(No Model.)

3 Sheets—Sheet 1.

R. SOLANO.

AUTOMATIC AIR BRAKE.

No. 405,855. Patented June 25, 1889.

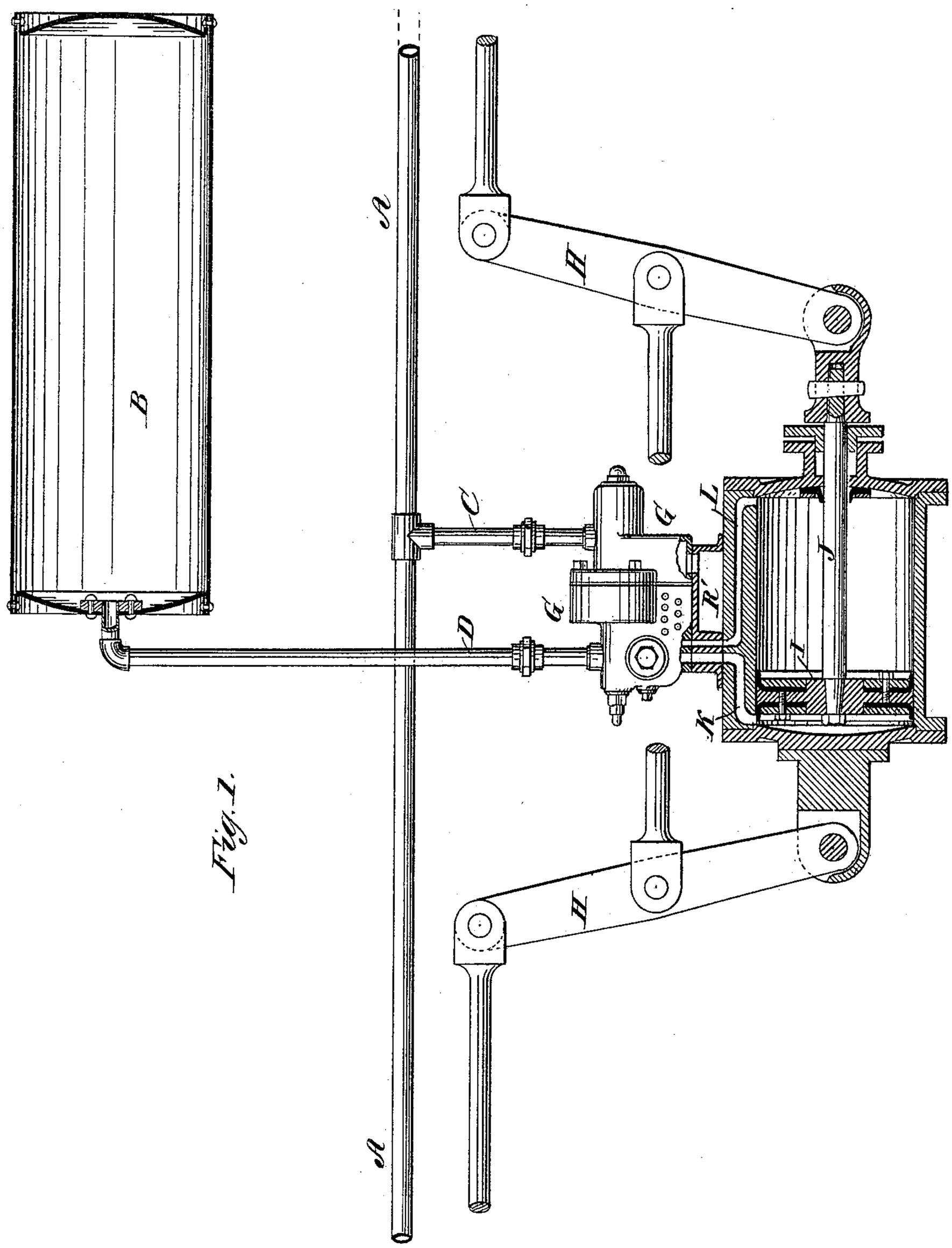

Fig. 1.

