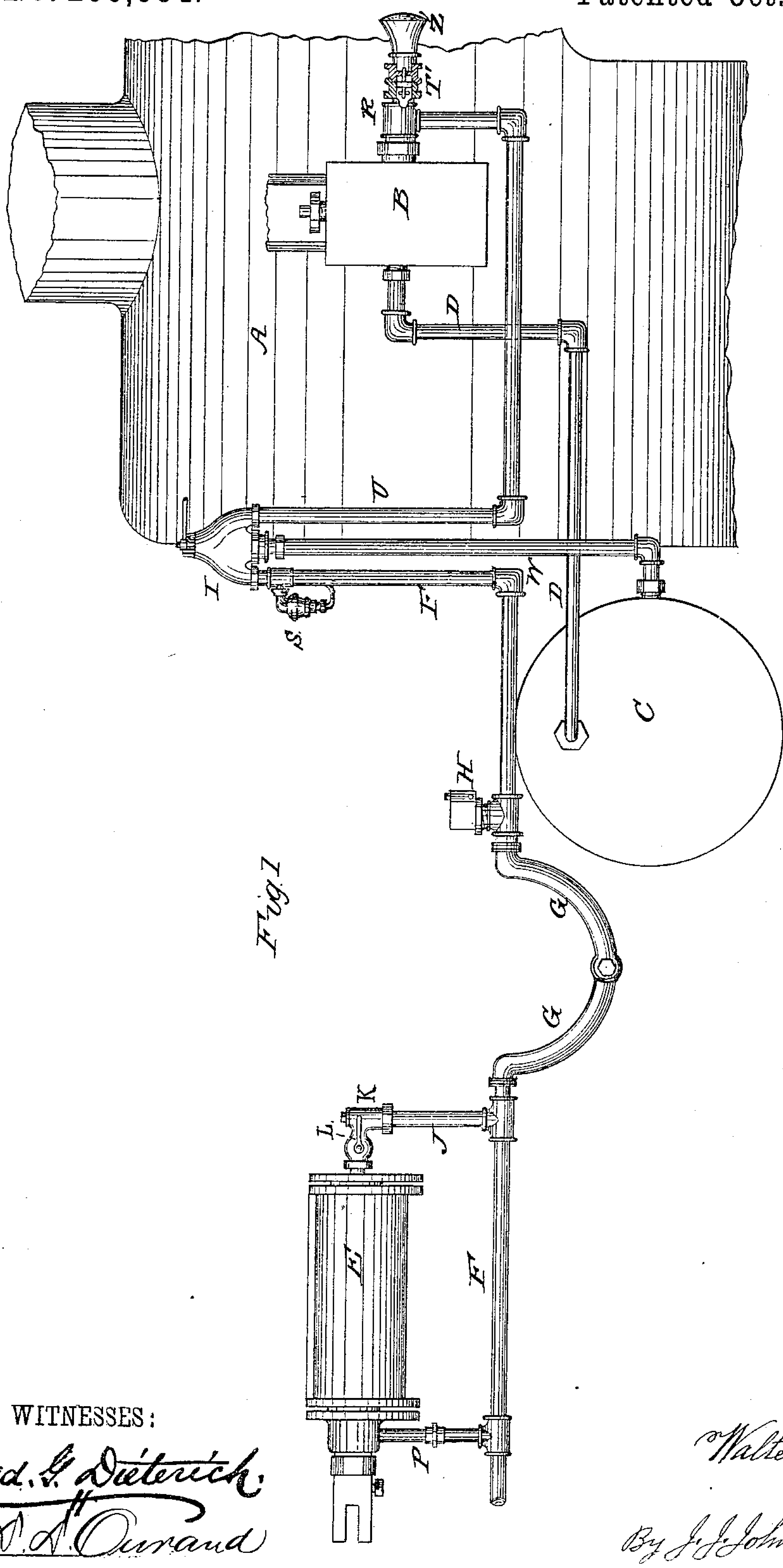
(No Model.) 5 Sheets—Sheet 1.

W. J. FORD.

AUTOMATIC AIR BRAKE FOR RAILWAY CARS.

No. 266,684. Patented Oct. 31, 1882.



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(No Model.)

