(No Model.)

4 Sheets—Sheet 1.

# J. LIPKOWSKI.

## RAILWAY BRAKE.

No. 549,800. Patented Nov. 12, 1895.

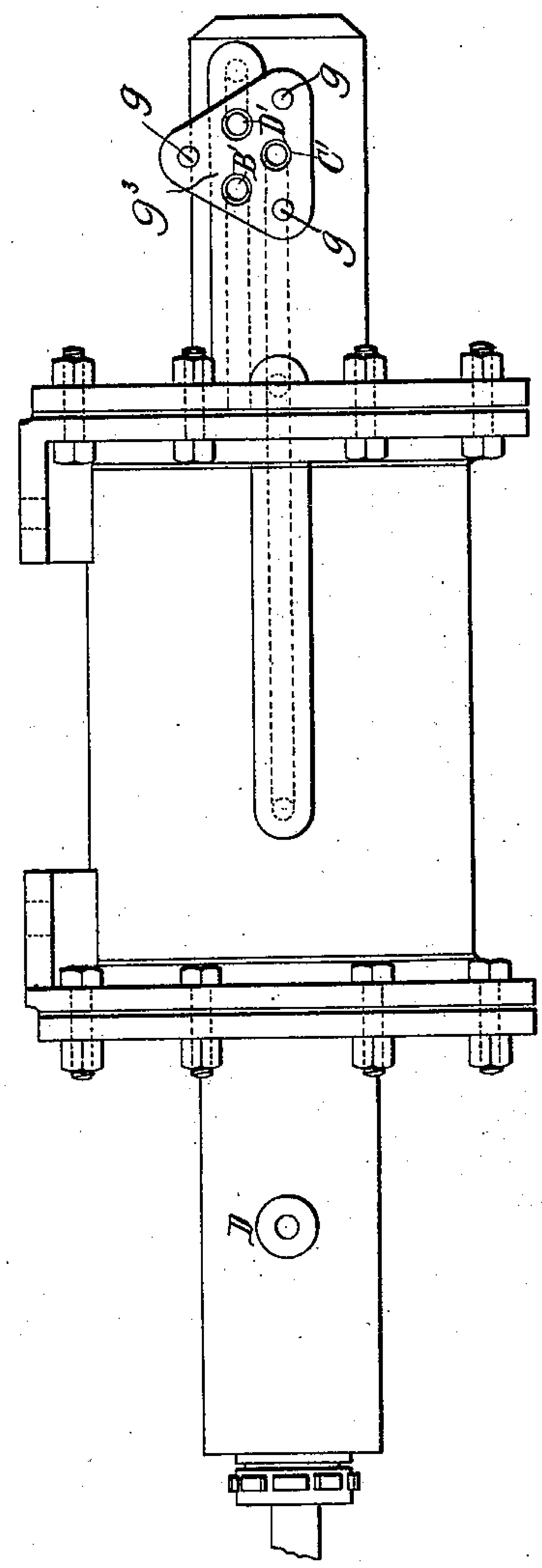

FIG. 2.

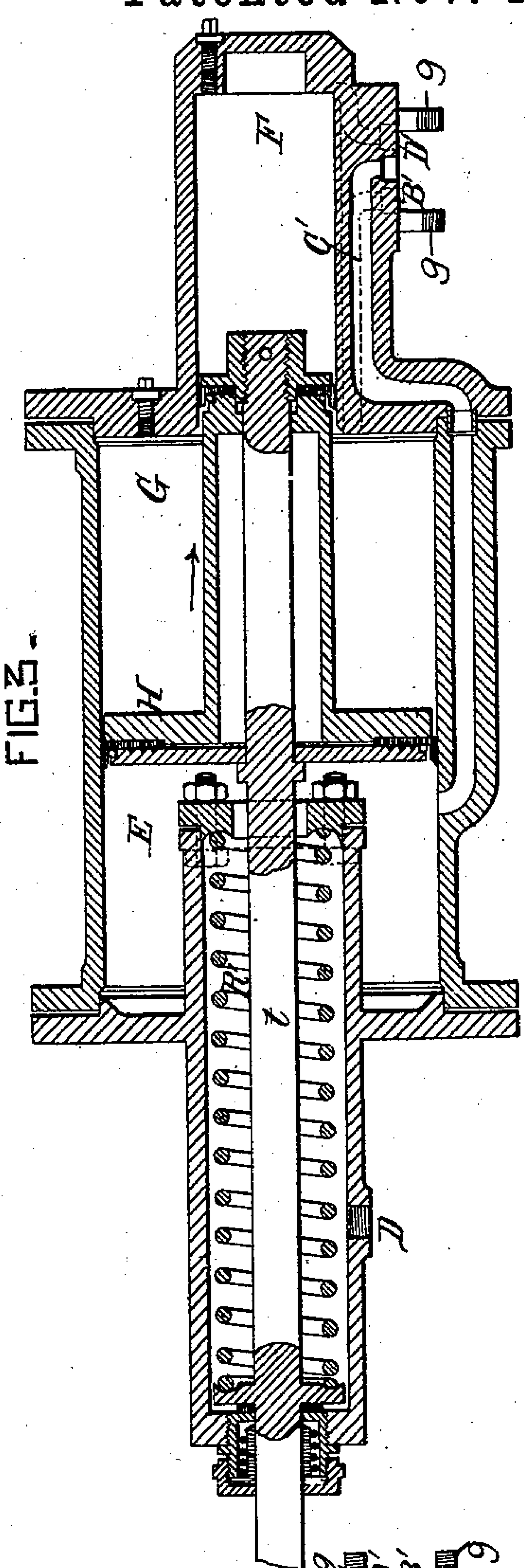

FIG. 3.

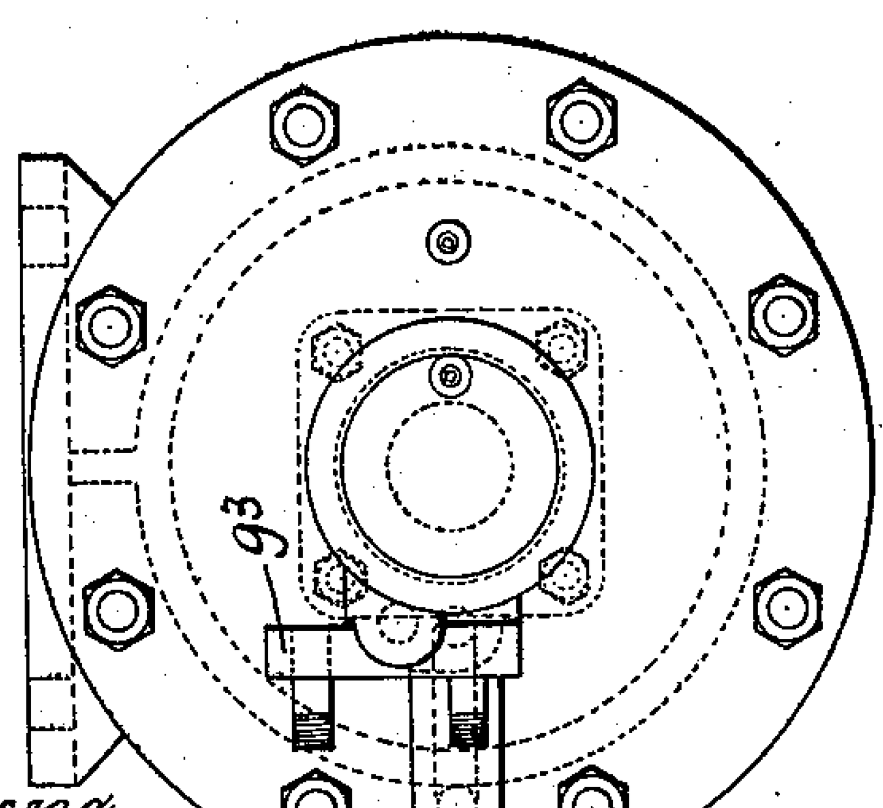

FIG. 1.