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Fig. 2.

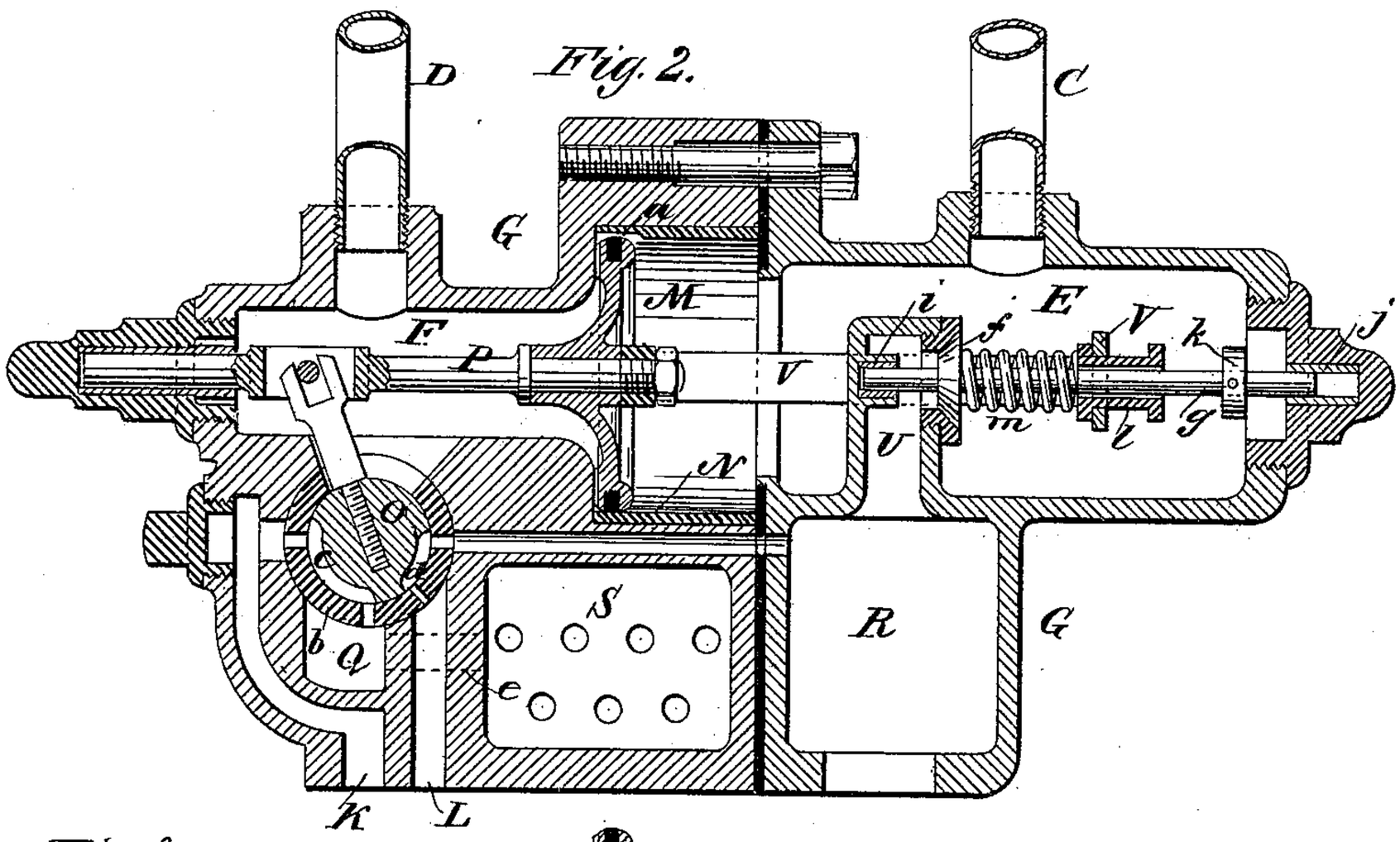

Fig. 3.

