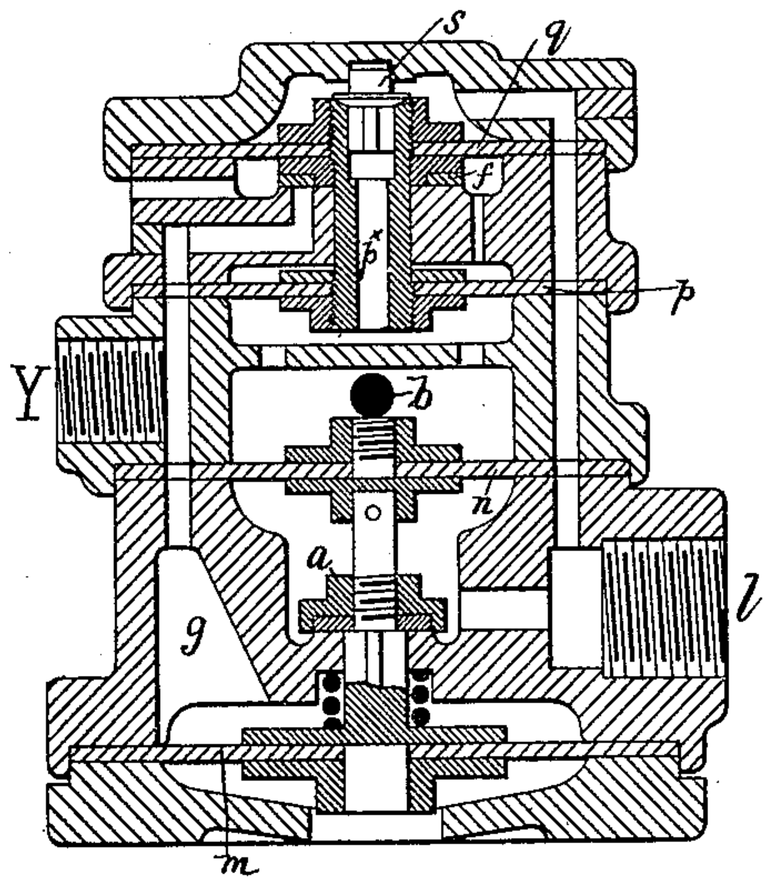
(No Model.) 4 Sheets—Sheet 1.

L. SOULERIN.

PNEUMATIC RAILWAY BRAKE.

No. 467,060. Patented Jan. 12, 1892.

Fig. 1.



WITNESSES:

John Revell

George Baumann

INVENTOR

Leon Soulerin

BY

Howson and Howson

his ATTORNEYS

(No Model.) 4 Sheets—Sheet 2.

L. SOULERIN.

PNEUMATIC RAILWAY BRAKE.

No. 467,060. Patented Jan. 12, 1892.

Fig. 1.