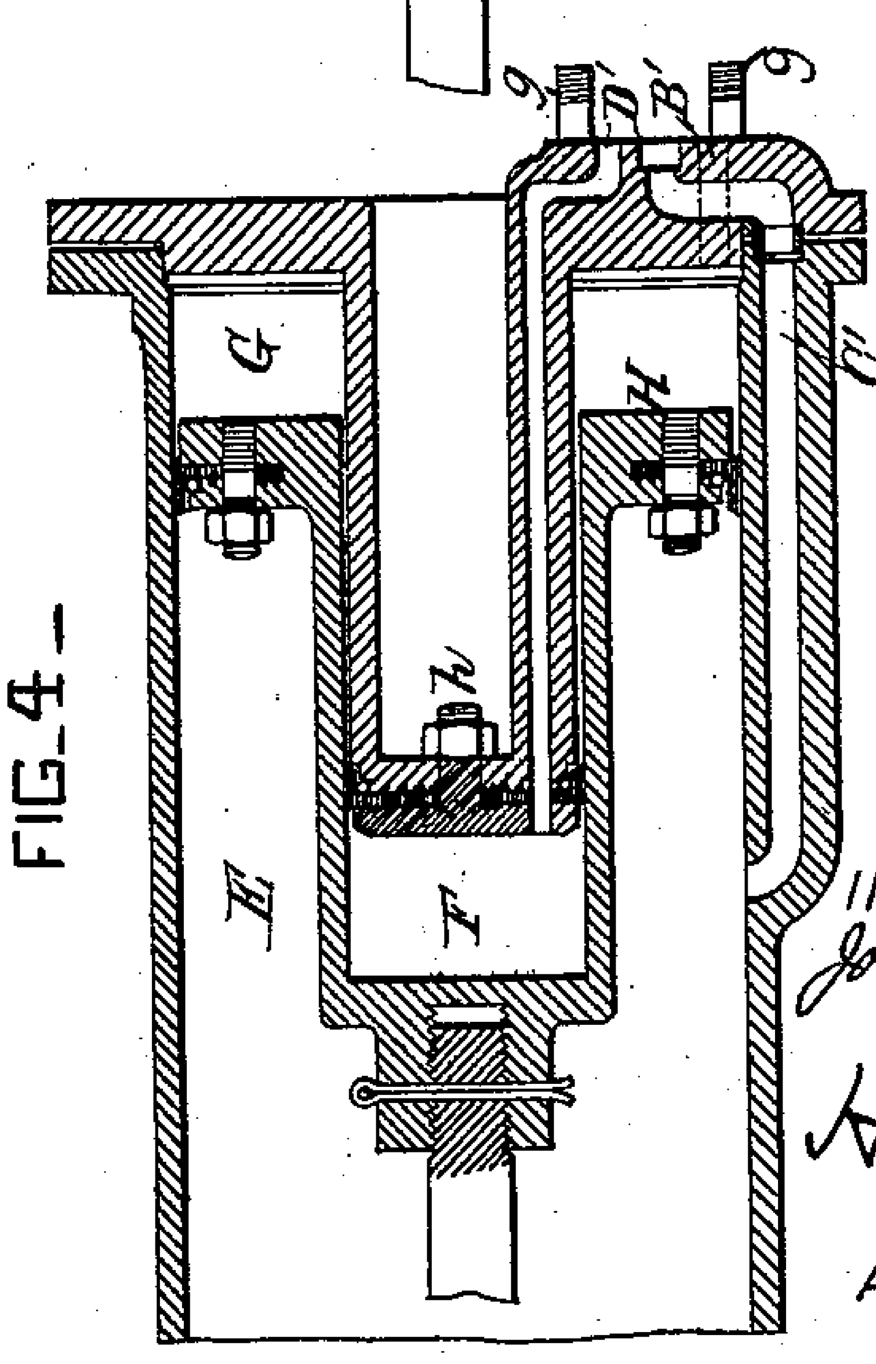

FIG. 4.

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(No Model.)

4 Sheets—Sheet 2.

J. LIPKOWSKI.

RAILWAY BRAKE.

No. 549,800.

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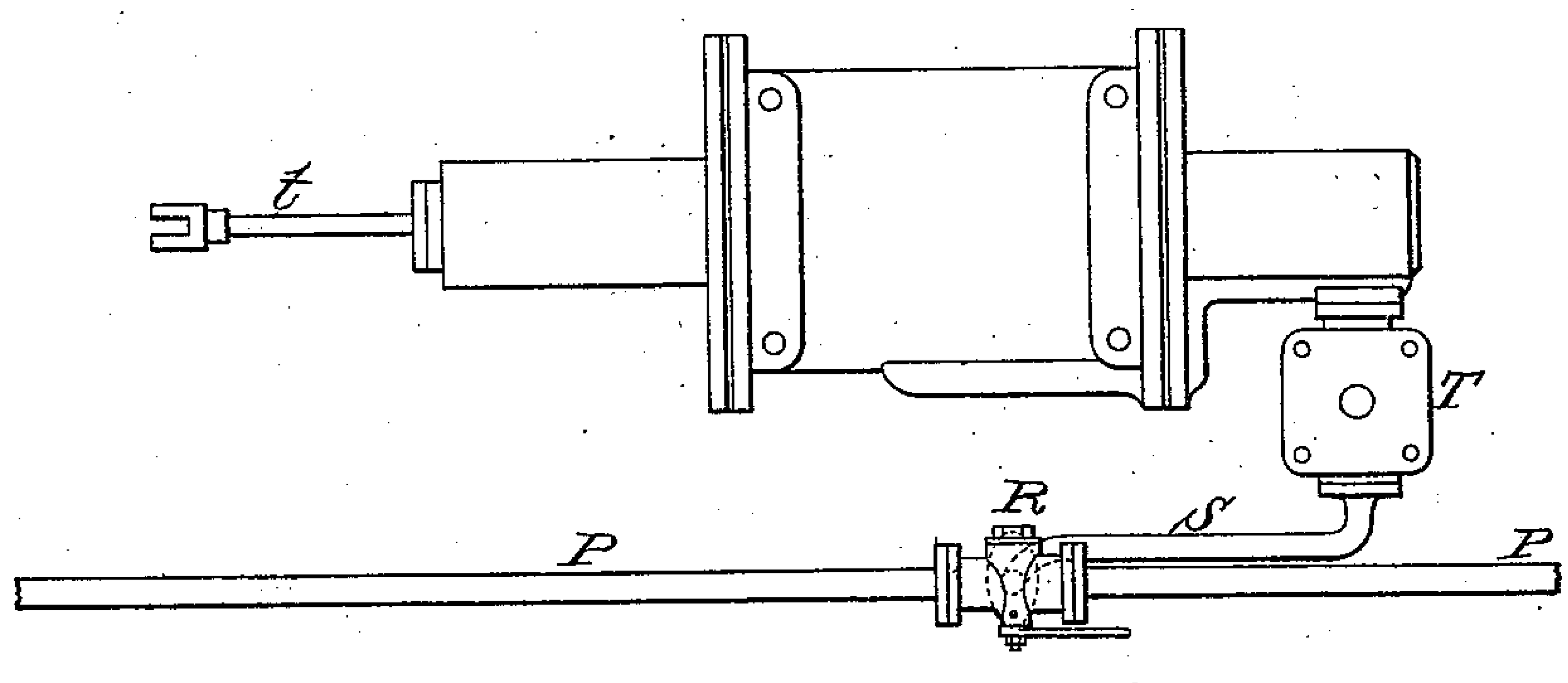
FIG. 5.