5 Sheets—Sheet 2.

W. J. FORD.

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Fig. 2

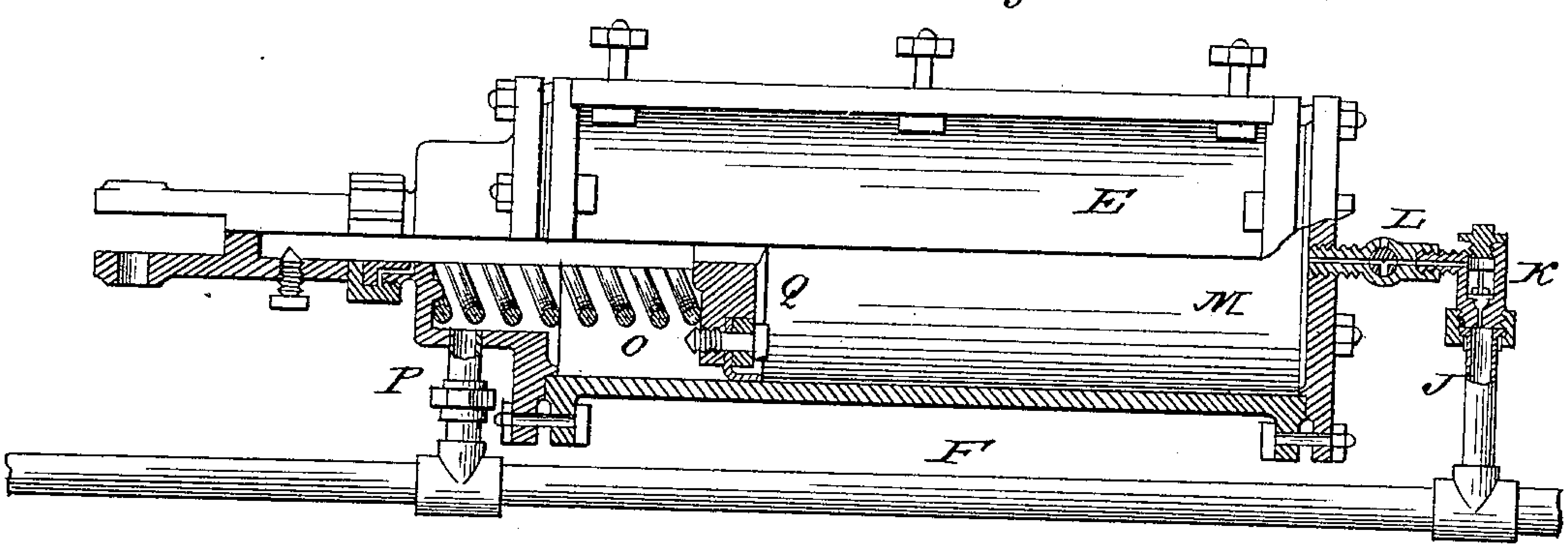

Fig. 3

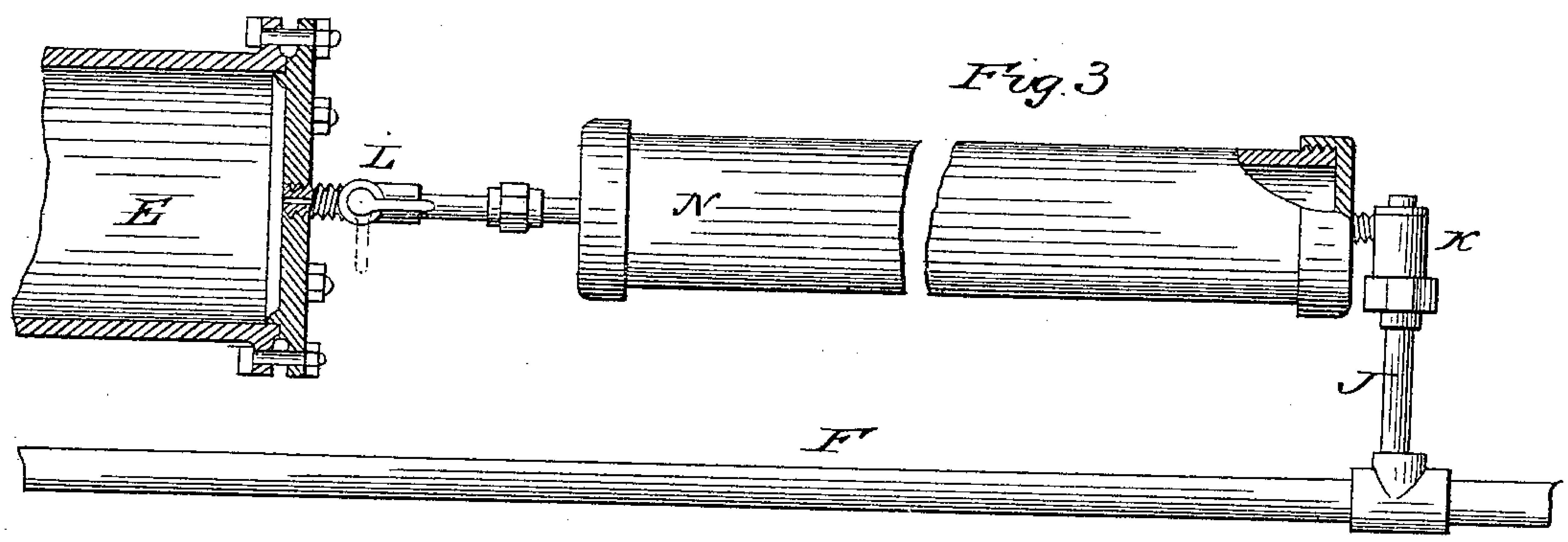

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Fig. 4

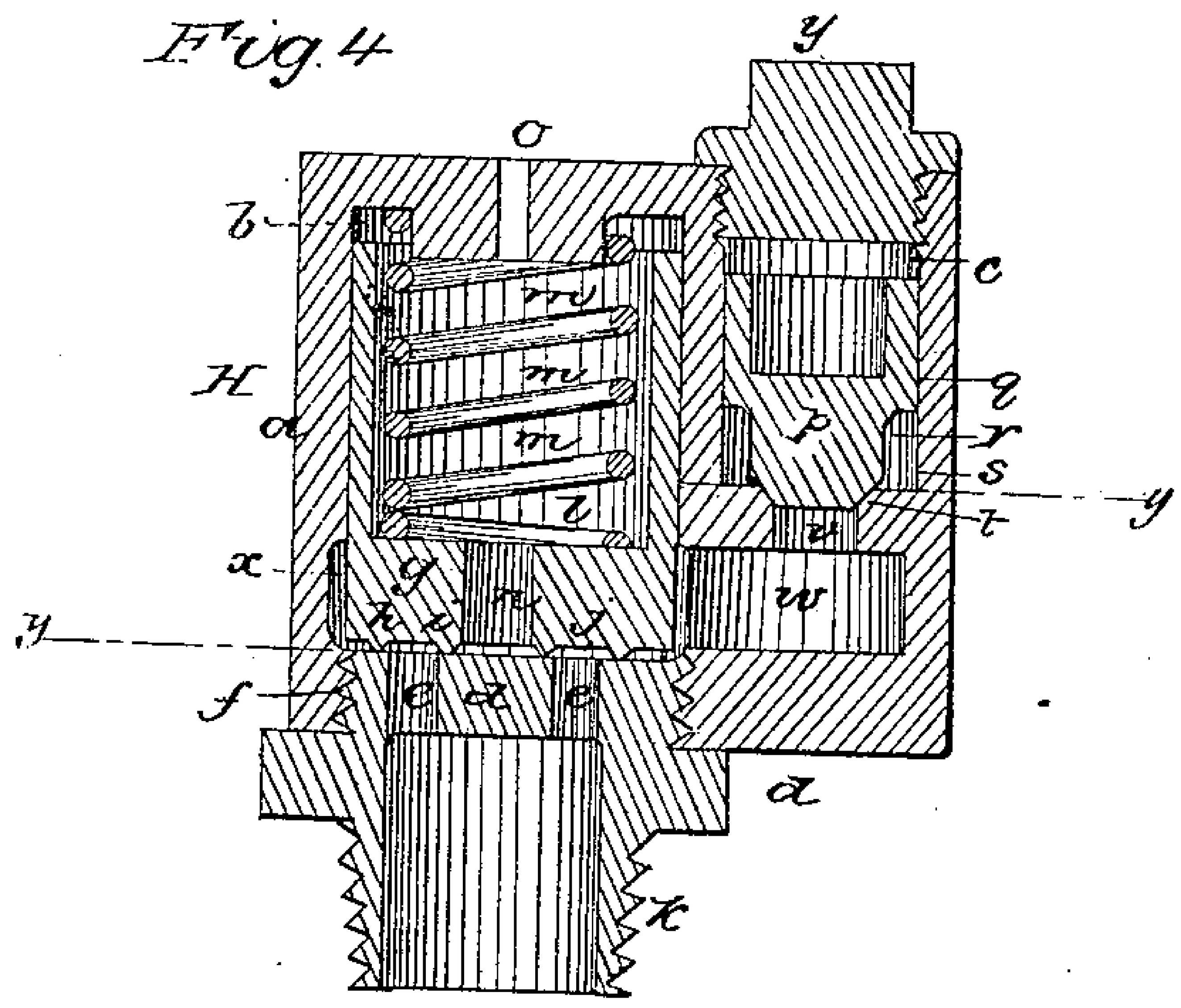
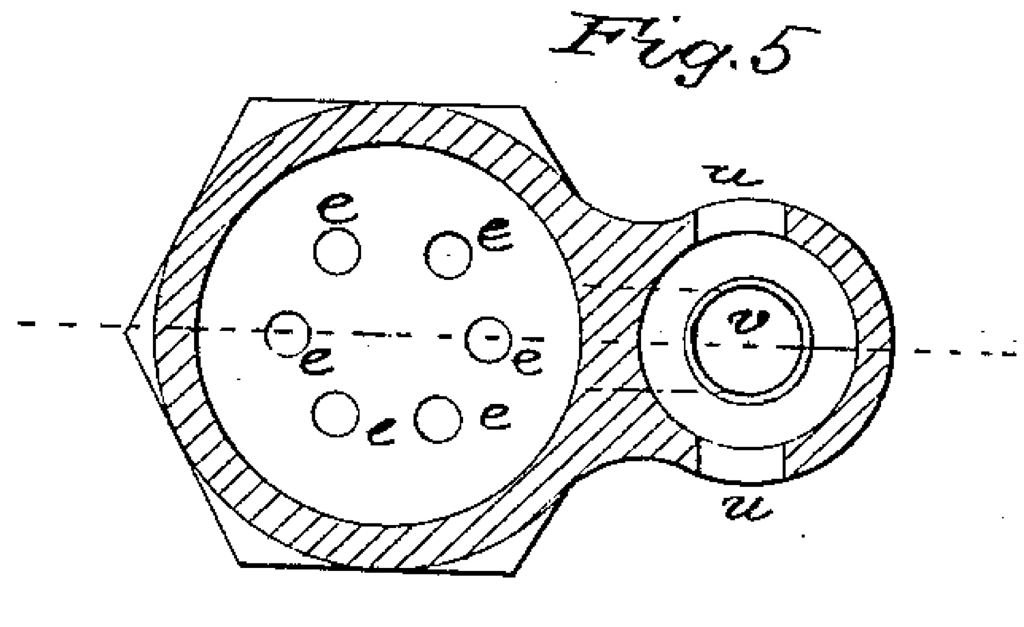


