directly connected with and operated from the piston-rod of the suspended steam-cylinder, give the engineer complete control over the train.

The train car connections with the brake-cylinder are made by one of the said separate brake-operating cross shafts and chains crossing between cars on what I denominate a "compensator," for the expansion and contraction between cars, and by which there is no lost motion in operating the brakes of the train from the engine. This compensator forms a stiff carrier between cars for the brake-operating chain-connections, while being freely accommodating in its connections to the movements of the cars. Provision is made for the automatic separation of this compensating-chain carrier in the event of the train separating. Provision is also made for the separation of the brake-operating connecting-chains in the event of the separation of the train and of the compensating chain carrier between cars; and in such event provision is made for causing friction-roll appliances to be automatically applied on the detached portion of the train to operate the brakes of the cars and retain them in full brake force.

The brakes of the locomotive are operated by separate levers pivoted in the brake-shoe frames, and each connected to a crank-arm on the outer suspended end of the separate cross-shafts, each lever having a pinch-toe projection adapted to operate upon an accommodat-

ing step or bearing seated loosely in the shoe-retainer, so as to depress the shoe upon the rail. By this construction the brakes of the locomotive and of the tender are operated by independent cross-shafts, which are themselves operated by a single cylinder and piston connections.

The brake-connections with the piston of the steam-cylinder are such that when the brakes are not in use the piston-rod will be within the cylinder, and thereby kept warm and clean, which is important to prevent the destroying of the piston head and rod joint packing. The cylinder is arranged with its steam-receiving end near the fire-box, and is thereby kept warm and frees itself of water.

A locking device is combined with the brake steam-cylinder for the purpose of retaining the brakes in holding positions independent of the action of the piston after the brakes are set, and thereby relieve the engineer from attention to the brakes for the time being. The cylinder receives the steam at its end opposite the piston-rod, and when the pressure is off the brakes are instantly released by steam-pressure.

Provision is made by which the separate pinch-toe lever-connections, with their separate operating cross-shafts, may be adjusted for the proper action of the pinch-toes upon the brake-shoes. The brake-shoes of the locomotive are forced down upon the rails by the action of the separate pinch-toe levers, the upper ends of which are drawn rearward to depress their pinch-toes by the crank-arms upon the cross-shaft, which are turned sufficiently for that purpose by means of sectors thereon, and with which the evener-bar of the piston-rod is connected on each side of the brake-cylinder, so that the outward movement of the piston-rod operates to apply the brakes with a short and powerful lever force of the pinch-toes and without friction, while the brakes of the tender are applied at the same time by connections with said cross-shafts operating to draw the levers of the pinch-toe shafts forward, the pinch-toe shafts of the tender-brakes being each operated by a separate lever having separate arm-connections with the said independent cross-shaft of the locomotive.

The brake-shoe carriers are adapted for vertical movement upon the brake-shoe frames, and are raised and held free of the rails when the brakes are off.

The brakes of the train in rear of the tender are operated by friction-roll appliances adapted to be operated by the momentum force of the train. This momentum force is put under the control of the engineer by means of the steam-brake connections, and is brought into action throughout the train when required, so that each car utilizes its own momentum force to stop itself when the engineer applies the steam force to the locomotive. The tender and the train break connections by means of the four-way cock.