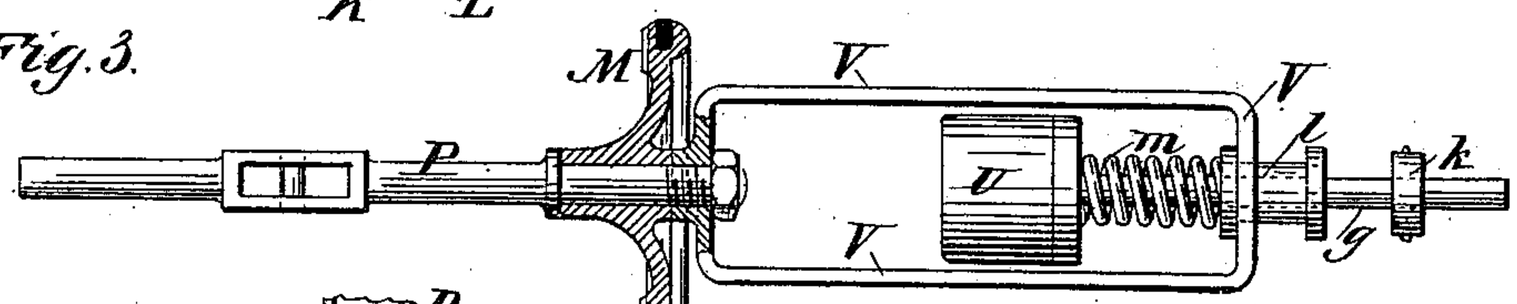

Fig. 4.

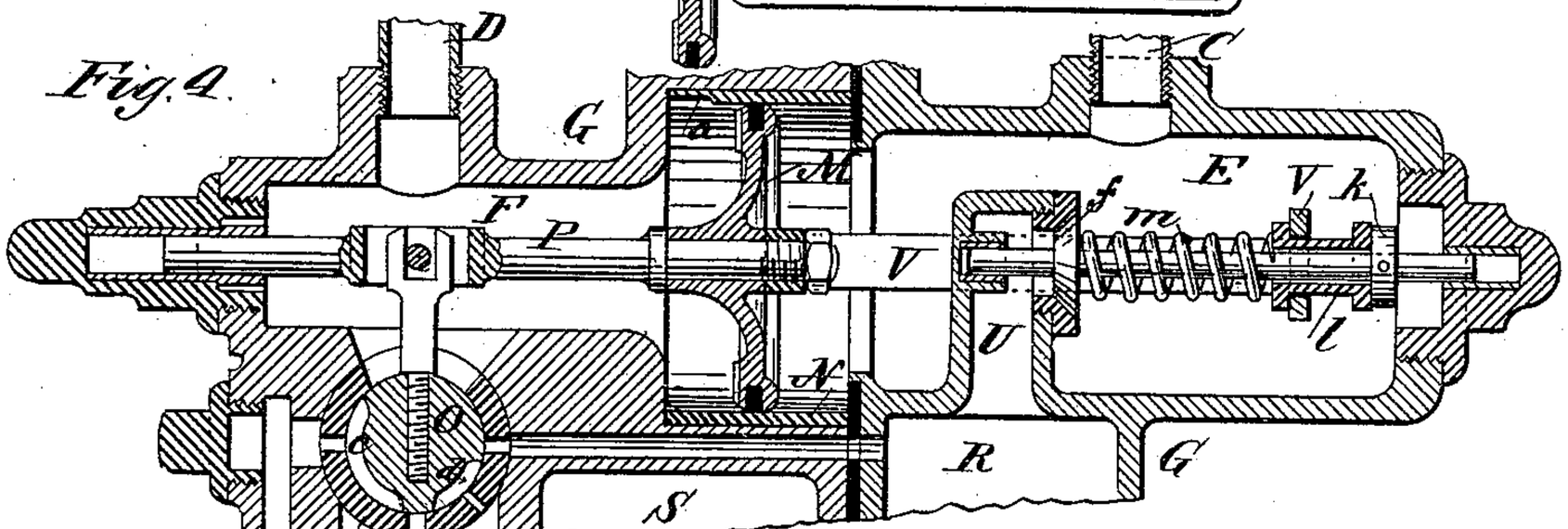

Fig. 5.