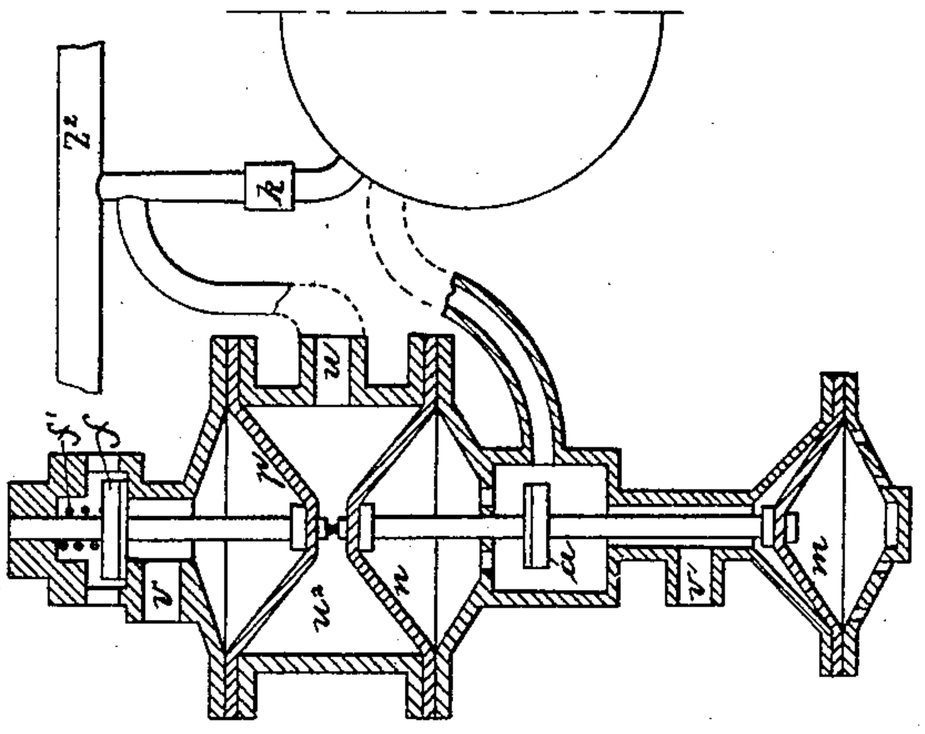
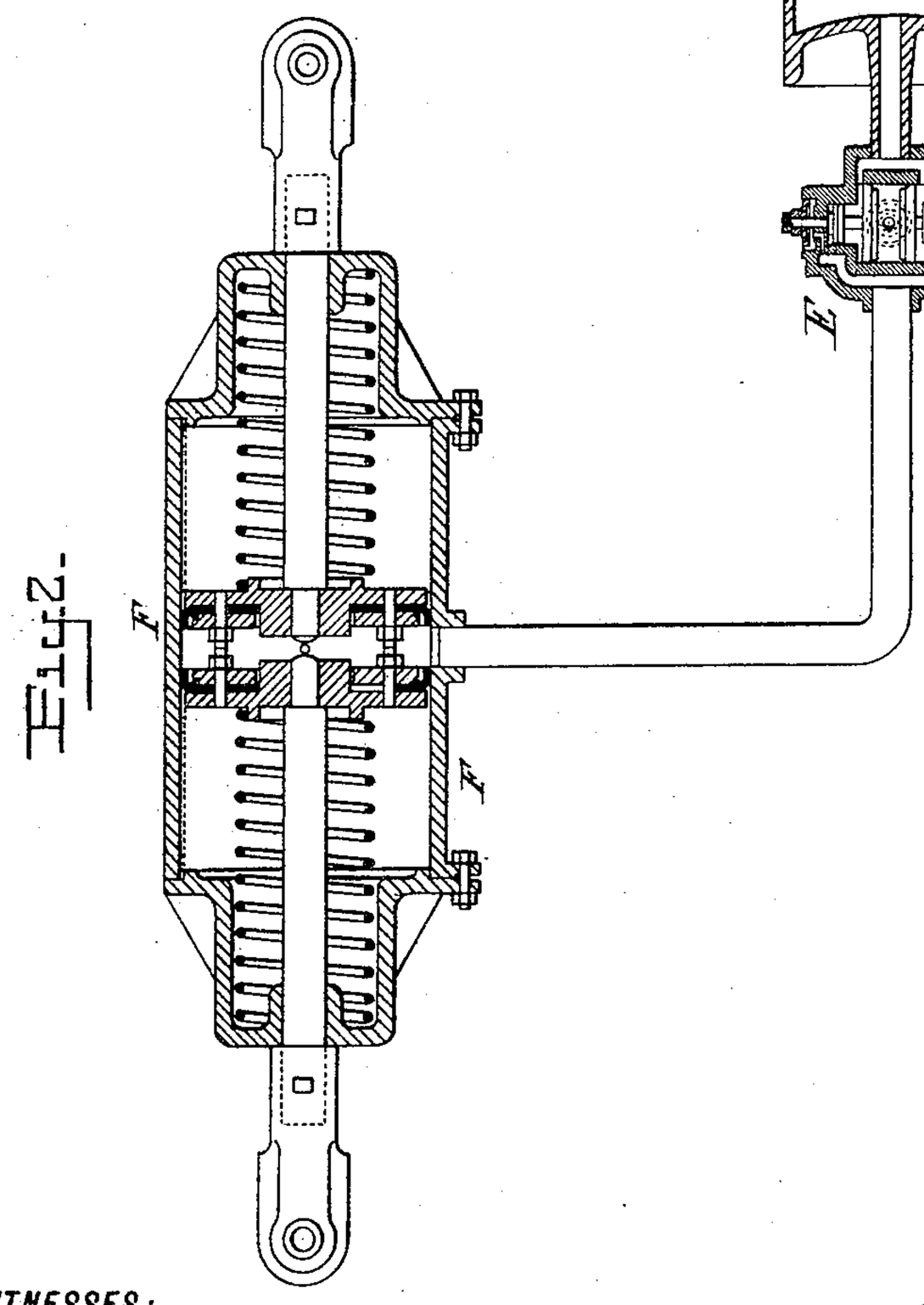