Fig. 5



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(No Model.) 5 Sheets—Sheet 4.

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AUTOMATIC AIR BRAKE FOR RAILWAY CARS.

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Fig. 6.

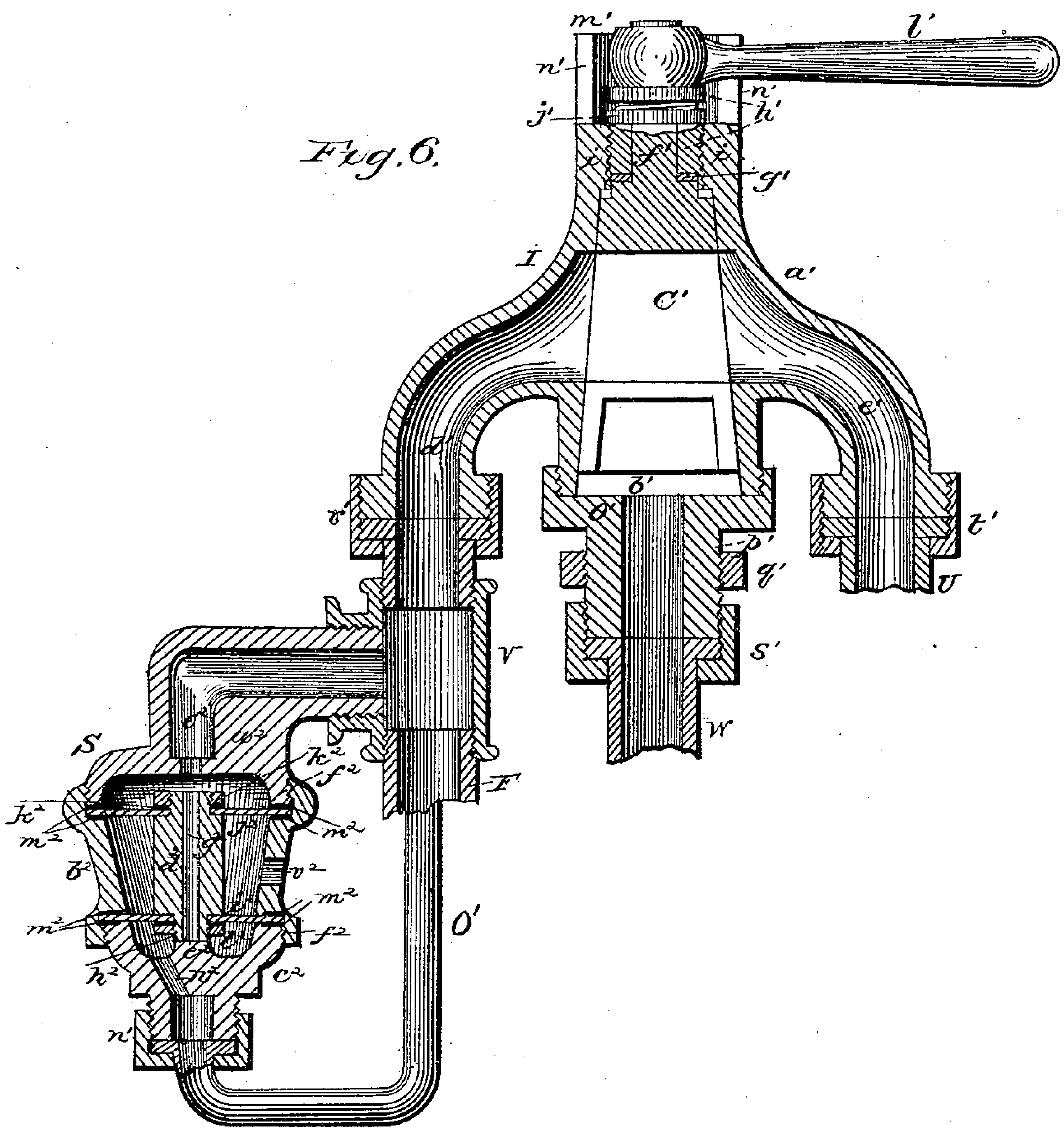
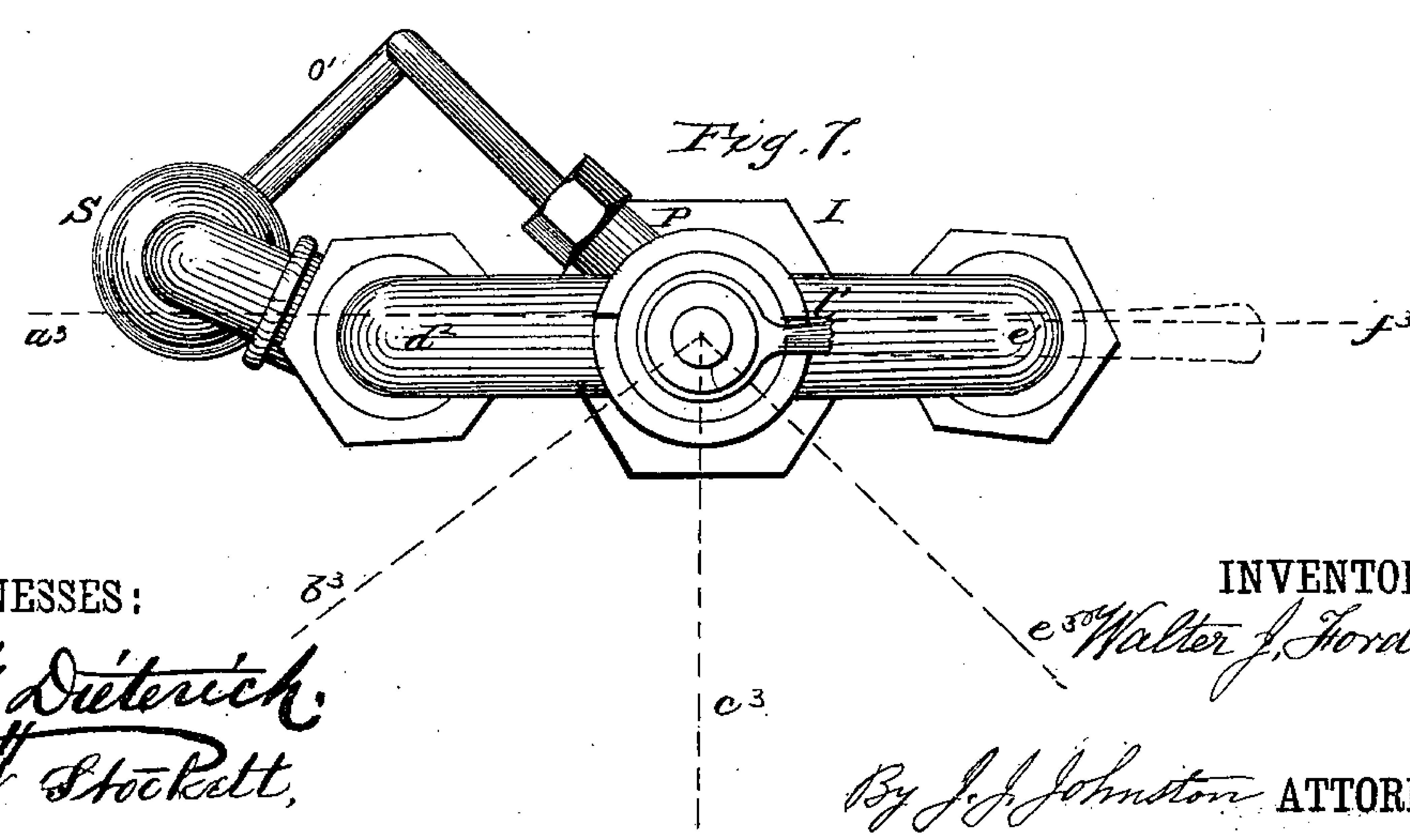