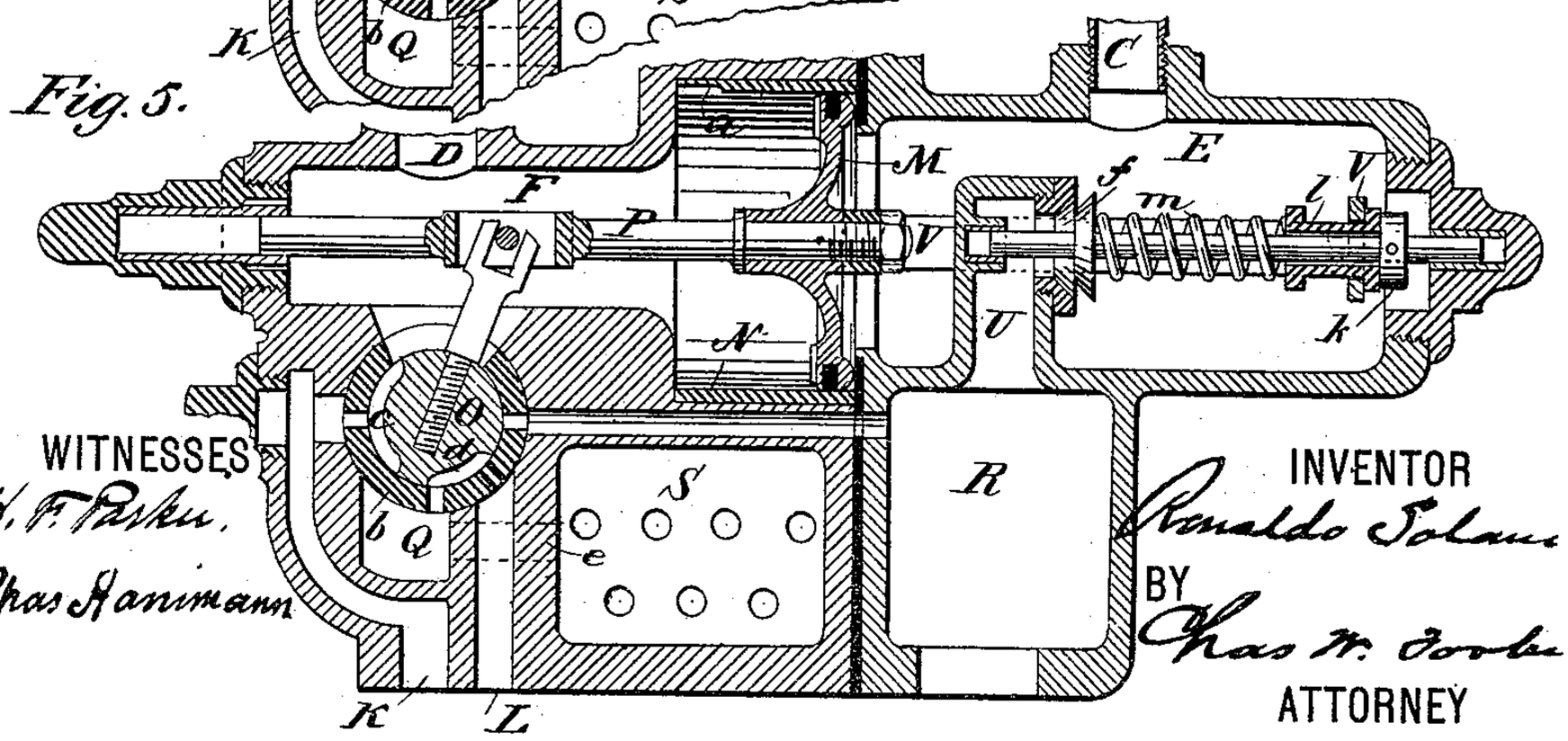

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Fig. 7.