Referring to the accompanying drawings, Figure 1 represents an elevation of the driving-wheel portion of a locomotive frame and boiler with my improved brake mechanism applied thereto, the brakes being shown as off; Fig. 2, a rear end elevation of the same, showing the suspended steam-brake cylinder and its boiler-connections and the connections of the piston with the independent cross-shafts for operating the brakes. Fig. 2ª shows a section of the four-way cock and its several ports connecting with the cylinder, the steam-chamber of the locomotive, and the fire-box. Fig. 3 is a top view of the steam-brake cylinder, showing the evener-bar and its chain-connections with the independent brake-operating cross-shafts; Fig. 4, a side elevation of the forward tender-truck and a longitudinal section of the rear tender-truck, showing the brake-operating mechanisms thereof and the compensating train-brake connection between the cars of the train; Fig. 5, a cross-section of the tender-truck, showing the positions of the brake-shoes when applied upon the rails and their operating pinch-toe cross-shaft. Fig. 5ª is the pinch-toe cross-shaft for operating the brake-shoes of the tender; Fig. 6, a top view of the platform ends of two cars, showing the compensating train-brake-operating connection between the cars. Fig. 7 is an enlarged top view of the same; Fig. 8, an enlarged elevation of the same, showing the compensating-arms and the brake-connections and operating-chains in both coupled and uncoupled positions. Fig. 9 is a detail front view of one of the swivel-joint hangers for the compensator-arms. Fig. 10 is a detail sectional view of the hook connecting end of one of the compensator-arms, and showing the spring-bolt retainer for the hook-connection. Fig. 11 represents a longitudinal section of so much of a car-frame as shows the frictional mechanism for operating the brakes and the through connections for train-brake operation, and Fig. 12 represents a top view of the parts shown in Fig. 11. These two latter figures represent the friction appliances by which the brakes of the cars in rear of the tender are operated, and such friction appliances are connected with the locomotive brake-operating devices and controlled thereby. They are, however, adapted for being operated by hand from the forward car or from any car of the train, and therefore are not specifically claimed in this steam-brake.

The brake-connections from the locomotive for the entire train are shown in Figs. 1 and 4, the views of which, if put together, show such connections from the locomotive to the car next in rear of the tender and beyond which the brake-connections for each car are the same, and are adapted to operate friction appliances for applying the brakes of the cars of the train.

The brake-operating cylinder *a* is arranged in horizontal position centrally beneath the floor of the cab and near the front of the fire-box A. It is firmly secured to the floor of the

cab by a suitable suspending hanger, *b*, or hangers, Fig. 2, and receives steam at its fire-box end, which is opposite to the piston-rod end, by the pipe *a'*, Figs. 1 and 2.

The piston-rod $a^2$, Fig. 3, is connected to two separate and independent shafts, *c c'*, Figs. 2 and 3, arranged above and transversely with the cylinder, by means of an evener-bar and chain connections. These shafts are mounted at their inner ends in suitable boxes, *d d*, upon the cylinder, so as to allow such ends to have a sufficient degree of pivotal action, while the outer ends of these shafts are suspended by pivoted hangers *e e*, one of which is shown in Fig. 1 secured to and depending from the sides of the frame B of the locomotive in such manner as to allow these outer ends of the shafts *c c'* to have a horizontal independent swinging movement, to give them an accommodating function when in brake action. The piston-rod $a^2$ is connected to these independent shafts by the evener-bar *f*, the chains *f' f'*, and the sectors $f^2$ $f^2$, fixed upon said shafts at their cylinder ends, as shown in Figs. 1, 2, and 3, so that the outward movement of the piston-rod will pull the sectors back and turn the shafts. The evener-bar *f* is sustained in position by a yoke-support, $f^3$, attached to the cylinder-sides, as in Fig. 3. The outer or swing ends of these shafts are provided each with a cross-arm, *g g*, the normal position of which, when the brakes are off, is oblique, their upper ends inclining rearward, as in Fig. 1. From the lower ends of these cross-arms *g* rods *h*, one of which is shown in Fig. 1, extend to and connect with the upper ends of the operating pinch-toe levers C of the locomotive brake-shoes. From the upper end of the cross-arms of the shaft *c* extends rod and chain connection *i*, Figs. 1 and 3, to and connects with a pinch-toe lever, *j*, Fig. 4, of the tender-truck brake-shoe appliances next to the locomotive, while the connection *i'*, Fig. 3, on the opposite side of the locomotive and from the upper end of the cross-arm *g* of the shaft *c'*, extends to and connects with the pinch-toe lever *j'*, Fig. 4, of the brake-shoe appliances of the other tender-truck. This gives a balanced brake-force connection to the brake-shoes of both locomotive and tender without lateral strain to the work connections of either.

Provision is made for adjusting the pinch-toe lever rod connections of the brake-shoe appliances of the locomotive and for securing such adjustment when made. This is effected by an open end, *h'*, of the rod *h* and an eyed screw-bolt, $h^2$, that screws into said open end, and with its forked eyed end secured to the upper end of the pinch-toe lever C by a bolt, $h^3$, which serves as a lock to the adjustment when made, so as to give equal force to the separate levers. The eyebolt or rod $h^2$ is provided with a nut, $h^4$, within the open end of the rod *h'*, for additional safety and strength.