Fig. 7.



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(No Model.)

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AUTOMATIC AIR BRAKE FOR RAILWAY CARS.

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Fig. 8

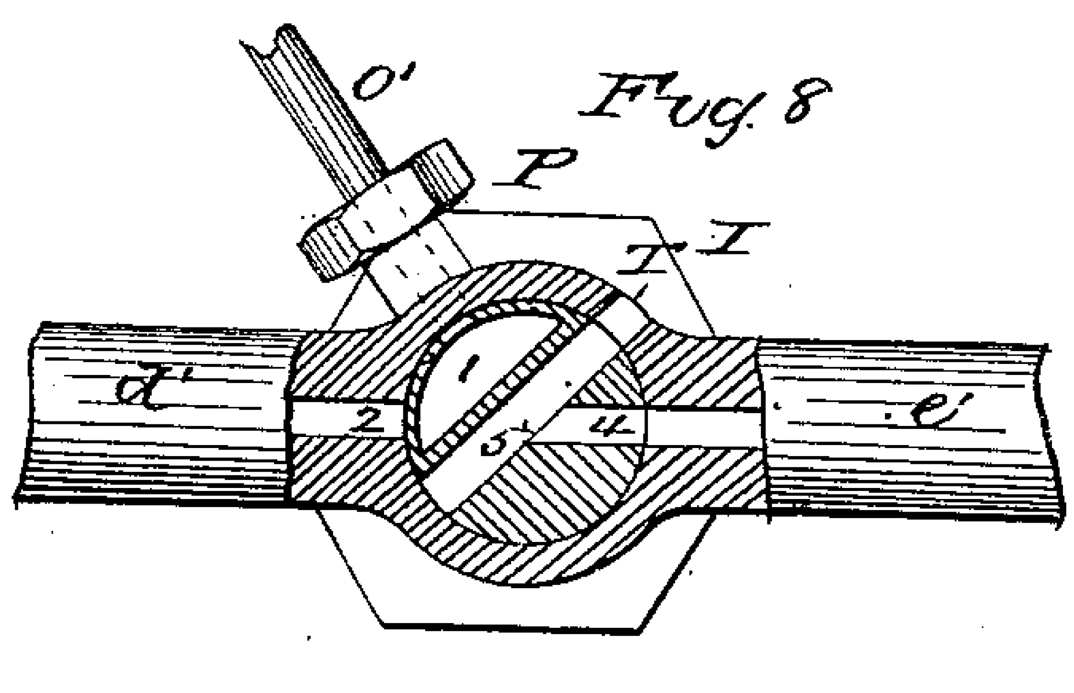


Fig. 9.