Fig. 2.



WITNESSES:

George Baumann

John Revell

INVENTOR

Leon Soulerin

BY

Howson and Howson

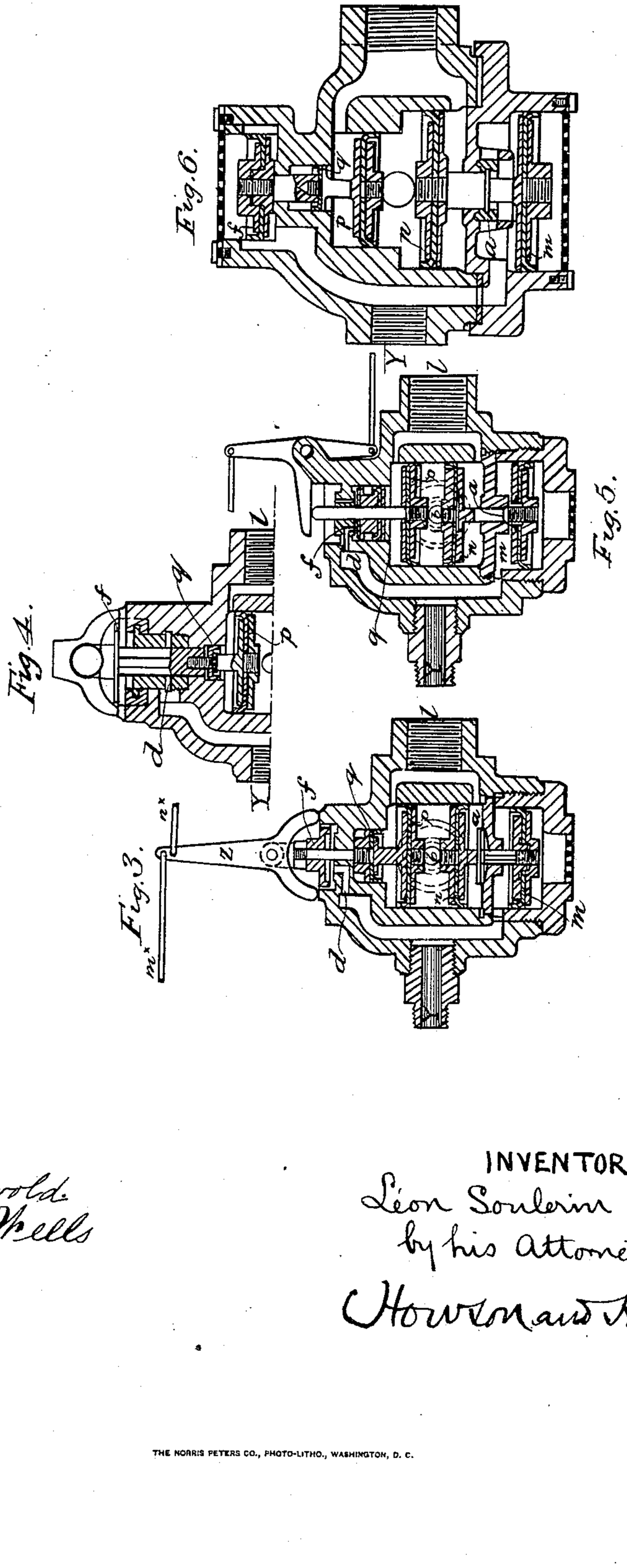
his ATTORNEYS

(No Model.) 4 Sheets—Sheet 3.

L. SOULERIN.

PNEUMATIC RAILWAY BRAKE.

No. 467,060. Patented Jan. 12, 1892.