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4 Sheets—Sheet 3.

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RAILWAY BRAKE.

No. 549,800.

Patented Nov. 12, 1895.

FIG. 6.

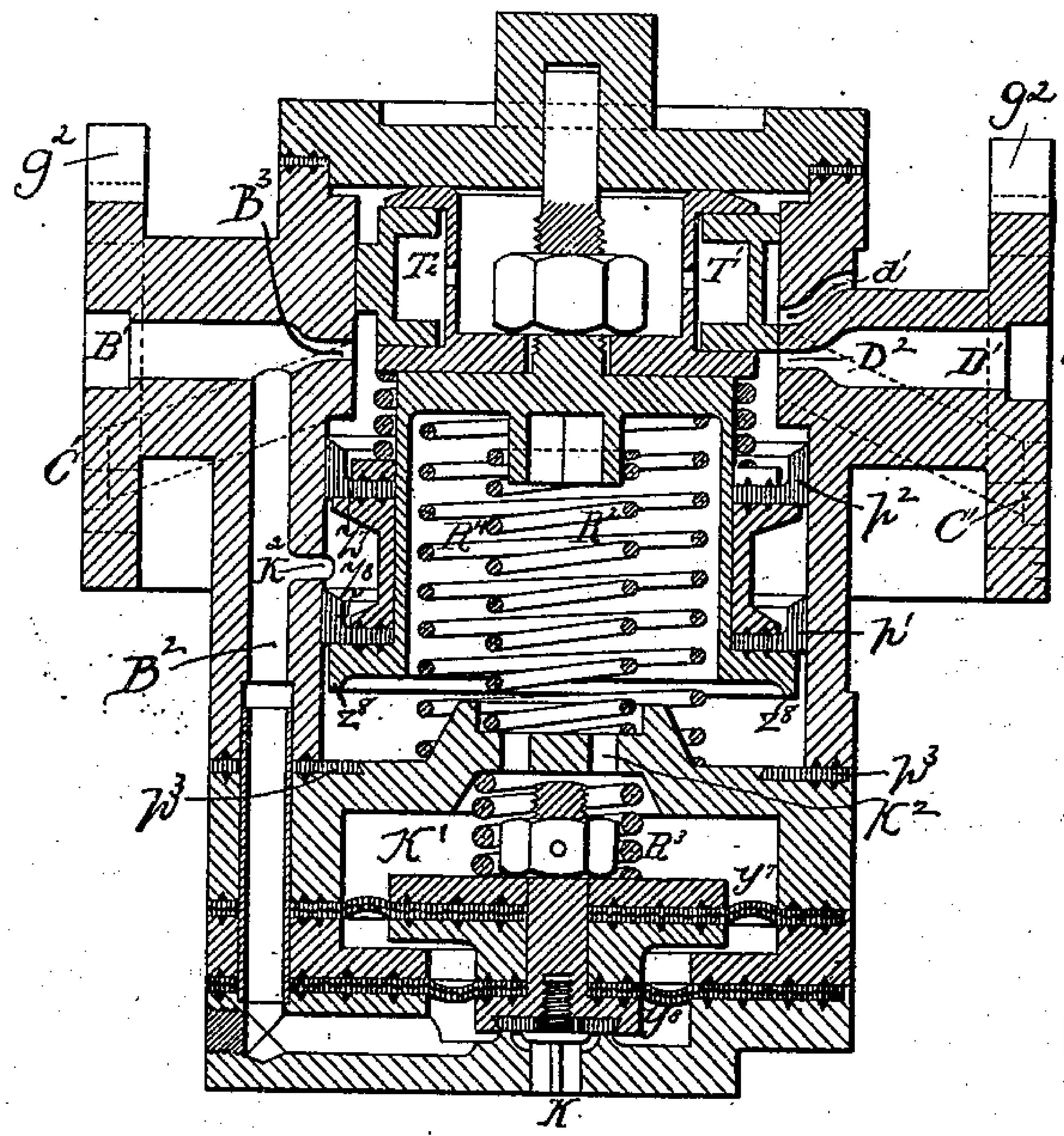


FIG. 7.