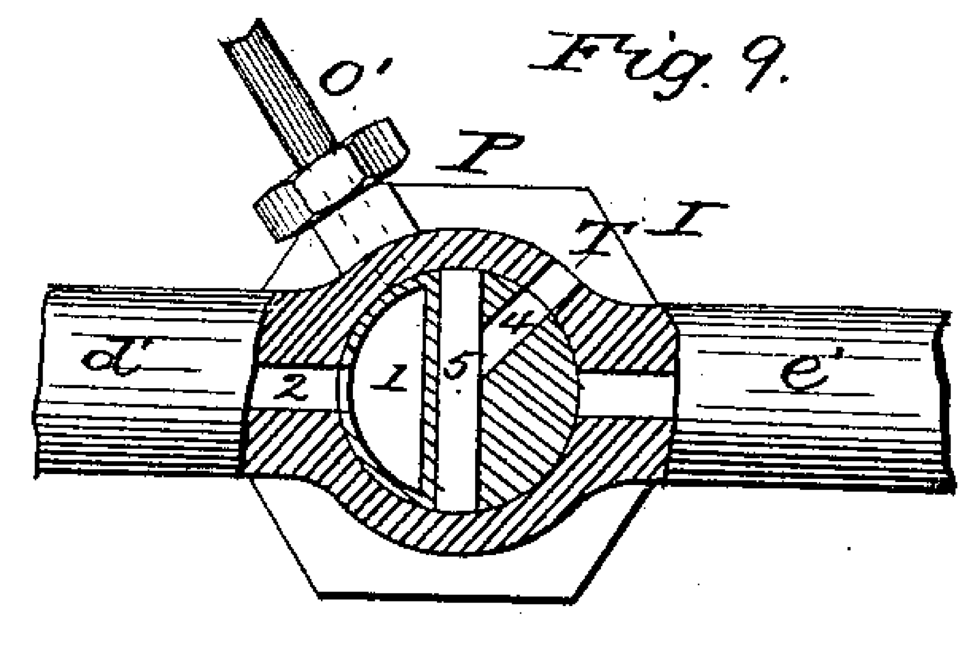


Fig. 10

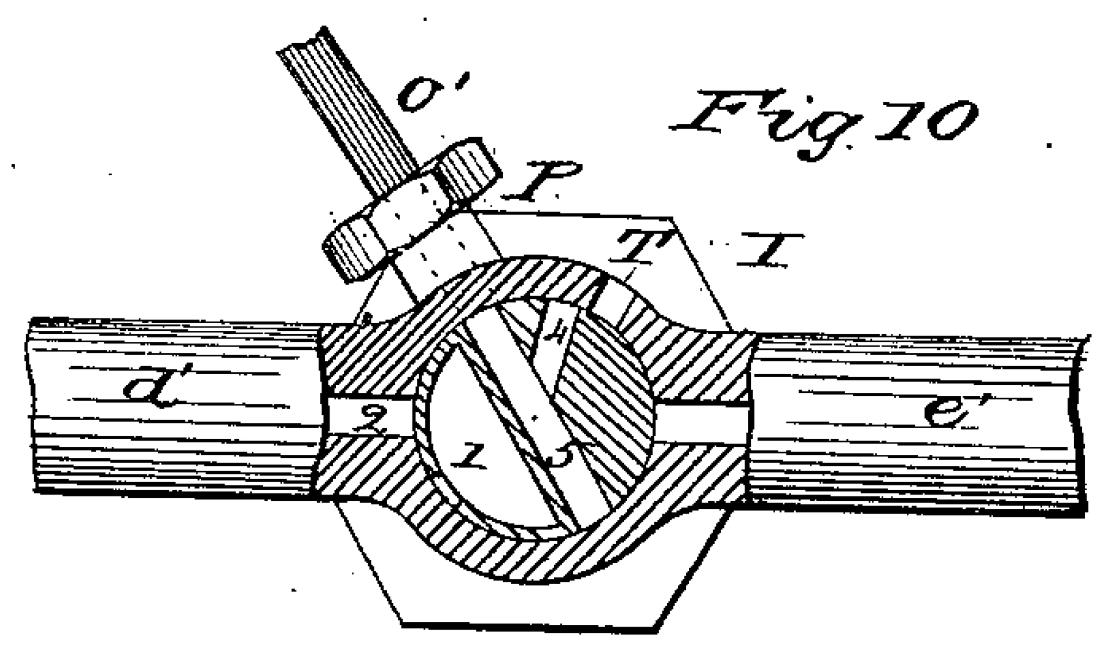


Fig. 11

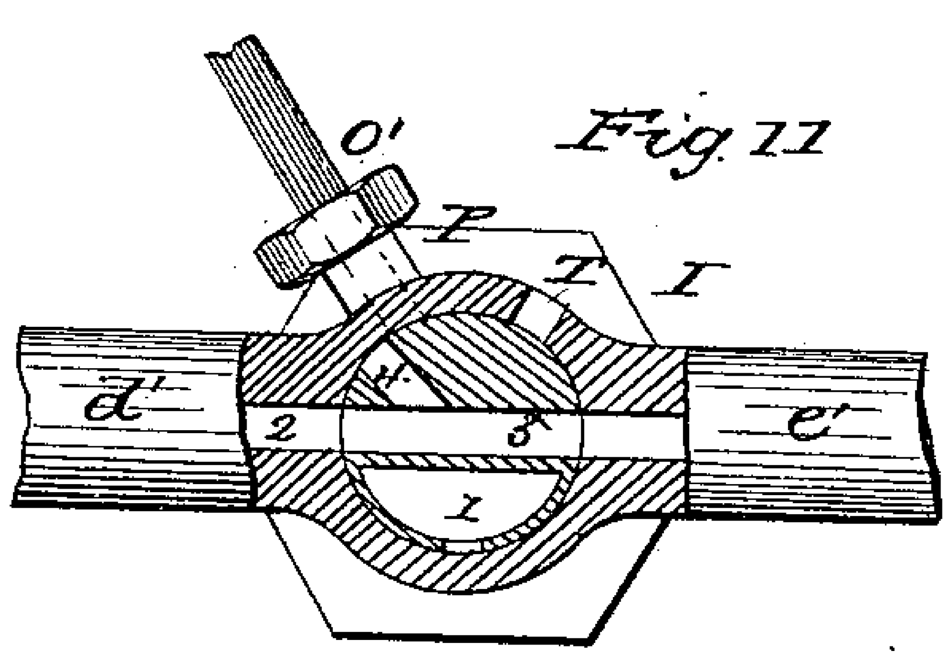
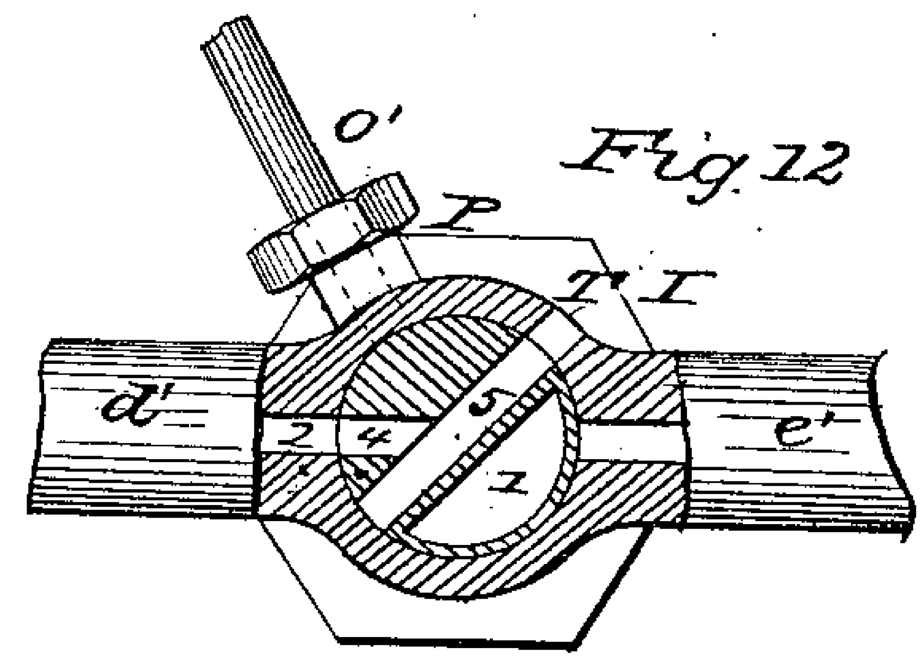


Fig. 12



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UNITED STATES PATENT OFFICE.