The pinch-toe levers C of the locomotive-brakes are of peculiar construction, and they operate with short bearings in applying the brake force. Each is pivoted at its heel *k* to a fixed projection of the brake-shoe frame or support *l* in such manner that its toe *k'*, which turns down from one side of the fulcrum of said lever, will bear upon a stud, $k^2$, into a concavity in the upper end of which the said toe fits, while the lower end of said stud is made convex, and fits into a corresponding cavity in the brake-shoe holder $k^3$ in such manner as to bring the bearing-pressure upon the shoe in the middle of its length, and without friction in applying the pinch-toes.

The brake-shoe frame or support *l* is formed with tubular guides *m m* at each end, through which pass vertical supports and guides *m' m'*, rising from the shoe-holder, to allow the latter freedom for vertical action. Coil-springs $m^2$ $m^2$ are interposed between the tops of the tubular guides *m* and the angle ends of safety-connections $m^3$ $m^3$, secured to the ends of the shoe-holder and passing through mortises in projections of the fixed frame outside of the tubular guides. The function of these springs is to free and retain the brake-shoes from brake action, when the brake-applying force is off, by pressing upward against the angle tops of the connections $m^3$, through which the upper ends of the supports *m'* pass.

The advantages of the pinch-toe levers C and their short pressure-receiving and force-transmitting studs $k^2$ are that they avoid friction under pressure and give a short and powerful leverage force by the action of the pinch-toes and their stud accommodating pressure connections; and for this purpose the said pressure-studs are adapted to have a sufficient vibratory play at their bearing connections with the toes of the pinch-levers.

When the brakes are set and the piston has forced the evener-bar *f* out under the full pressure of the steam, provision is made whereby the brakes can be retained in holding positions upon the rails independent of the holding action or pressure of the piston by means of one or more locking devices, such as a notched lock-bar, $f^4$, (shown in Fig. 1,) pivoted to the cylinder or to the frame of the locomotive in such manner that the engineer, by means of a chain or rod, $f^5$, can operate the lock bar or bars so as to bring its notched side $f^6$ against the inner edge of the evener-bar, and thereby hold it to the position to which it was forced by the piston under the pressure of the steam. Only one lock-bar is shown on one side of the piston-rod, as in Fig. 3; but two may be used—one on each side of the piston-rod—and they may be connected for simultaneous action. They may also be pivoted so as to operate on being either raised or lowered; but the holding force must be borne by said lock-bars as abutments, and the employment of such lock bar or bars relieves the engineer from attention to the brakes whenever he may desire to take off the steam-pressure and yet keep the brakes on. The release of the lock-bars is effected by applying the steam-brake

force so that the engineer can remove the notched bar or bars from locking position with the evener-bar.

Provision is made by which the brakes of the locomotive can be applied, when the locomotive is separated from the tender, by hooking the brake-connecting chain *i* to a hook, $i^2$, Fig. 1, on the frame of the locomotive and obtain a resisting-point, from which the brakes can be applied when the locomotive is detached. This is especially useful in connection with the locking device $f^4$ for the evener-bar of the piston-rod.

The pinch-brake levers C of the locomotive are arranged one upon each side, and are connected with the independent operating cross-shafts *c c'*, while a single pinch-toe brake-lever, *j*, of the first tender-truck is fixed upon a cross-shaft, $j^2$, secured to the fixed frame of the brake-shoes, which are secured to the lower bolster-timber of the truck. The lever *j*, as before described, operates the brake-shoes of the second tender-truck in the same way and manner as the lever *j*, but from the opposite side of the locomotive, to obtain the balanced action of the tender-brakes.