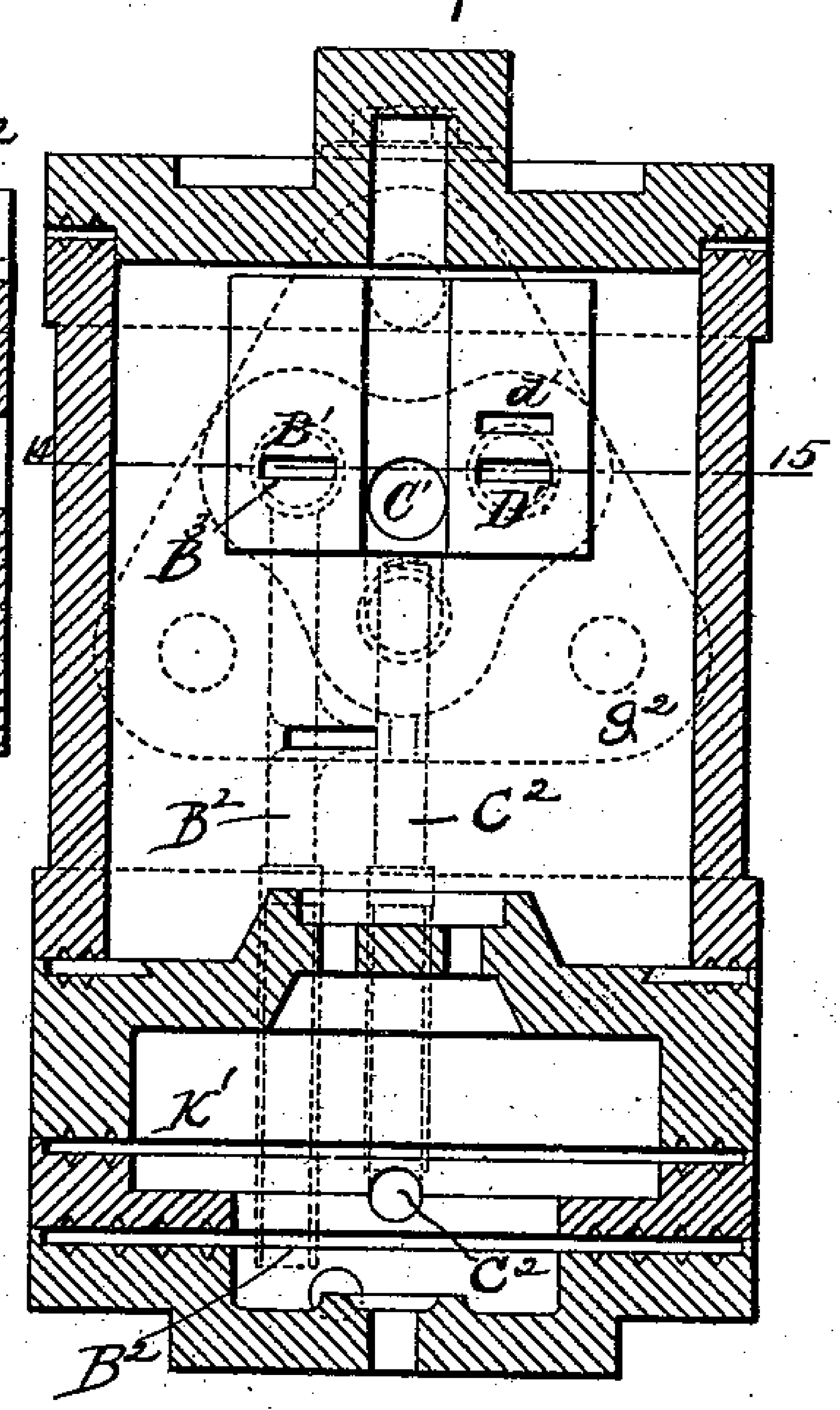


FIG. 8

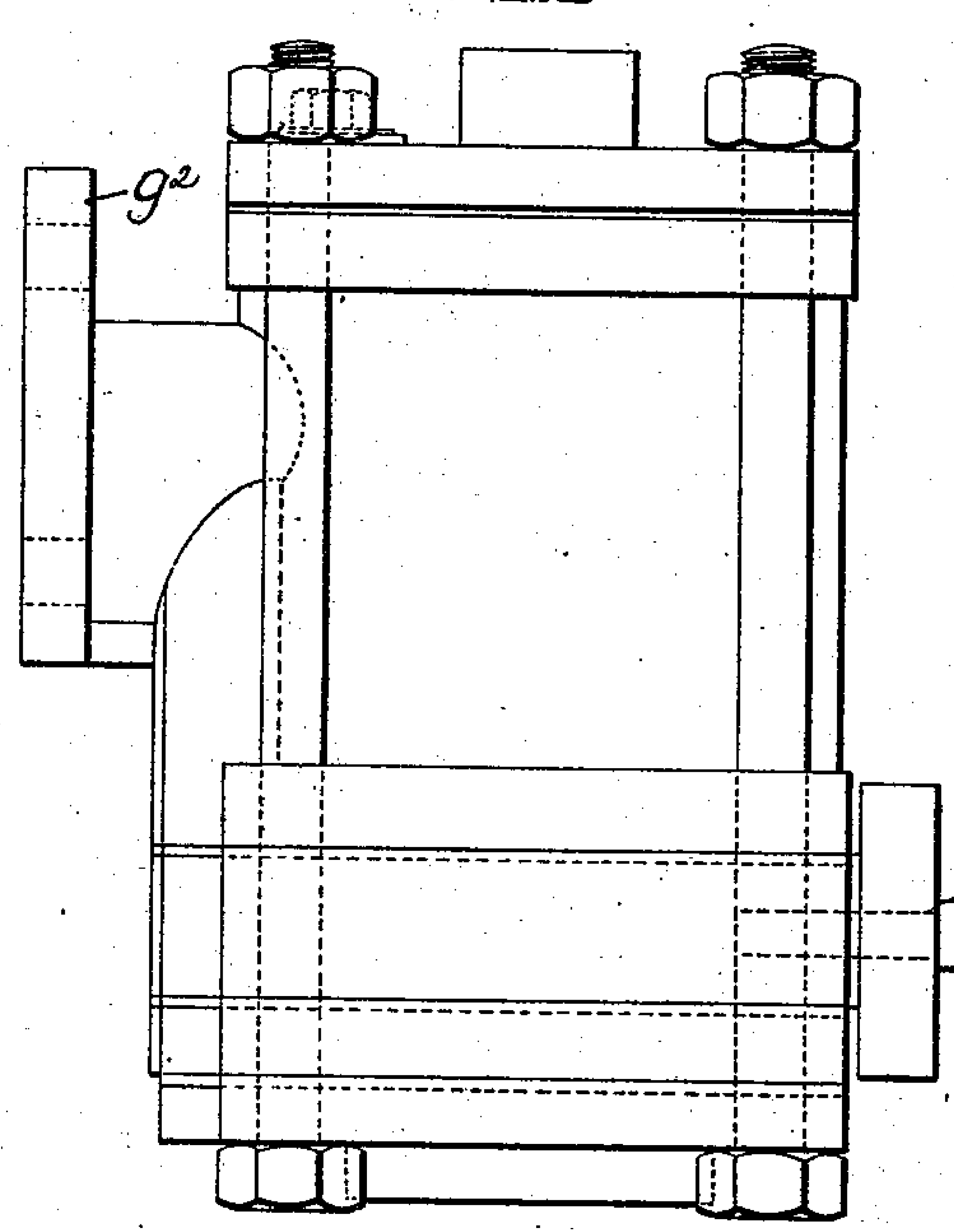
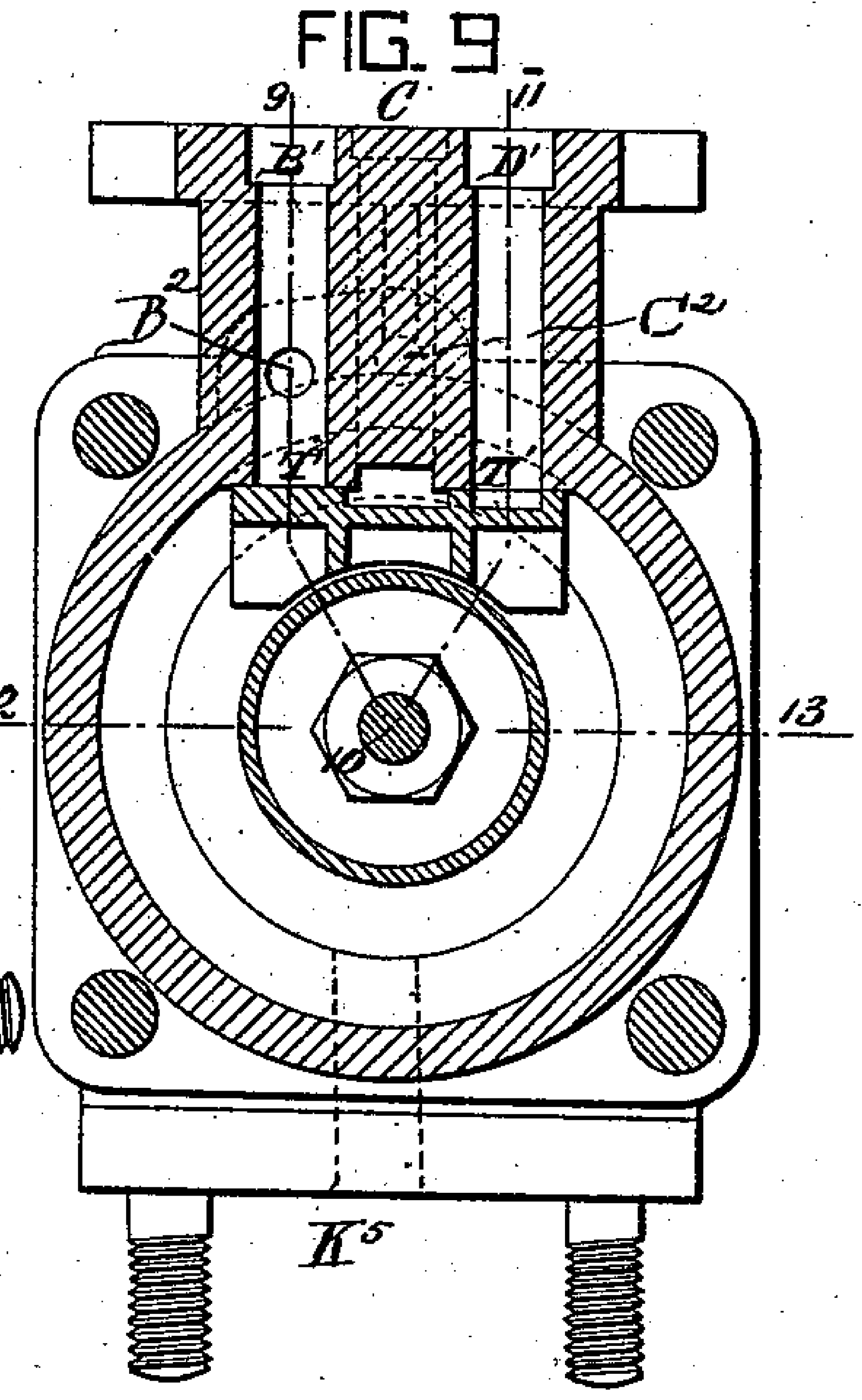


FIG. 9.