WALTER J. FORD, OF CONCORD, TENNESSEE.

AUTOMATIC AIR-BRAKE FOR RAILWAY-CARS.

SPECIFICATION forming part of Letters Patent No. 266,684, dated October 31, 1882.

Application filed May 24, 1882. (No model.)

To all whom it may concern:

Be it known that I, WALTER JOHN FORD, of Concord, in the county of Knox and State of Tennessee, have invented a new and useful Improvement in Automatic Air-Brakes for Railway-Cars; and I do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

In the known improvements in automatic air brakes for railway-cars experience has demonstrated that they are deficient in the following particulars: first, in economy of construction and simplicity of operation; second, in that their construction and operation are so complex as not to be adapted to the skill and intelligence of the average "train-man;" third, in not being adapted to safe and certain manipulating of the brakes when the train is in motion on varying grades at different altitudes; fourth, in not being able to apply the brakes and release them without a jerking and jarring of the train and its braking mechanism; fifth, in not having at all times and under all conditions when the train is in motion a sufficient supply of compressed air to apply or release the brakes to meet any emergency that a train may be subjected to; sixth, in not being able to maintain a maximum of force for manipulating the brakes; seventh, in subjecting the air-compressing mechanism and valves connected therewith to undue wear by the induction of dust and gritty matter into the air-compressor, air-reservoir, and into and through the valve-chambers, and around the valves and their seats; eighth, in undue waste of the compressed air and of the power employed for compressing it.

My invention has for its object the overcoming of the disadvantages due to the foregoing-recited deficiencies in air-brakes; and it consists in the method of operating such brakes, as hereinafter described, to wit: compressing air and transmitting it to the brake-cylinders, and subsequently returning the compressed air back to the air-compressing mechanism for reuse, maintaining a maximum of pressure of air in the train-pipe, balancing the piston of the air-cylinder, and controlling the distribution of the compressed air to the air-cylinders and its return back to the air-compressing mechanism, and cause it to rapidly escape in case of any sudden emergency at the will of the operator, which method and its advantages and the means for carrying it into effect will hereinafter more fully and at large appear.

To enable others skilled in the art with which my invention is most nearly connected to make and use it, I will proceed to describe its construction and operation.

In the accompanying drawings, which form part of this specification, Figure 1 is a side elevation of my improvement in automatic air-brakes for railway-cars. Fig. 2 is a side view of the air-cylinder and train-pipe, represented partly in section. Fig. 3 represents a section of the air-cylinder, train-pipe, and an auxiliary air-reservoir combined therewith. Fig. 4 is a vertical section of the relief-valve for the train-pipe. Fig. 5 is a transverse section of the same at line $y\ y$ of Fig. 4. Fig. 6 is a vertical section of the control-valve and check. Fig. 7 is a top view of the control-valve. Figs. 8, 9, 10, 11, and 12 are horizontal sections at line $y'\ y'$ of Fig. 6, representing the various positions of the ports of the valve in the operating of it.

Reference being had to the accompanying drawings, A represents the locomotive steam-boiler, B the air-compressing mechanism, C the reservoir for the compressed air, D the pipe which connects the air-compressing mechanism with said reservoir, E the air or brake cylinder, F the train-pipe, and G G the couplings of said pipe, all of which parts are of ordinary construction and operation, and are arranged with relation to each other, and secured on the locomotive and cars in the usual manner; but combined with said parts is a relief-valve, H, and control-valve I, of peculiar construction and operation, and also check-valves, whereby I am enabled to reuse the compressed air, maintain a maximum of pressure of air in the "train-pipe," balance the piston of the air or brake cylinder, and control the distribution of the compressed air.

The construction of the air or brake cylinder E and its connection with the train-pipe F is clearly shown in Fig. 2, which also represents the branch pipe J of the train-pipe F provided with a check-valve, K, having a stop-cock, L, interposed between it and cylinder E, and communicating therewith, for exhausting the air from the end M of the cylinder E in case of the train parting, or from any single cylinder of any car of the train. In some cases it may be desirable to connect the end M of the air or brake cylinder with an auxiliary air-reservoir, N, for the supply of additional air required for long trains, in which case the auxiliary air-reservoir is arranged between the stop-cock L and check-valve K, as shown in Fig. 3. The spring end O of the air or brake cylinder E communicates with the train-pipe F through the medium of a branch pipe, P. The piston Q of the air or brake cylinder E is connected with the brake mechanism in the usual manner.

The relief-valve H (represented in Figs. 4 and 5) is for the purpose of maintaining the maximum of air-pressure in the train-pipe F, and consists of a case, *a*, having valve-chambers *b c*, chamber *b* having a base, *d*, with a series of openings, *e*, therein, said base being secured in the case *a* by means of screw-threads *f*, which base forms a rest for the main valve *g*, having a double seat, *h* and *i*, forming an annular space, *j*, which is directly over the openings *e* in the base *d*, which base, by means of screw-threads *k*, is secured in the train-pipe, as shown in Fig. 1. The valve *g* is fitted in the chamber *b* so that it will move easily, yet so that but little air can escape around its periphery, and its weight adjusted to suit the desired working-pressure. In a cavity, *l*, in a valve, *g*, is placed a spiral spring, *m*, for loading the valve by tension of the spring *m*, just sufficient to balance the pressure of air acting on the annular space *j* of the main valve *g* at working-pressure. In the valve *g* is an opening, *n*, which communicates with the cavity *l*, and in the upper end of the case *a* is an opening, *o*. In the chamber *c* is fitted a valve, *p*, so that but little air can escape around its periphery at *q*, said valve being recessed or made smaller in diameter at *r*, so as to form an annular recess, *s*, above its seat *t*, which communicates with openings *u u* in the case *a*. (Shown in Fig. 5.) In the seat of the valve *p* is an opening, *v*, which communicates with a cavity, *w*, which communicates with an annular recess, *x*, in the case *a*, surrounding the lower part of the main valve *g*. The chamber *c* is provided with a screw-cap, *y*.

The operation of the relief-valve H is as follows: As soon as the working-pressure is obtained or exceeded in the train-pipe F the air admitted through the openings *e* leaks through the seat *i* and aperture end to the upper side of the valve *g*, and thence escapes to the atmosphere through the opening *o*. At the same time the air leaks through the seat *h*, and since the exits *v* and *u* are closed by the valve *p*, and the main valve *g* is fitted in the chamber *b* so that but little air can escape around its periphery, it is confined, and acting on a larger area of the main valve than the annular space *z*, for which the spring *m* was calculated, the main valve is thereby raised, a portion of the air escaping through openings *n* and *o*; but the valve *p* not being loaded to sustain a greater pressure than a leak, the greater portion escapes through the space *x w* and openings *v u u*, thus obtaining a rapid exit. As the opening *o* is smaller than the opening *n*, when the air is escaping more can pass through the opening *n* than can pass through the opening *o*. The pressure on the top of the main valve *g* is thus increased, while its pressure on the bottom is decreased by its rapid escape through the space *w* and openings *v u u*. The closing of the valve *g* at the pressure determined upon is thus secured to any degree of accuracy required by the relative sizes or diameters of the openings *n* and *o*.