Having now described the brake-connections of the locomotive and the tender as being operated directly from the independent shafts *c c'* of the brake-cylinder, it remains to describe the connections of said independent operating-shafts with the brake devices of the continuous train. This is effected by means of an arm, *n*, Figs. 1, 2, and 3, fixed to and rising from the shaft *c'* of the steam-brake cylinder, and from which suitable chain and rod connections, *o p*, Figs. 1, 2, and 4, lead to the compensating-connection between the cars, and which is termed, in train-railroading, a "brake-connecting compensator," because its function is to compensate for train expansion and contraction. This compensator consists of metallic arms *q q'*, of peculiar construction, being swivel-jointed at their connection with the under-side ends of the cars, each car having a pair of such arms at each end and placed in line with the brake-operating connections. A pair of these arms constitutes the compensator, and they are of such construction as to have both a flexing and a swiveling joint. The swiveling joint is made by an open angle-bar, $q^2$, pivoted by a bolt, $q^3$, Fig. 9, to an open iron retainer, $q^4$, Fig. 8, secured to the under side of the car-body, so as to afford swiveling capacity to said angle-bar. The flexing connection is made by short rivets $q^5$, Fig. 9, passing through the lower ends of the swivel angle-bar $q^2$, and also through the upper ends of the arm-bars *q q'*, so as to allow the said arms to swing thereon in the direction of the brake-connections, while they are also free to turn on their swivel-connections to accommodate the lateral movements of the cars. These bar-arms are shown as being made of united bars, so as to provide for securing chain-sheaves $q^6$ between; but they may be of any suitable construction that will allow of the arrangement of such sheaves to admit of the passage of the brake-chain connections *o* over and under them. For this purpose the arm *q'* has such a sheave near its upper end and its lower end, while the arm *q* is provided with such a sheave only near its upper end. The sheave-pins are shouldered and riveted so as to securely hold the bars in place. The side bars of the arm *q'* have a greater space between them at their lower half-length, so as to admit of the hooking and free pivotal connection of the lower end of the arm *q*, the bars of which terminate in hooks $q^7$, Figs. 8 and 10, adapted to hook over the end of the pin of said lower sheave, the object of which is to afford a connection for the passage of the chain between the cars without lost motion and to afford a compensating action for train contraction and expansion.

To prevent the accidental separation of the hooked connection of the compensator, a spring-bolt attachment, *r*, Fig. 10, on the arm *q* is adapted to retain the hook upon the sheave-pin in work position.

The brake-operating chains *o* are connected at the junction of the arms *q q'*, and such connection is made by a hook, *o'*, hooking into the unwelded end $o^2$ of a spring-link, $o^3$, Fig. 8, the object of which is to have sufficient hook-force connection to set the friction-brakes of the cars of the train without separating the unwelded end of said spring-link; but in the event of the coupling of any of the cars of the train separating by accident or by breaking of the coupling pin or link, and causing the train to separate at such broken locality, then such separation brings the arms *q q'* of said compensator toward a horizontal line. In this action the extended lower ends of the bars of the arm *q'*, which are formed with inwardly-turned angle-projections $q^8$, Fig. 7, come in contact with the under side of the side bars of the arm *q* and lift and unhook the said arm *q* as it approaches a horizontal line, and thus the arms become self-separating, leaving the tension of brake-connections of the separated portion of the train upon the hooked brake-chain as the only existing connection of the said train separated section. As the train continues its separation at this point it tends to apply the friction-rolls of the separated portion of the train until the chain and its brake-connections *o p* bring a cross centrally-pivoted lever, *s*, Fig. 12, against the shoulder $s^2$ of an angle-iron, *s'*, said shoulder $s^2$ forming one side of a depression, $s^3$, which receives and limits the swinging action of said bar *s* in applying the rolls in frictional contact, and through the action of which friction-rolls the brakes are set. When said lever *s* comes in contact with the shoulder $s^2$ its swinging movement is stopped, and, train separation being continued, of necessity draws the hook *o'* of the chain *o* through the unwelded end of the spring-link $o^3$, as shown at $o^2$ in Figs. 8 and 12, and the end of said lever drops into said depression $s^3$ of

the angle-iron *s'*, and retains the brakes in brake position on the separated portion of the train, and forms an automatic device for retaining the brakes in brake positions upon the cars of the train thus separated.