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(No Model.)

4 Sheets—Sheet 4.

# J. LIPKOWSKI.
## RAILWAY BRAKE.

No. 549,800.

Patented Nov. 12, 1895.

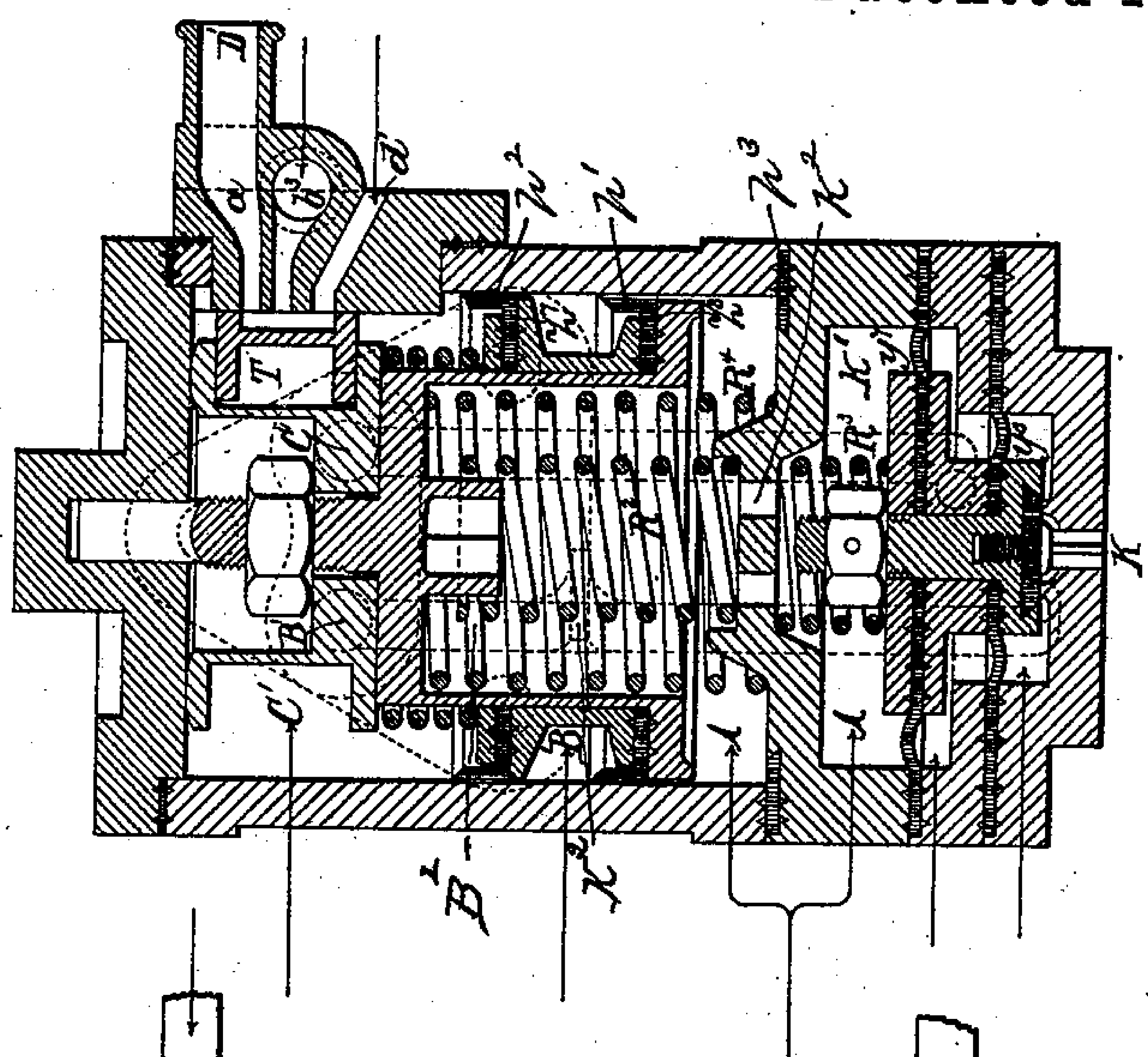

FIG. 12.

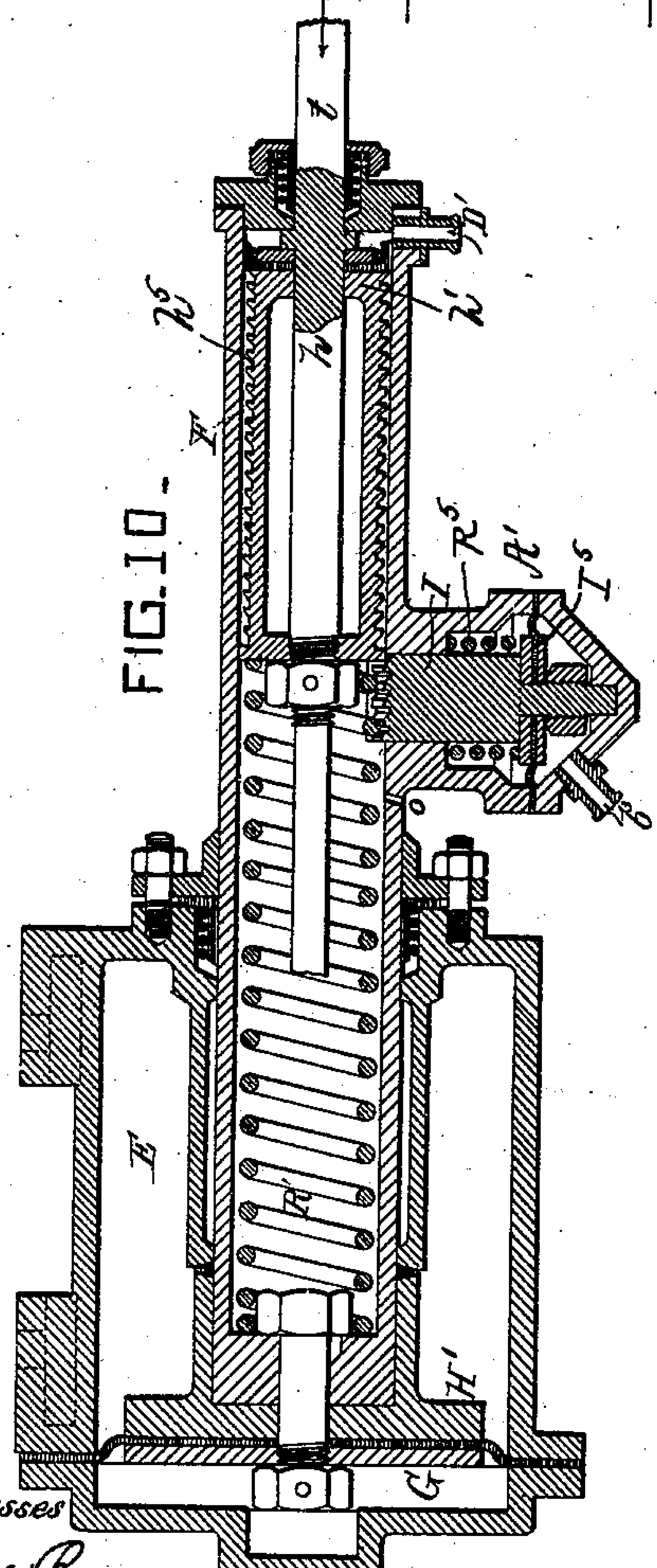

FIG. 10.