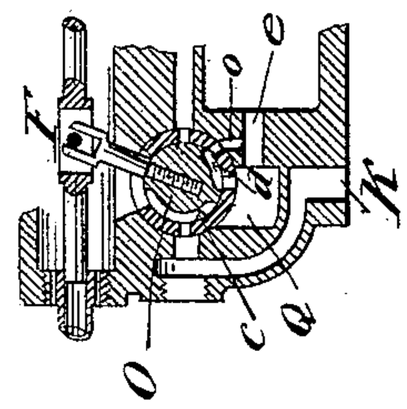
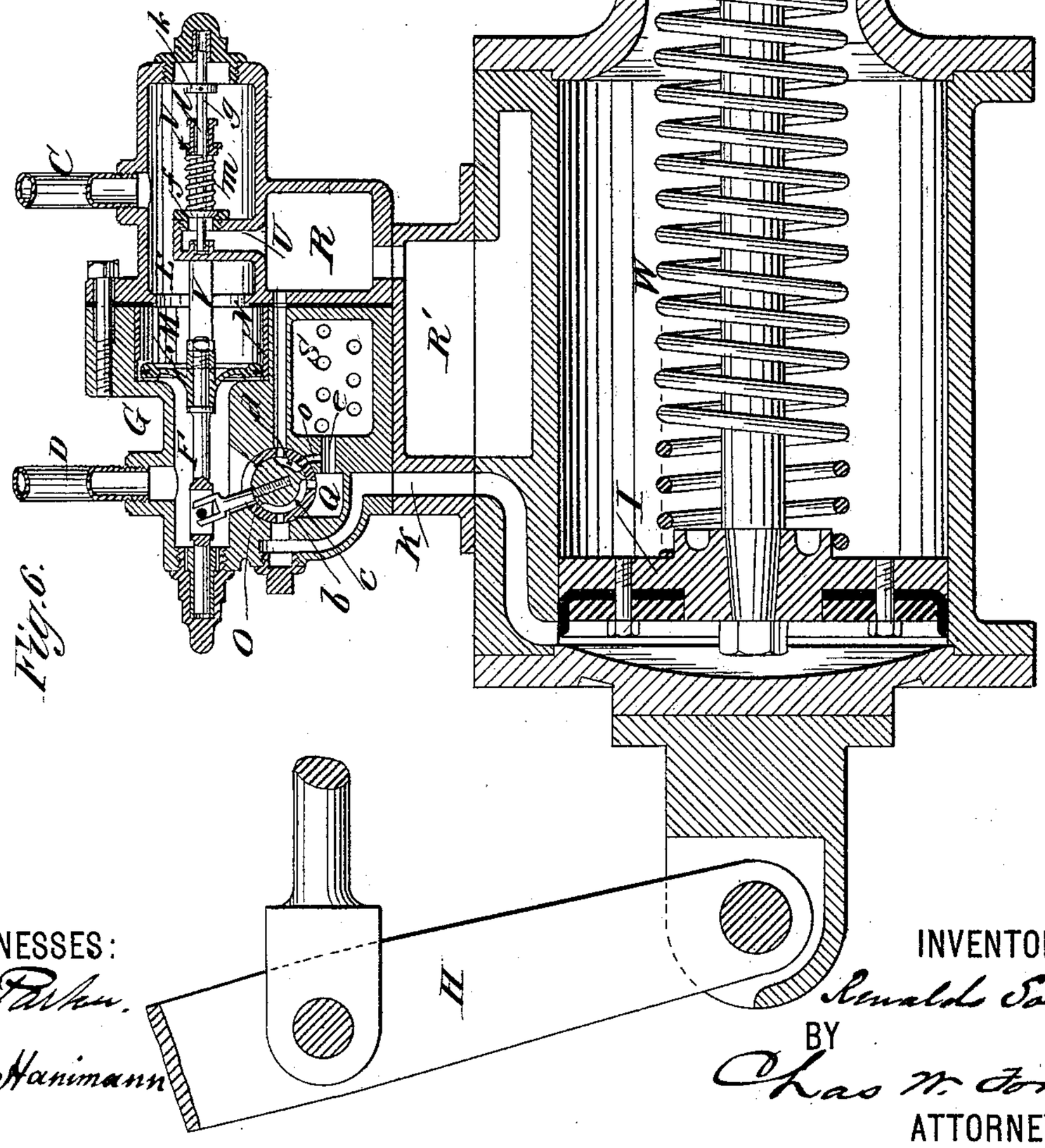