WITNESSES

E. J. Griswold.

Wm Chester Wells

INVENTOR

Léon Soulerin

by his Attorneys

Howson and Howson

(No Model.) 4 Sheets—Sheet 4.

L. SOULERIN.

PNEUMATIC RAILWAY BRAKE.

No. 467,060. Patented Jan. 12, 1892.

Fig. 7.

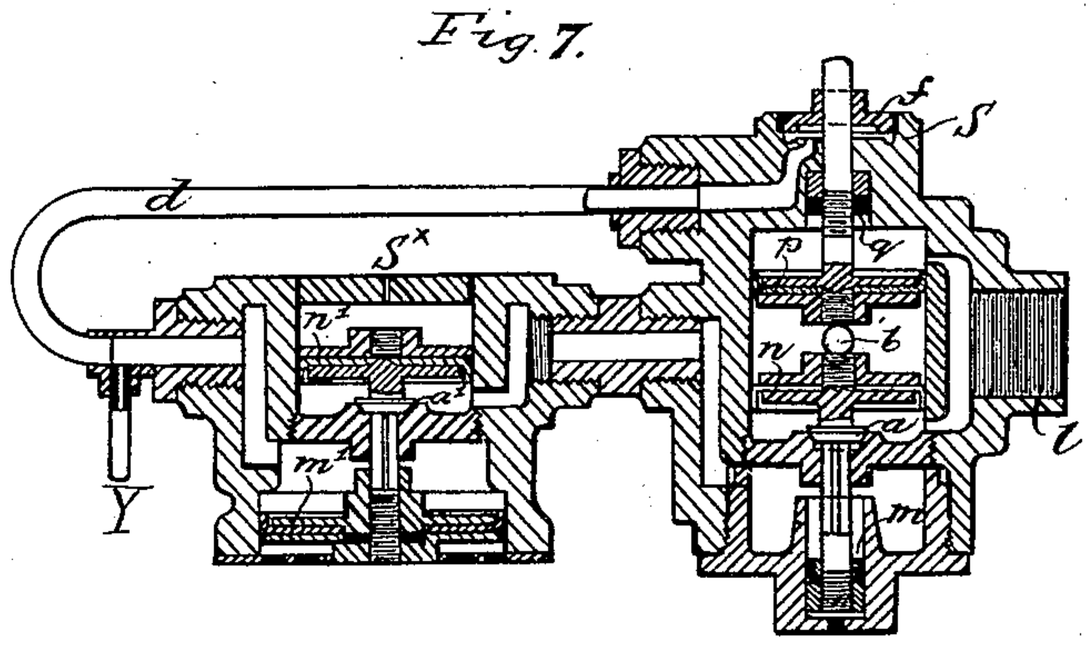


Fig. 8.