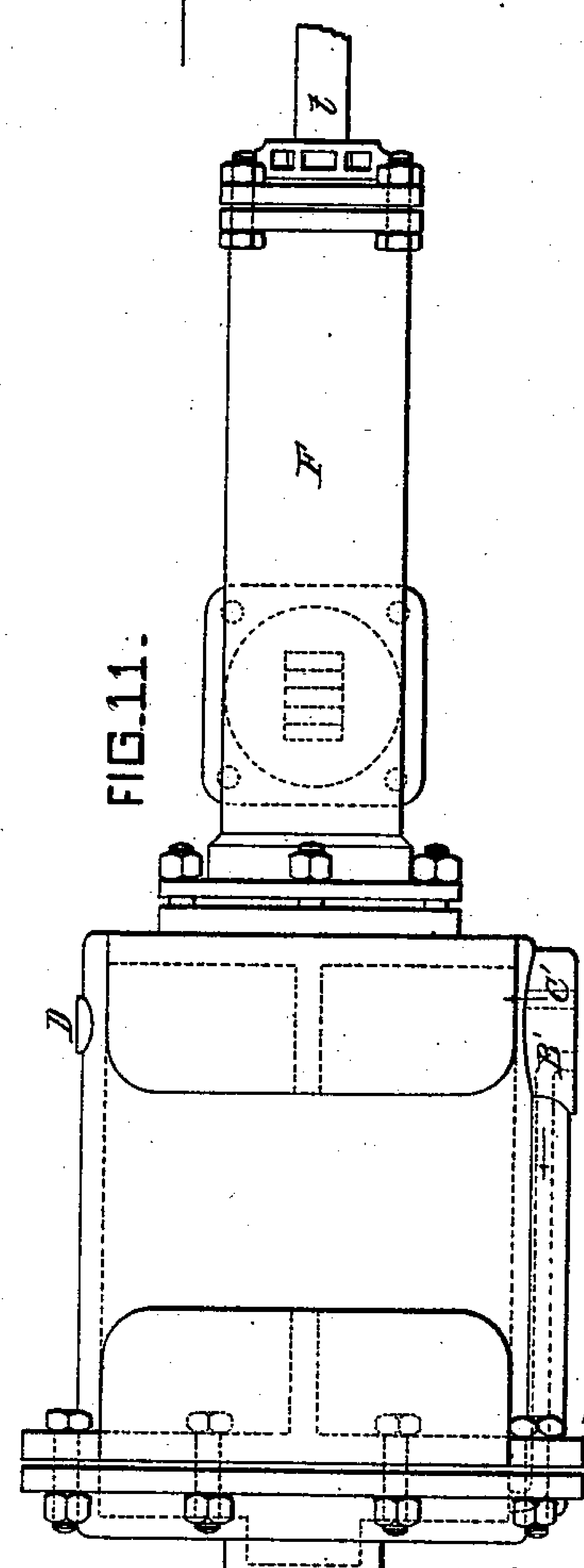

FIG. 11.

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# UNITED STATES PATENT OFFICE.

JOSEPH LIPKOWSKI, OF PARIS, FRANCE, ASSIGNOR TO THE SOCIÉTÉ GENERALE DES FREINS LIPKOWSKI, OF SAME PLACE.

## RAILWAY-BRAKE.

**SPECIFICATION** forming part of Letters Patent No. 549,800, dated November 12, 1895.

Application filed September 15, 1893. Serial No. 485,633. (No model.) Patented in France July 26, 1892, No. 223,244; and in England July 20, 1893, No. 14,085.

*To all whom it may concern:*

Be it known that I, JOSEPH LIPKOWSKI, engineer, residing in Paris, France, have invented certain Improvements in Railway-Brakes, for (which I have obtained a French patent, dated July 26, 1892, No. 223,244, and British patent, dated July 20, 1893, No. 14,085,) of which the following is a specification.

This invention relates to a continuous automatic railway-brake actuated by compressed air.

In all pneumatic brakes the pressure of the air displaces the main piston which actuates the brake mechanism or levers and presses the brake-shoes against the tires of the wheels. The capacity generated by the piston is the measure of the volume of air expended at each application of the brake on each vehicle.

According to this invention the action of the compressed air is divided into two distinct periods. In the first period the air acts upon a small piston which actuates the brake mechanism and moves the shoes into contact with the wheels, and during the second period the air acts upon a large piston which moves through a relatively small or almost imperceptible distance, owing to the intermediate mechanism being already in a state of tension, and produces the pressure required for the braking action. To accomplish this I combine with the two different sized pistons and the compartments in which they work a distributer which alone controls the admission to and exhaust from the compartments, independently of the pistons, so that no matter how much the brake-shoes or wheels may become worn down the small piston will always have brought the shoes up to the wheels before the pressure is applied to the large piston.

In the following description the small cylinder and its piston are referred to as the "reducer" and the principle of dividing the action of the air in the brakes is referred to as the "air-reducer."

In the accompanying drawings, Figure 1 is a front elevation, Fig. 2, a side elevation, and Fig. 3 a horizontal section, of one form of my brake-cylinder. Fig. 4 illustrates in horizontal section a modification of the brake-cylinder. Fig. 5 represents in plan a brake-cylinder, its distributer, a portion of the train-pipe, and the connection between the distributer and the train-pipe. Fig. 6 represents two different sectional elevations of the distributer, the left-hand side being taken on line 9 10, Fig. 9, and the right-hand side on line 10 11, Fig. 9. Fig. 7 is a vertical section on line 12 13, Fig. 9. Fig. 8 is an outside elevation of the distributer, and Fig. 9 is a horizontal section taken on line 14 15, Fig. 7. Figs. 10 and 11 illustrate a modification of the brake-cylinder with an external reducer in vertical section through the axis and in plan, respectively. Fig. 12 illustrates a modification of the distributer for the expansion employed with this modification of the brake-cylinder having an external reducer.

The principal parts of the brake working by reduction which are carried by the locomotive are as follows: An air-compressing pump, a moderator, a main reservoir, a regulator, a cock or valve worked by hand, two pressure-gages, and the necessary connecting-pipes.

The parts of the reduction-brake located upon the vehicles are as follows—namely, a brake-cylinder working by reduction with an expansion distributer, a main pipe, stop-cocks, pipe-couplings, and brake mechanism.

The supply of compressed air for the brake is taken from the main pipe through a three-way cock R, Fig. 5, by means of which any brake-cylinder may be isolated from the system without interrupting the continuity of the main pipe. The compressed air, after passing through the cock R and the pipe S, reaches the distributer T, which suitably distributes the air in the brake-cylinder in such manner, as hereinafter described, that when the engineer decreases the pressure in the main pipe the piston in the brake-cylinder and its rod $t$ is so displaced as to move the brake mechanism to apply the brakes.

The brake-cylinder illustrated in Figs. 1, 2, and 3 is divided into three chambers E, G, and F by the pistons H and $h$. The shaft $t$ of the pistons H and $h$ moves the brake mechanism and the spring R′ tends to move the rod $t$ in a direction to take the brakes off. The action of the air in the small chamber F on the piston $h$ actuates the piston $t$ to move the brake-shoes up to the wheels. I call this small chamber F the "reducer." The chamber E, I call the "reservoir," as it acts as such in the operation of the apparatus, while the chamber G, I call the "cylinder." The chambers E, G, and F are in communication with an air-distributer by means of the channels C′, B′, and D′, respectively. The chamber E is provided with a discharge-valve at D.