Fig. 6.



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UNITED STATES PATENT OFFICE.

RENALDO SOLANO, OF BROOKLYN, NEW YORK, ASSIGNOR OF THREE-FOURTHS TO JOHN W. HOWARD AND DAVID R. MORSE, OF SAME PLACE, AND LUCIUS G. FISHER, OF CHICAGO, ILLINOIS.

AUTOMATIC AIR-BRAKE.

SPECIFICATION forming part of Letters Patent No. 405,855, dated June 25, 1889.

Application filed February 7, 1889. Serial No. 299,029. (No model.)

To all whom it may concern:

Be it known that I, RENALDO SOLANO, a citizen of the United States, residing at Brooklyn, county of Kings, and State of New York, have invented certain new and useful Improvements in Automatic Air-Brakes, of which the following is a specification.

My invention relates to fluid-brake apparatus wherein stored pressure is rendered active upon the braking appliances automatically by the reduction of pressure in the train-pipe.

The object of my invention is to quicken the reduction of pressure in the sections of train-pipe local to each braking apparatus on the successive cars, and to thereby render the response of the brake valves and cylinders as nearly simultaneous as possible throughout the train.

My present invention consists of apparatus similar in function to that described by me in Letters Patent No. 376,970, dated January 24, 1888, in which the actuating-piston for the brake-cylinder valves is controlled between opposing pressures—namely, the stored pressure and the train-pipe pressure—so that a predominance of either shall actuate the valves in the one direction or the other. The brake-piston is held at such limit of stroke as it may reach by confined air on opposite sides thereof, or by confined air on the one side in case of a single-acting cylinder, and such limit of stroke may be predetermined by the amount of pressure reduction given to the train-pipe by the engineer's operating-valve, imparting to the brake a variable degree of pressure at will, which may be further increased or maintained continuously without the necessity of release.

Referring to the accompanying drawings, forming a part of this specification, and in which similar letters of reference indicate corresponding parts throughout, Figure 1 is a plan view of the apparatus attached to each car, the brake-cylinder and storage-reservoir being in section; Fig. 2, a horizontal section of the brake-cylinder valves, valve-piston, and casing enlarged; Fig. 3, a detail view of the valve-piston and rod, viewed from a side taken perpendicular to that shown in Fig. 2; Figs. 4 and 5, sectional views similar to Fig. 2, showing different positions of the mechanism; and Figs. 6 and 7, a sectional elevation and a sectional detail view, respectively, of a modification of the invention.

In Fig. 1, A is the main train-pipe, the usual couplings for the same between the cars, the main reservoir to which it connects, the air-compressors, and the engineer's operating-valve for charging and exhausting the train-pipe being of any well-known or suitable construction. B is an auxiliary or storage reservoir, such as provided to each brake-cylinder, and the train-pipe and storage-reservoir are respectively connected by the pipes C and D with the chambers E and F of the brake-cylinder-valve casing G.

In Fig. 1 the apparatus is shown in a position to effect the release of the brakes, the levers H H being connected with the brakes by rods in the usual manner, so that when the piston and piston-rod I J are forced out by pressure introduced through the port K the brakes will be applied, or when such pressure is exhausted and a counter-pressure introduced through the port L the brakes will be thrown off.