I do not claim the relief-valve H herein shown and described, but reserve the right to make it the subject-matter of another application for Letters Patent of the United States.

The control-valve I communicates with the train-pipe F, inlet-pipe R of the air-compressing mechanism B, and reservoir C, and is furnished with a check-valve, S, for maintaining a less pressure of air in the train-pipe F than in the reservoir C. Said control-valve is employed for the purpose of returning the compressed air in the train-pipe (at the will of the operator) to the inlet-pipe R, provided with a check-valve, T′, and through it to the air-compressing mechanism B, which forces it through pipe D into the reservoir C, from which it passes through pipe W to the control-valve I, and from it back into the train-pipe F, for reuse for operating the braking mechanism; and the operator can also by said valve cause the compressed air to rapidly escape from the train-pipe and the end O of the air or brake cylinder E for applying the brakes in case of any sudden emergency. The operator can so allow the escape of the compressed air from the end O of the brake-cylinder E and conduct it back to the compressor that the piston Q will be balanced in the brake-cylinder, and at the same time relieve the brakes.

The control-valve I consists of a case, *a′*, having a valve-chamber, *b′*, for the coniform valve *c′* and two ways, *d′* and *e′*. On the stem of the valve *c′*, resting on a shoulder, is a washer, *g′*. The stem *f′* is fitted in a hollow nut, *h′*, in the neck *i′*, on which is a lock or "jam" nut, *j′*, for securing the nut *h′* in a fixed position, and the washer *g′* and nut *h′* are for the purpose of adjusting the valve *c′* in its chamber *b′* for avoiding undue friction. On the upper end of the stem *f′* of the valve *c′* is secured a lever, *l′*, for operating the valve. A part of the neck *i′* of the case *a′* is cut away, so as to leave a segment, *m′*, the vertical faces *n′* of which serve as stops for the lever *l′*. On the lower end of the valve-chamber *b′* is a cap, *o′*, which may be supported by a bracket, at *p′*, arranged in any convenient position and secured to said bracket by means of the nut *q′*.

To the way *d′* of the control-valve I, by means of a union, r', is attached the train-pipe F, and to the cap o' is attached, by means of a union, s', a pipe, W, which communicates with a reservoir, C, and to the way e' is attached, by means of a union, t, a pipe, U, which communicates with the inlet air-pipe R of the air-compressor B. Experience has demonstrated that in very long trains the friction of the air in the train-pipe F causes it to move slowly, and that the pressure therein is therefore reduced slowly, which is due to the construction of the check-valve ordinarily employed in connection with the train-pipe and control-valve. The check-valve, being nearly balanced, does not seat itself firmly, and the air leaks through it at about the same rate as the air is exhausted from the train-pipe. To obviate this difficulty, I employ a diaphragm-valve, S, which is more sensitive to the fall of pressure in the ratio of the area of the diaphragm to that of the valve-seat. Said valve is constructed as follows: Its case consists of three parts, a^2, b^2, and c^2, secured together, as indicated at f^2. The valve d^2 has a vertical opening through it, and has secured to it, by means of nuts k^2 and l^2, two diaphragms i^2, and j^2, constructed of leather or other suitable material. The peripheries of said diaphragms are secured between gum washers m^2 in recesses formed in the part b^2 of the case, and the part a^2 and c^2 are screwed against said washers, thereby thoroughly packing the peripheries of said diaphragms. The valve d^2 should be of sufficient weight to produce the desired pressure in the reservoir C over that of the pressure in the train-pipe F. The seat h^2 of the valve is an annular ring or short cylinder, so that it will not increase in size or require readjustment as it wears, therefore when once regulated will remain always of the same size and rest upon the seat e^2 of the part c^2 of the case. The valve d^2 has a vertical opening, g^2, through it. In the side of the part b^2 of the case is an opening, v^2, which admits the atmosphere into the interior between the diaphragms i^2 and j^2. The part a^2 has a port, o^2, and the part c^2 has a port, n^2. The part a^2 is secured to the T (marked V) on the train-pipe, and to the part c^2 is attached, by means of a union, n', the lower end of the pipe O′, the upper end of which communicates with the control-valve at P, as shown in Figs. 7 to 12, inclusive.

The operation of the check-valve is as follows: Air enters from the pipe O′ through the port n^2 to the under side of the diaphragm i^2, thereby operating and raising valve d^2 from its seat, and then passes through the port g^2 to the upper side of the diaphragm j^2, and through port o^2 to the train-pipe F. When the area of the diaphragm j^2 multiplied by the air-pressure in the train-pipe F is less than the area of the diaphragm i^2 multiplied by the pressure in the reservoir C the valve will rise and permit the air to flow from the reservoir C to the train-pipe F until the larger diaphragm j^2 with less pressure balances the smaller diaphragm i^2 with greater pressure, so that the pressure in the reservoir C will exceed that in the train-pipe F inversely as the areas of the diaphragms acted on, and the diaphragms may be varied in size to produce any desired difference of pressure.

The operation of the control-valve is as follows: When the lever or handle l' is in the position indicated by the dotted line a^3 in Fig. 7 that will be the position of the lever or handle l' when the train is in motion. The port 1 in the valve c' is always in communication with the main reservoir C by way of the pipe W, and is also in connection with the pipe O′, leading to the bottom of the check-valve S, and feeding air into the train-pipe F whenever the pressure in the said pipe plus that due to the valve d^2 is less than the pressure in the reservoir C. When the lever or handle l' is in the position indicated by dotted line b^3 in Fig. 7 port 1 of the valve c' communicates with the large port 2 in the case a' of the control-valve I, as shown in Fig. 9, leading to and filling the train-pipe F with compressed air from the reservoir C, thereby releasing the brakes by the pressure of the air from the reservoir passing through the train-pipe F and entering the end O of the air or brake cylinder E. The lever or handle l' is then moved back to the dotted line a^3 to maintain the pressure therein. When the lever l' is in the position indicated by the dotted line e^3 the ports in the valve c' will be in the position shown in Fig. 11, in which position communication through port 1 is cut off from the reservoir C, and direct communication will be had through port 5 with the train-pipe F and the pipe U communicating with the inlet-pipe R of the air-compressing mechanism, which inlet pipe R is provided with a check-valve, T′, for preventing the escape of the returning compressed air out through the screen mouth Z of the inlet-pipe R. With the valve in the position shown in Fig. 11 the compressed air will be withdrawn from the train-pipe F, and the end O of the air-brake cylinder E, passing through the control-valve I and pipe U to the inlet pipe R and to the air-compressing mechanism B, which will force it into the reservoir C for reuse. The brakes at this time will be applied in full, and thus the compressed air can be used over and over again continuously. This method of using the compressed air over again instead of allowing it to escape from the end O of the air or brake cylinder E into the atmosphere, as in the ordinary practice, will be very advantageous when the train is passing over sandy or dusty railways, by avoiding the drawing into the air-compressing mechanism, sand, dust and other gritty matter, having a tendency to clog and unduly wear the valves, pistons, and chambers forming part of said mechanism. Another very great advantage in not allowing the compressed air to escape from the end O of the air or brake cylinder E and train-pipe F into the open atmosphere, but, in contradistinction thereto, returning it to the air-compressing mechanism B for reuse, consists in the fact that it adapts my improvement in automatic air-brakes equally well for trains running on railways on the plains, lowlands, and at the highest altitudes at which railways are or may be constructed.