The flange $g^2$ of the air-distributer is placed against the flange $g^3$ on the brake-cylinder and the two are secured together by bolts $g$. The said air-distributer, as represented in Figs. 6, 7, 8, and 9, is constructed with a cylinder containing two pistons $Z^7$ and $Z^8$, carrying cup-leathers $p'$ $p^2$, and acted upon by two springs $R^2$ and $R^4$. These pistons are connected with a slide T′ $T^2$. At the lower part of the cylinder there are provided two diaphragms $y^7$ $y^8$, forming three distinct chambers. The upper chamber into which the pipe S from the train-pipe P opens communicates with the under side of the piston $Z^8$. The lower chamber is provided with a valve K, which is controlled by the diaphragm $y^7$ and $y^8$. On the side of the cylinder there are distribution orifices $B^3$, C′, and $D^2$, leading to the three chambers in the brake-cylinder, the orifices $B^3$ and $D^2$ being controlled by the slide T′ $T^2$. The passage B′, leading from the chamber G of the brake-cylinder, communicates with the space above the piston $Z^7$ through the orifice $B^3$, controlled by the slide-valve $T^2$, Figs. 6, 7, and 9. A passage $B^2$ opening into the passage B′, Fig. 6, leads to the space below the diaphragm $y^8$. The passage C′, leading from the reservoir or chamber E, also opens into the space above the piston $Z^7$ continuously—that is, the valve does not cover the opening to this passage C′. Another passage $C^2$ connects the passage C′ with the space $C^3$ between the diaphragms $y^7$ and $y^8$, Figs. 7 and 9. The passage D′, leading from the reducer, opens into the space above the piston $Z^7$ at $D^2$, the orifice $D^2$ being controlled by the slide-valve T′. This valve T′ is adapted to put the passage D′ into communication with the exhaust $d'$, which opens into the atmosphere.

I will now describe the action of the brake in combination with its air-distributer. When the train is running, compressed air fills the train-pipe and passing through the valve R and pipe S enters the chamber K′ of the distributer at $K^5$, Fig. 8. The compressed air passes through the openings $k^2$ into the space below the piston $Z^8$, depresses the leather $p'$, and penetrates into the space between the pistons $Z^7$ and $Z^8$, and, depressing the leather $p^2$, enters the space above the piston $Z^7$. When the train is running, the orifice $K^2$ is uncovered and the compressed air may pass out through the opening $K^2$ and down the passage $B^2$ to the space below the diaphragm $y^8$. Compressed air is also present in the space between the diaphragms $y^7$ and $y^8$ by way of the passages $C^2$ and C′, opening into the space above the piston $Z^7$. As long as the normal pressure is maintained in the train-pipe, and consequently in the compartments of the distributer, as just described, the spring $R^4$ keeps the pistons $Z^7$ and $Z^8$ and the slide-valve T′ $T^2$ raised to their highest point. Consequently the orifices $D^2$ and $B^3$ are uncovered and the compressed air passing through orifice $B^3$ and passage B′ fills the chamber G of the brake-cylinder, through orifice $D^2$ and passage D′, and fills the reducer or chamber F, and through the passage C′ (always open to the space above the piston $Z^7$) to the reservoir or chamber E. The pistons H and $h$ being therefore in equilibrium, the spring $K^7$ maintains the brakes in the off position. During the movement of the train the compressed air has the same pressure in the reservoir E, in the cylinder G, and in the space K′, the two diaphragms $y^7$ and $y^8$ are in equilibrium, and the spring $R^4$, as well as the pressure of compressed air on the face of the valve K, maintain this valve on its seat.

When the brakes are to be applied, the engineer by opening the operating-valve allows a certain quantity of air in the train-pipe to escape. The depression thus caused acts first in the chamber K′ of the distributer and in the space below the piston $Z^8$, which compartments are in direct communication with the train-pipe. The leather $p'$ applies itself immediately against the sides of the distributer, and the difference of pressure above and below the piston $Z^8$ causes the pistons $Z^7$ and $Z^8$ and the slide-valve to descend, compressing the spring $R^4$, until the spring $R^2$ is reached. In this position the slide-valve T′ puts the passages D′ and $d'$ in communication with each other, and the compressed air in the reducer or chamber F escapes into the atmosphere through these passages. The pistons H and $h$ will no longer be in equilibrium. The face of the piston H toward the reservoir E being greater than the face toward the chamber G, the piston H will be driven in the direction of the arrow, the spring R′ will be compressed, and the piston-rod $t$ will actuate the brake mechanism to carry the brake-shoes up to the brake-wheels. During this movement of the piston H the compressed air driven ahead in the chamber G passes through the passage B′, orifice $B^3$, which is still uncovered, and into the space above the piston $Z^7$, thence through passage C′ to the reservoir or chamber E.

During the whole of the period occupied in moving the brake mechanism there is no expenditure of air in the cylinder, the air contained in the reducer F being alone expended, the diameter of the said reducer being calculated in proportion.

When the necessary movement has been imparted to the brake mechanism, a greater depression in the train-pipe causes the pressure above the pistons $Z^7$ and $Z^8$ to force these pistons down to the bottom of their course, compressing the spring $R^2$. In this position the edge $z^8$ of the piston $Z^8$ is forcibly applied against the leather $p^9$ and completely isolates the main pipe and the compartment K′ from the rest of the apparatus. The slide-valve T′ still maintains the communication between the reducer F and the exhaust $d'$, but the slide-valve $T^2$ has closed the orifice $B^3$, thus shutting off all communication between the chamber G and the reservoir E. At this moment the lower part of the distributer, formed by the diaphragms $y^7$ $y^8$ and the valve K, being termed the "expander" of the cylinders, is brought into action. As explained above, in this expander the space comprised between the diaphragms $y^7$ and $y^8$ communicates continuously with the chamber or reservoir E, the space K′ above the diaphragm $y^7$ communicates with the pipe, and the lower space communicates with the chamber or cylinder G.

During the two first phases above described the depression made in the main pipe is insufficient for the difference of pressure of the air on the two diaphragms to overcome the resistance of the spring $R^3$. When the depression in the pipe and space K′ is sufficient, the compressed air under the diaphragms overcomes the resistance of the spring $R^3$, the valve K is raised, and the air in the cylinder G escapes.

As the area of the diaphragm $y^7$ is three times, for example, greater than that of $y^8$, it is evident that the valve K will remain open as long as the depression made in the cylinder G is not three times greater than the depression in the main pipe and in the space K′. Therefore the depression made in the cylinder G depends on that made in the main pipe, and the engineer can easily obtain the desired degree of braking force. Moreover, this arrangement allows of accelerating the action of the brake and of economizing considerably the compressed air of the main pipe, since for a depression of one and one-half atmospheres made in the main pipe the cylinder G is completely emptied, which gives the maximum of braking force.

I am aware that it has been proposed to make air-brakes with large and small cylinders and pistons; but in such case one of the pistons at a fixed point in its stroke determined the time of application of pressure to the large cylinder. In my invention the distributer alone and independently of the stroke of the pistons controls the application of pressure to the large cylinder, and no matter how much the brake shoes and wheels may become worn the small piston will always have time to bring the brake-shoes quite up to the wheels before pressure is applied to the large piston.