A stop angle-iron, *s'*, is secured beneath the bottom of each car and beneath a cross-lever, *s*, which is centrally pivoted to the bottom of each car; but it is only the cross-lever of the first car in separation that is thus locked with the angle-iron *s'*, as the brakes of the other cars of the separated portion are held in brake action by this lever *s* and angle-iron stop, and the friction-brakes of such cars are all applied in the same manner by the brake-chain and compensator connections. To effect this automatic locking of the brakes of the separated portion of the train, brake-connections *o p* are attached to the end of the cross-lever *s*, Figs. 11 and 12, pivoted at its center to the under side of the car-body, and one end of this lever works over and into the angle-iron *s'*, one end of which forms the stop $s^2$ and lock $s^3$, while the other end, $s^4$, of said angle-iron serves to limit the swing of the pivoted lever in its relaxed or normal position, as shown in dotted lines in Fig. 12. This cross-lever *s* is connected by the rod *p* with the friction-brake-applying mechanism by which the momentum force of the train is brought into action; but as this friction mechanism forms a part of brake appliances which is the subject of a separate application for a patent, it need only be briefly described herein.

Each car is provided with a friction-brake-power device adapted to be put into operation by the engineer, and then to utilize the momentum force of the train to wind the brake-chain connections *o p* to apply the brakes of all the cars of the train in rear of the tender. This friction device and its connections are shown in Figs. 11 and 12, and it consists of a driver-roll, *v*, secured upon one of the truck-wheel axles, and a leading-roll, *v'*, mounted loosely upon a shaft, and is moved in frictional contact with said driver-roll by a spring-lever, $v^2$, Fig. 11, the upper end of which is connected with a cushioned rod, $v^3$, by which said lever is connected to the brake-operating cross-lever *s*, Fig 12. The leading friction-roll *v'* is caused to rotate its shaft by means of a pressure friction-disk, and this shaft drives by suitable gearing the brake-chain-winding barrel $v^4$, the chain $v^5$ from which connects with one end of a brake evener-bar, $v^6$, the other end of which connects with the brake-shoe-operating lever of the truck upon which friction-brake mechanism is mounted. To simultaneously operate the brake-shoe of the other truck, a similar evener-bar, *w*, is connected to the truck by the rod *w'*, and this second evener-bar is connected by one end to the rod $w^2$ and to the brake-shoe lever of the other truck, the other end of said evener-bar *w* being connected by rod and chain connection with the hand brake wheel operating device at the other end of the car. The brakes of each car are operated by pinch-toe lever-shafts like those of the tender-trucks; but such operation is made by the action of the friction device after the friction-rolls are brought into contact by the engineer, the said pinch-toe shafts being each operated by a single lever, *j*, for each truck-brake, and the cross-shaft having pinch-toes operating upon accommodating step-bearings supported by the shoe-retainer. A spring, *t*, connected with the said cross-lever *s*, serves to bring it and its train rod connections *p* back to their normal positions of rest.

When the pressure upon the brake-shoes is applied with full force, such pressure tends to lift the car-body from the bolster-springs, and to prevent such lifting action the shoe-frames are formed with arms *z*, Fig. 5, extending outward and upward from the outer sides of said frames and in positions beneath the axle equalizing-bars Z Z, at which points said arms are provided with set-screws *x*, which are so adjusted as to come in contact with said equalizers Z whenever the brake-shoes are applied upon the rail, and thus prevent lost bolster-spring motion.

To apply the brakes, steam is admitted to the cylinder *a* by the engineer opening the cock *u*, Figs. 1 and 2, to admit steam into the pipe *a'*, which connects with a four-way cock, *u'*, from which leads a feed-pipe, $u^5$, into the pressure end of the cylinder *a;* and also a pipe, $u^6$, leads from said four-way cock into the piston end of said cylinder *a*, while a fourth pipe, $u^7$, leads from the said cock into the fire-box of the locomotive. The engineer, by turning the crank $u^2$ of the operating-tube connection $u^4$ to the plug of the four-way cock, allows the steam from the chamber of the locomotive-boiler to pass through the pipe *a'* into the four-way cock *u'*, from thence into the pipe $u^5$, which allows the steam to enter into the pressure end of the brake-cylinder *a* and forces the piston-head outward. The evener-bar *f*, connected with the piston-rod $a^2$, is forced rearward, and by means of its chain-connections *f'* operates the sectors $f^2$, which thus turn the independent shafts *c c'*, and operates the cross-arms *g g* thereon, and thus applies the brakes upon the locomotive and tender thereof simultaneously through the rod and chain connections *h i*, (shown in Fig. 1.)