The efficiency of the air-brakes hitherto known has been found to be much less and more difficult to be made efficiently operative on cars of railways at a great altitude, for example, in the mountainous parts of the west, north-west, and south-west of the United States.

It will be apparent to the skilled mechanic that it is much more difficult and requires many more strokes of the air-compressing mechanism B, and more time to charge the reservoir C when empted at a great altitude than when at or near the level of the sea, and this loss of time on railways in the mountainous parts of the country, with grades varying from five feet to the mile to two hundred and more feet to the mile, makes it a necessity to have some means provided for the rapid, frequent, and efficient manipulation of the brakes with the least possible loss of compressed air, and to have at all times sufficient supply of it in the air or brake cylinders, train-pipe, and reservoir for use in case of emergency, and thereby be able at all times to apply and release the brakes as may be required on heavy or light trains, and on ever-varying grades of the railways. This is especially so on steep up and down grades of railways at great altitudes. These conditions and requirements are fully and efficiently provided for by the method and means hereinbefore described.

When it is necessary to make a quick stop in an emergency the lever or handle l' is moved from the dotted line a^3 to the dotted line f^3. Then the port 4 of the valve c' will be in communication with the port 2, and the port 5 in communication with the opening T in the case a', as shown in Fig. 12, thereby allowing a sufficient amount of the compressed air in the end O of the cylinder E and train-pipe F to discharge into the atmosphere for efficiently applying the brakes. The graduating position of the lever l' is at the dotted line c^3 in Fig. 7. The lever or handle l' being in that position, all the ports are closed, as shown in Fig. 10. If then the lever or handle l' is moved to the dotted line e^3 for a second and then brought back to the dotted line c^3, a little air will be exhausted from the train-pipe and the brakes will be applied lightly. A repetition of this process will set them still tighter, and if the lever or handle l' is allowed to remain at dotted line e^3 the brakes will be applied full; but if the said lever or handle is moved from the dotted line c^3 to dotted line b^3 and after a second of time brought back to dotted line c^3, the brakes will be eased to a corresponding extent by the admission of air from the reservoir C through port 1 of the valve c' to the train-pipe F, and will be thus held so long as the lever or handle l' is at the dotted line c^3, and thus, through the medium of the control-valve I, the brakes can be graduated on or off to any degree of nicety at the will of the operator.

I am aware that a portion of the compressed air has been exhausted from a brake-cylinder through the medium of a pump and forced into an air-reservoir.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In an automatic air-brake for railway-cars, the method of operating the same herein described, viz., compressing the air and transmitting it to the brake-cylinders and automatically returning the compressed air back to the air compressing mechanism for reuse, substantially as and for the purpose set forth.

2. In an automatic air-brake for railway-cars, the method of operating the same, viz: compressing air and transmitting it to the brake-cylinders and returning the same to the compressing mechanism for reuse, maintaining a maximum pressure of the compressed air in the train-pipe through the medium of a relief-valve and controlling the distribution thereof to the brake-cylinders and its return to the compressing mechanism and its rapid escape into the atmosphere in case of emergency by means of a control-valve at the will of the operator, substantially as and for the purpose set forth.

3. An automatic air-brake provided with a valve adapted to control the transmission of compressed air to the brake-cylinder, maintain an equilibrium of pressure therein, and then return the same to the compressing mechanism, substantially as herein described, and for the purpose set forth.

4. An automatic air-brake provided with a valve adapted to control the transmission of compressed air to the brake-cylinder, balance the piston therein, and in an emergency to suddenly relieve the cylinder of pressure and return the air to the compressing mechanism, substantially as herein described, and for the purpose set forth.

5. In an automatic air-brake, the combination of the air-brake cylinder E, valve L, auxiliary reservoir N, check-valve K, and train-pipe F, communicating with air-compressing mechanism, substantially as herein described, and for the purpose set forth.

6. In an automatic air-brake, a control-valve, I, communicating with the train-pipe F, air-reservoir C, and the inlet-pipe R of the air-compressing mechanism B, substantially as herein described, and for the purpose set forth.

7. In an automatic air-brake, a control-valve, I, communicating with the train-pipe F, air-reservoir C, and the inlet-pipe of the air-compressing mechanism B, in combination with the check-valve S and pipe O′, substantially as herein described, and for the purpose specified.

8. In an automatic air-brake, the control-valve I, consisting of the case a, having ways

$d' e'$, opening T, segment of a cylinder, m', having vertical faces n', valve c', having ports 1, 4, and 5, cap o', and adjusting-nut h' and jam-nut j', constructed and arranged substantially as herein described, and for the purpose set forth.

9. In an automatic air-brake, the check-valve S, the case constructed in three parts, a^2 b^2 c^2, secured together by screw-threads at f^2, the part a^2 having port o^2, and part c^2 having port n^2, part b^2 having opening r^2, the valve d^2 having port g^2 and cylindrical seat h^2, and nuts k^2 l^2, and the diaphragms i^2 j^2, constructed, arranged, and operating substantially as herein described, and for the purpose set forth.

10. In an automatic air-brake, the combination of the control-valve I, train-pipe F, pipe U, inlet-pipe R, having check-valve T, air-compressing mechanism B, pipe D, and reservoir C, communicating with said control-valve, substantially as herein described, and for the purpose set forth.

11. In an automatic air-brake, the air or brake cylinder E, having the end M, communicating with the train-pipe F through the medium of the branch pipe J, provided with stop-valve L, and check-valve K, and the end O, communicating with said train-pipe through the medium of branch-pipe P, substantially as and for the purpose set forth.

12. In an automatic air-brake, the auxiliary reservoir N, interposed between the check-valve K and stop-valve L, and communicating with the brake-cylinder E and train-pipe F, substantially as herein described, and for the purpose set forth.

13. In an automatic air-brake, the combination of the brake-cylinder E, control-valve I, train-pipe F, pipe U, inlet-pipe R, having check-valve T', air-compressing mechanism B, pipe D, and reservoir C, communicating with said control-valve, substantially as herein described, and for the purpose set forth.

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Witnesses:
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