In Fig. 2 the brake-valves and valve-piston M are also shown in position of release corresponding with Fig. 1, and in such position the reservoir B is charged from the pipe C through the enlargement or passage *a* in the cylinder N until the pressures are equalized, the passage *a* being closed at other positions of the piston M than that of Fig. 2.

O is an oscillating valve fitted to operate in the fixed bushing *b* by the reciprocation of the piston-rod P. The oscillating valve O has ports *c d*, the port *c* of which controls the connection of the port K or the braking side of the brake-cylinder with the chamber F (reservoir) or with the chamber Q, (exhaust,) while the port *d* controls the connection of the port L or the release side of the braking-cylinder with the chamber R (releasing pressure) or with the exhaust-chamber Q, such different positions being indicated by Figs. 2 and 5, while an intermediate position of the valve O, as in Fig. 4, cuts off all the ports from communication with one another.

The exhaust-chamber Q connects with the enlarged exhaust-chamber S by the passage *e*, whence egress is had to the atmosphere through the perforations shown, the same acting as a muffler.

The chamber R is connected with the confined space R′, Fig. 1, to enlarge its capacity, and acts as an expanding chamber. It is also provided with an extension U, furnished with a valve-seat in line with the axis of the piston M, and there is an independent valve *f* to control the connection of the chamber R with the chamber E, the stem *g* of said valve having bearings in the castings at *i* and *j*. A shoulder *k* is fixed to the valve-stem *g*, and there is a yoke V, secured to the piston M, which embraces and slides loosely upon a double-shouldered sleeve *l*, held toward the yoke by a spring *m*, bearing upon the valve, so that when the yoke V is moved toward the shoulder *k* the spring *m* is first distended, as in Fig. 4, until the sleeve *l* abuts upon the shoulder *k*, whence a continued movement of the yoke will abut upon the shoulder of the sleeve *l*, adjacent the shoulder *k*, lifting the valve *f* from its seat.

Referring to the operation of the apparatus, as shown by Figs. 1 to 5, inclusive, to release the brakes the train-pipe A is charged with the working-pressure from the engineer's valve, moving the piston M to the position of Fig. 1, exhausting the braking side of the brake-cylinder through the port K, while the reduced train-pipe pressure, which was received in the expanding chamber R from the previous braking operation and is now confined therein, expands into the release side of the brake-cylinder through the port L, moving the piston I to the position of Fig. 1, this act of expansion still further reducing the pressure of the air in chamber R. The reservoir B is simultaneously charged in the manner aforesaid through the passage *a* with the full working-pressure.

To apply the brakes, the pressure in the train-pipe A is reduced in a moderate degree, the piston M moving its full stroke to the position of Fig. 5, charging the braking side of the brake-cylinder from the reservoir B through the port K, while exhausting the pressure from the releasing side of the brake-cylinder through the port L and spaces Q S. The present position of the piston M, Fig. 5, is momentary, the same returning to a mid-position, as in Fig. 4, as soon as the pressure in the reservoir B, expanding into the brake-cylinder, becomes reduced to a degree of equalization (or slightly beyond equalization) with the reduced train-pipe pressure, such mid-position of stoppage in the return-stroke of the piston M being insured by the abutment of the yoke V upon the shoulder of the sleeve *l* adjacent the spring, the latter affording sufficient opposition in its distended position for this purpose. Such mid-position of the piston M closes all the ports, confining the brake-piston between the pressure remaining in the brake-cylinder when the period of equalization is reached, and the degree of application of the brakes is therefore predetermined by the amount of reduction of pressure given to the train-pipe, as described in the aforesaid patent, as also the further advancement of the brake-stroke may be imparted by succeeding reduction of pressure in the train-pipe without previous restoration.