To take off the brakes the engineer turns the operating-valve in the position for moving, and the compressed air again fills the main pipe. As soon as the normal pressure is re-established in the main pipe and the compartment K′ of the distributer, Fig. 6, the spring $R^3$ closes the valve K, and the springs $R^2$ and $R^4$ raise the pistons $Z^7$ $Z^8$ and return the valves T′ and $T^2$ to the position for running of the train. In this position the valves T′ and $T^2$ uncover the orifice $B^3$ and $D^2$ (isolating the exhaust $d'$) and the compressed air from the reservoir E immediately fills the cylinder G and the reducer F, which give a very rapid unlocking of the brakes. The equilibrium of the pistons H and $h$, Fig. 8, being instantly re-established, the spring $R^2$ moves the shaft $t$ to take off the brakes. The compressed air, which still comes through the main pipe, re-establishes in the reservoir E, the cylinder G, and the reducer F the initial pressure —say, four atmospheres—but to take off the brakes it suffices to re-establish this pressure in the main pipe only.

Fig. 4 illustrates a modification of the brake-cylinder in which the small cylinder or reducer is formed in the body of the piston H, the piston $h$ being stationary. The working of the modification of the brake represented in Fig. 4 is absolutely identical to that which we have described in reference to Figs. 1, 2, and 3, the distributer used being the same as shown in Figs. 6 to 9.

Figs. 10 and 11 represent, in vertical section and in plan, another modification of the brake-cylinder, and Fig. 12 illustrates the construction of the distributer used with this brake-cylinder. In this arrangement the movement of the brake mechanism is made by the rod $t$ of the small piston $h'$ of the reducer F, without the large piston H′ moving from its place. The piston $h'$ is formed of a hollow cylinder of cast-steel. The surface of this cylinder presents deep circular grooves $h^5$. A locking device actuated by a diaphragm $I^5$, as hereinafter explained, is provided with a bolt I, having teeth which engage in the grooves $h^5$ at the desired moment to lock the piston $h'$, and thus prevent it from returning after the brakes are moved up. In this modification the reducer F is normally open to the atmosphere through the passage D′, Figs. 10 and 12, and exhaust $d'$, Fig. 12, as described below. The distributer, Fig. 12, used with this brake is the same in construction as the distributer shown by Figs. 6 to 9, with two exceptions, first, the slide $T^3$ (similar to T′ in Fig. 10) normally maintains the passage D′ in communication with the exhaust $d'$, and, second, the distributer is provided with another passage $b^3$ leading to the locking device, this passage $b^3$ being controlled by the slide $T^3$, as hereinafter described. In this modification when the train is in motion the compressed air in the main conduit passes to the distributer at K′, and, through the openings $k^3$ to the space below the piston $Z^8$, depresses the leather $p'$ and penetrates through orifice $K^2$, situated between the leathers $p'$ and $p^2$ in the channel $B^2$, and into the cylinder G. The compressed air then depresses the leather $p^2$ and passes directly to the reservoir E by the passage B′. The locking device A and the reducer F, Figs. 10 and 11, communicate with the exhaust $d'$ by the channels $b'$ and $D'$, respectively, and the slide-valve $T^3$, and under these conditions the spring $R'$ maintains the piston $h'$ and the brake mechanism in the position with the brakes off, and the spring $R^5$ maintains the bolt I depressed. In order to apply the brakes the engineer causes a depression in the main pipe, which has the effect of making the pistons $Z^7$ $Z^8$ of the distributer descend, compressing the spring $R^4$, and the slide $T^3$ uncovers the orifice $D'$, communicating with the reducer. The compressed air in the space above the piston $Z^7$ passes through $D'$ to the reducer, and acting on the piston $h'$ and rod $t$, moves the brake-shoes into contact with the brake-wheels. The depression in the pipe increasing, the piston descends still farther, compressing the spring $R^2$, and the slide $T^3$ uncovers the orifice $b^3$, through which the compressed air passes into the locking device I, and acting on the diaphragm $I^5$ causes the teeth of the sliding bolt I to engage with the circular grooves in the piston of the reducer. The expander of the cylinders formed by the two diaphragms $y^7$ and $y^8$ and valve K comes into action at this moment, its action being in all points identical to that in the preceding distributer, Figs. 6 to 9, and the depressions made in the cylinder G determining, as for the preceding brake-cylinder, the force of braking. In this arrangement the piston H′ scarcely moves, since the brake mechanism has been previously displaced by the piston $h'$. This peculiarity permits of replacing the leathers of the piston H, Fig. 8, by a leather diaphragm H′, Fig. 10, which assures an absolute air-tightness and does not require any repairs. To take off the brakes the engineer re-establishes the initial pressure in the train-pipe, which causes the distributer first to empty the locking device I and afterward the reducer. This allows the spring $R'$ to act on the piston $h'$, causing the brakes to be taken off, after which the compressed air re-establishes the initial pressure in the cylinder and in the air-chamber.

In conclusion, I do not limit myself in any way with regard to the forms, dimensions, proportions, and relations of the several constituent parts of the apparatus hereinbefore described, which may also be constructed of any suitable material; and I use the term "piston" in a sufficiently broad sense to include a flexible diaphragm.

I claim as my invention—

1. An air brake cylinder having two compartments of different diameters each provided with a piston and each having admission and exhaust ports, a distributer for controlling the admission and exhaust whereby the small piston first moves up the brakes to the brake wheel and the large piston then supplies the pressure or braking power, and a locking device to lock the two pistons together when the brakes are moved up, substantially as set forth.

2. An air brake cylinder having two compartments of different diameters each provided with a piston, the piston in the larger compartment having a greater extent of acting surface on one side than on the other, admission and exhaust ports from each compartment, and a distributer provided with a valved communication to each end of the larger compartment and with means to control the admission and exhaust ports and the said valved communication, substantially as and for the purposes set forth.

3. An air brake cylinder having two compartments of different diameters each compartment provided with a piston, in combination with a casing provided with a port leading to one end of the smaller compartment, and ports leading to each end of the larger compartments, a slide valve controlling the said ports, a piston connected to the slide valve, and actuated by the difference in the pressure in the train pipe and the brake cylinder, and two springs adapted to act upon the said piston to divide the movement of the slide valve into two distinct periods, all substantially as and for the purpose set forth.

4. A compressed air brake cylinder having two compartments of different diameters each compartment provided with a piston, in combination with a distributer comprising a casing provided with a port communicating with one end of the small compartment in the brake cylinder ports communicating with each end of the large compartment, a piston actuated by the difference of pressure in the brake cylinder and the train pipe, a slide valve connected to the piston and adapted to first control the passage leading to the small compartment, and then control the ports to the large compartment, and a second valve adapted to then open the exhaust from one end of the large compartment, all substantially as and for the purpose set forth.

5. A compressed air brake cylinder having two compartments of different diameters and each provided with a piston, in combination, with a distributer comprising a casing provided with ports leading to one end of the small compartment and to each end of the large compartment, a valved exhaust passage from one end of the large compartment, a slide valve controlling the said ports, a piston controlled by the difference of pressure in the train pipe and in the cylinder and connected to the slide valve and an expander to actuate the valve in the said passage, the said expander comprising two diaphragms, one side of the expander being in the passage from one end of the large compartment, the space between the diaphragm communicating with the other end of the large compartment and the space on the other side of the expander communicating with the train pipe, all substantially as and for the purposes set forth.

6. A compressed air brake cylinder having two compartments of different diameters and

each provided with a piston, a locking device to lock the two pistons together at a certain time, a casing and piston to actuate the said locking device, in combination with a distributer comprising a casing provided with ports leading to the said compartments and the said locking device casing, a slide valve controlling the said ports and a piston connected to the valve, and controlled by the difference in pressure in the train pipe and in the cylinder, all substantially as and for the purposes set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JOSEPH LIPKOWSKI.

Witnesses:
LÉON CRANCKEN,
CLYDE SHROPSHIRE.