To release the brakes, the engineer gives a reverse movement of the crank $u^2$, which turns the plug of the cock *u'* in a quarter-turn, which lets the boiler-pressure steam into the opposite end of the brake-cylinder *a* through the branch pipe $u^6$ and correspondingly puts the pipe $u^5$ in open communication with the waste-pipe $u^7$, and thus causes the exhaust-steam to pass into the fire-box, which operation releases the brakes, when the engineer turns the crank *u* half-way between the position for applying and releasing the brakes, and thereby closes steam-communication with the brake-cylinder.

In case the tender should be separated from

the locomotive, provision is made for applying the brakes of the locomotive by hooking the disconnected ends of the tender-connecting chains *i i'* to hooks $i^2$ on the rear-end frame of the locomotive, as shown in Fig. 1, and such hooked connections afford the same brake-force resistance as if the tender were connected in the application of the locomotive-brakes, which render the operation of the locomotive-brakes independent of either tender or train connections.

Having now described the manner in which the brakes of the locomotive are applied and released, and also those of the connected locomotive and tender, it will be observed that the same operations will correspondingly apply the brakes throughout the train by making the chain and rod connections *o p* with the arm *n* on the shaft *c'* of the steam-brake cylinder.

This construction gives the engineer full and entire control over the brake forces of the locomotive, the connected locomotive and tender, and of the entire train; and in applying and releasing the brakes it is important to notice that the release of the brakes is made compulsory by the direct action of the steam and in the same manner and by the same force by which they are applied.

I claim—

1. In a steam-brake for railway-trains, the combination of the steam-cylinder *a* and the brakes operated by piston-rod connections therewith with independent brake-operating rocking cranked shafts *c c'*, connected with and operated by the piston of said cylinder, substantially as described, for the purpose specified.

2. The combination, in a steam-brake for railway-trains, of the steam-cylinder *a* and brakes operated by piston-rod connections therewith with independent brake-operating rocking cranked shafts *c c'*, an evener-bar, *f*, pivoted to the piston-rod of said cylinder, and means for connecting said evener-bar with the said independent brake-operating rocking cranked shafts, for operation substantially as described, and for the purpose specified.

3. The combination, in a steam-brake for railway-trains, of the steam-cylinder *a* and brakes operated by piston-rod connections therewith with independent brake-operating shafts *c c'*, an evener-bar, *f*, pivoted to the piston-rod of said cylinder, the chains *f' f'*, and the sectors $f^2$ $f^2$, connecting said evener-bar with said independent brake-operating shafts, for operation substantially as described, for the purpose specified.

4. The combination, in a steam-brake for railway-trains, of the steam-cylinder *a* and brakes operated by piston-rod connections therewith with independent brake-operating shafts *c c'*, means for connecting the said shafts with the piston-rod of said cylinder, and pivoted hangers *e* for supporting the brake connecting and operating ends of said separate shafts, for operation substantially as described, for the purpose specified.

5. In a steam-brake for railway-trains, the combination of the steam-cylinder, the independent brake-operating shafts *c c'*, connected with the piston-rod of said cylinder, substantially as described, with the pivoted hangers *e* for said shafts, the cross-arms *g g* on the suspended ends thereof, the adjustable rods *h*, and the brake-shoe-operating levers C, for operation substantially as described, for the purpose specified.

6. The combination of the rail brake-shoes and accommodating bearing-steps $k^2$, supported substantially as described, with brake-levers formed with pinch-toes and adapted for operation with the said shoe-bearing steps, and mechanism connecting said pinch-toe levers with the piston-rod of the steam-cylinder, substantially as described, for the purpose specified.

7. The steam-brake cylinder *a*, suspended in horizontal position by a hanger or hangers, in combination with independent brake-operating cross-shafts *c c'*, having their inner ends supported in fixed boxes upon said cylinder, their outer ends suspended by pivoted hangers and connected with the brake-operating mechanism, and having piston-rod connections at points between their suspended and fixed ends, substantially as described, for the purpose specified.