When the initial reduction occurs in the train-pipe, the valve *f* is thrown from its seat by a positive motion, the yoke V forcing the shoulder *k* by its abutment upon the shouldered sleeve. The chambers R R′, containing a minimum or nominal pressure due to the previous expansion into the releasing side of the brake-cylinder, afford an expanding space into which the bulk of the portion of air required to be withdrawn from the train-pipe to effect a partial brake-stroke is simultaneously admitted, the sections of train-pipe corresponding to the several cars thereby being more directly and equally relieved than should the exhaustion beyond the initial reduction be performed through the engineer's valve.

Referring to the modification of the apparatus shown by Figs. 6 and 7, the same description applies thereto as applies to Figs. 1 to 5, inclusive, with the exception that the brake-cylinder is single acting, the port L being omitted. A spring W effects the return of the piston I when pressure is released on the braking side thereof. Connection of the expanding chamber R is established with the atmosphere in lieu of with the releasing side of the brake-cylinder when the brake-valve O is in its normal position, as in Fig. 6, pressure being entirely withdrawn from the expanding chamber. The port *o* connects with the exhaust-passage *e*, and is used in substitution for the port L, connecting with the brake-cylinder. As the valve O assumes the position of Fig. 7 by the initial reduction of train-pipe pressure such exhaust is cut off, the relief-valve *f* opening and relieving the local pressure in the train-pipe by admission to the expanding chamber, as hereinbefore described.

I claim as my invention—

1. In an air-brake, the combination of a double-acting brake-cylinder, a brake-cylinder valve for connecting opposite sides of the brake-cylinder alternately with pressure or exhaust, a connected valve-piston or its equivalent permanently exposed to the train-pipe and auxiliary-reservoir pressures on opposite sides thereof, an expanding chamber connective by means of the said brake-cylinder valve with the releasing side of the brake-cylinder, and a normally-closed relief-valve controlling communication between the expanding chamber and the train-pipe, said relief-valve being opened by the valve-piston when communi-

cation between the expanding chamber and the brake-cylinder is closed, for the purposes set forth.

2. The combination, with a double-acting brake-cylinder, of a valve capable of connecting opposite sides of the brake-cylinder with pressure or exhaust, a connected valve-piston exposed to the train-pipe and auxiliary-reservoir pressures on opposite sides thereof, an expanding chamber connective with the releasing side of the brake-cylinder through said valve, a puppet-valve operative in line with the valve-piston to open toward the train-pipe pressure and control communication of the expanding chamber therewith, a shouldered stem provided to said puppet-valve, and a yoke upon the valve-piston that engages with said shouldered stem to trip the puppet-valve to an open position when the brake-cylinder valve is moved to a position to disconnect the expanding chamber with the brake-cylinder.

3. The combination, with the brake-cylinder valve capable of closing all the cylinder-ports at a mid-position, the connected piston or its equivalent, the puppet relief-valve in line therewith, the retarding-spring upon the stem thereof adapted to retard the return movement of the valve-piston at mid-stroke, as described, and a piston-yoke straddling the puppet-valve seat and traversing the spring-bearing stem to afford an abutment of the piston upon said spring, and the shouldered sliding collar, as *l*, whereby the spring and valve-stem shoulder are kept in proper relation with one another and with the said yoke.

4. In an air-brake, the combination of a brake-cylinder, valve controlling the passage of air to and from the cylinder, a valve-operating piston or its equivalent movable between two chambers, one E in communication with the train-pipe and the other F with the reservoir, an expanding chamber communicating with the chamber E through a port closed by a relief-valve, and connections between the relief-valve and valve-piston arranged to open the relief-valve when the communication between the expanding chamber and brake-cylinder is closed, substantially as set forth.

5. The combination, with the valve controlling the flow of air between the brake-cylinder, reservoir, and external air, and a valve controlling the flow of exhaust-air from the train-pipe to a receiving-chamber, of a single valve-operating piston connected to operate both valves, substantially as set forth.

6. The combination, with the relief-valve and its operating-piston, of a spring bearing on the valve and a bearing V, carried with the piston and having a limited movement between the end of the spring and a stop *k* on the valve-rod, substantially as and for the purpose set forth.

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