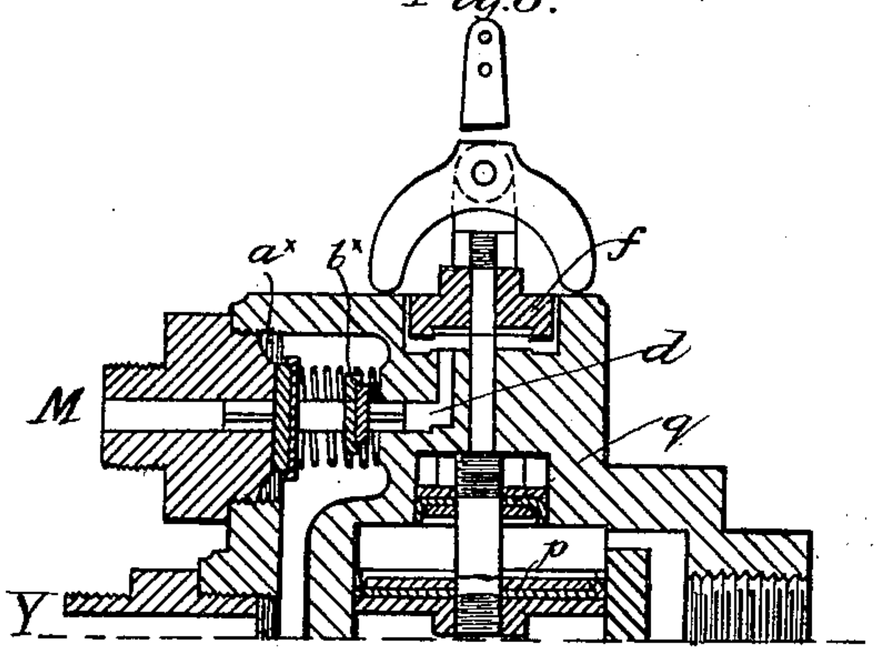


Fig. 9.

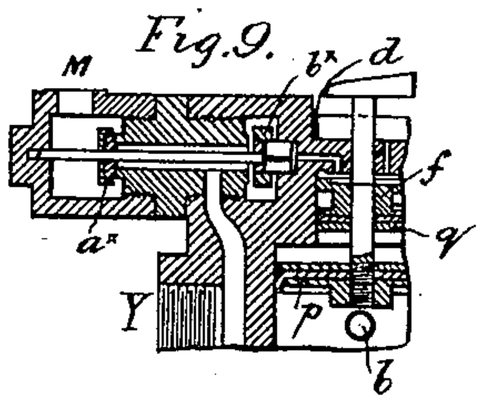
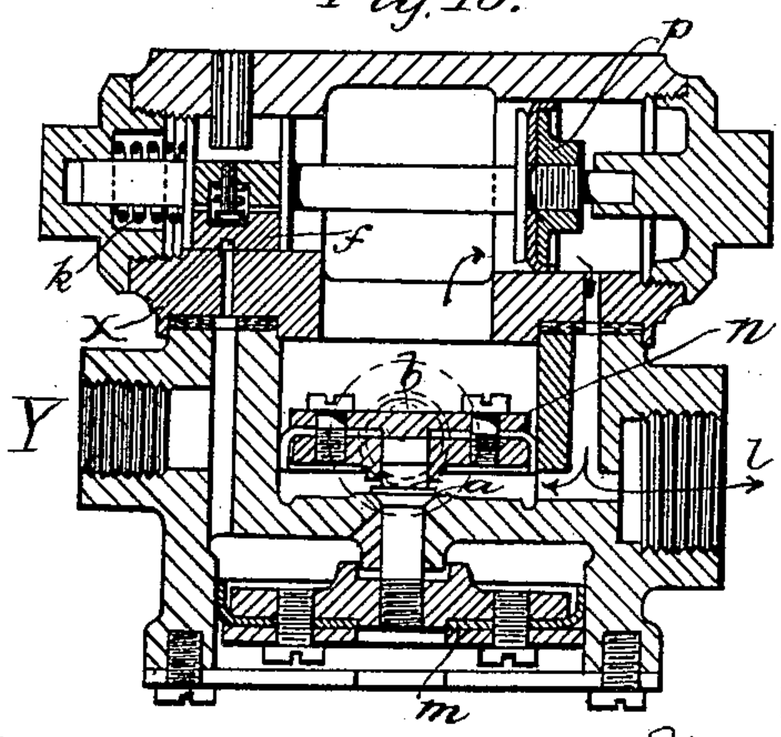