8. The combination of the steam-cylinder *a* and brake mechanism connecting with the piston-rod thereof and with the brake-shoe levers, substantially as described, with the adjustable locking-connections for the levers, substantially as described, for the purpose specified.

9. In a steam-brake, the combination of the horizontal brake-cylinder *a* and brake mechanism connecting with the piston-rod thereof and with the brake-shoe levers, substantially as described, with a four-way cock and pipes connecting it with the steam-chamber of the locomotive, the cylinder, and the exhaust, substantially as described, for the purpose specified.

10. In a steam-brake, the combination of the brake-cylinder *a* and independent operating-shafts *c c'*, connected with the piston-rod of said cylinder, suspended at their outer ends, and having cross-arms at said suspended ends, substantially as described, with the brake-operating connections, with the levers C of the locomotive, and the connections *i i'*, with the brake mechanism of the tender, substantially as described, for the purpose specified.

11. In a steam-brake, the combination of the brake-cylinder *a*, independent brake-operating shafts *c c'*, and means for connecting said shafts with the piston-rod of said cylinder, and the levers of the brake-shoes of the locomotives, the brake-levers of the tender, and of the cars of the train, substantially as described, with a jointed hanging carrier for the train-brake-operating connections between the cars of the train, substantially as described, for the purpose specified.

12. The combination, in a steam-brake for railway-trains, of the cylinder *a*, means for connecting its piston-rod with independent brake-operating shafts *c c'* of the locomotive, and means for connecting said shafts with the brake-shoe-operating levers C, substantially as described, with an arm, *n*, carried by one of said independent shafts, the train-brake connections *o p*, connected with said arm, and a stiff-jointed hanging carrier between cars for said train-brake-operating connections, substantially as described, for the purpose specified.

13. The combination, in a steam-brake, of the cylinder *a*, means for connecting its piston-rod with independent brake-operating shafts *c c'*, and means for connecting said shaft with the brake-shoe levers C of the locomotive, substantially as described, with the train-connections *i i'* and fixed hooks $i^2$ on the frame of the locomotive, substantially as described, for the purpose specified.

14. The combination, in a steam-brake, of the cylinder *a*, means for connecting its piston-rod with independent brake-operating shafts *c c'*, and means for connecting shafts with the brake-shoe levers, substantially as described, with a locking device controlled by the engineer, and adapted to lock the piston-rod of said cylinder, to retain the brakes in holding positions after being set, and independent of the action of the piston, substantially as herein set forth.

15. The combination, in a steam-brake, of the cylinder *a*, the independent brake-operating shafts *c c'*, a pivoted evener-bar, *f*, connecting said shafts with the piston-rod of said cylinder, and means for connecting said shafts with the brake-shoe levers C of the locomotive, the tender, and of the train, substantially as described, with a pivoted toothed locking device, $f^4$, and an operating-chain therefor, substantially as described, for the purpose specified.

16. The combination, in a steam-brake, of the horizontally-arranged cylinder *a*, the independent brake-operating shafts *c c'*, a pivoted evener-bar, *f*, connecting said shafts with the piston-rod of said cylinder, and means for connecting said shafts with the brake-shoe levers C of the locomotive, substantially as described, with the brake-lever shafts *j j'* $j^2$ of the tender-truck and means for connecting them with the said independent shafts, for operation substantially as described, for the purpose specified.

17. A locomotive steam-brake consisting of the cylinder *a*, the independent shafts *c c'*, an evener-bar, *f*, pivoted to the piston-rod of said cylinder and connected with said shafts by chains and sectors, the pivoted suspending-arms *e* for the outer ends of said shafts, cross-arms *g g* on said suspended ends, the rods *h*, the pinch-toe levers C, bearing-steps $k^2$ therefor, the brake-shoes, a four-way cock, *u'*, and the connections *i i'* with said cross-arms, the several parts being constructed and adapted for operating rail-shoes substantially as described.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

W. H. WARD.

Witnesses:

A. E. H. JOHNSON,

J. W. HAMILTON JOHNSON.