Fig. 10.



WITNESSES

E. J. Griswold.

Wm. Chester Wells

INVENTOR

Léon Soulerin

by his Attorneys

Howson and Howson

UNITED STATES PATENT OFFICE.

LÉON SOULERIN, OF PARIS, FRANCE.

PNEUMATIC RAILWAY-BRAKE.

SPECIFICATION forming part of Letters Patent No. 467,060, dated January 12, 1892.

Application filed January 17, 1888. Serial No. 261,066. (No model.) Patented in Belgium March 31, 1886, No. 72,575, and May 20, 1886, No. 73,197; in France August 31, 1886, No. 178,265; in Italy September 30, 1886, No. 20,525; in Spain October 29, 1886, No. 9,720; in England October 29, 1886, No. 13,890, and in Germany May 18, 1887, No. 44,697.

To all whom it may concern:

Be it known that I, LÉON SOULERIN, engineer, a citizen of the Republic of France, residing at 4 Rue Marsollier, Paris, in the said Republic, have invented certain new and useful Improvements in Pneumatic Railway-Brakes, (for which patents have been obtained in Great Britain, dated October 29, 1886, No. 13,890; in France, dated August 31, 1886, No. 178,265; in Belgium, dated March 31, 1886, No. 72,575, and May 20, 1886, No. 73,197; in Germany, dated May 18, 1887, No. 44,697; in Italy, September 30, 1886, No. 20,525, and in Spain, dated October 29, 1886, No. 9,720,) of which the following is a specification.

This invention relates to apparatus for operating railway-brakes either by means of compressed air or by means of rarefied air or vacuum.

In carrying out this invention with reference to compressed-air brakes the locomotive (or other convenient part of the train) is provided with an air-pump and a steam-pump operating the air-pump, a main compressed-air reservoir, and an engineer's valve. Each vehicle composing the train carries apparatus illustrated in section in Figure 2, and consisting of a distributing-valve S, an auxiliary compressed-air reservoir $B^{\times}$, and a brake-cylinder F, containing one or more pistons or diaphragms operated by the compressed air, as hereinafter described. The air compressed by the pump is conducted to the main reservoir, in which it is stored for use as required, its exit therefrom being governed by the engineer's valve, through which it must pass to the main pipe Z^2, extending along the train. The compressed air from the main reservoir passing through the engineer's valve enters the main pipe Z^2 and passes thence through the distributing-valves S into the auxiliary reservoirs $B^{\times}$, which are maintained full of compressed air so long as the brakes are not required to be used.

By reducing the pressure of air in the main pipe the distributing-valves will be caused to act so as to establish communication between the auxiliary reservoirs and the brake-cylinders, thereby setting in motion the pistons or diaphragms therein and so applying the brakes. Upon restoring the pressure of air in the main pipe the organs of the distributing-valve will resume their former positions, the air which had entered the brake-cylinders will escape into the atmosphere, and the brakes will be removed.

Fig. 1 is a sectional elevation of one form of my distributing-valve with which each vehicle of a train is provided and in which two pairs of flexible diaphragms *m n* and *p q* are fitted, but which may, if desired, be replaced by pistons. The two pairs of diaphragms are independent of one another, and one pair controls the communication between the auxiliary air-reservoir and the brake-cylinder, while the other controls the communication between the brake-cylinder and the air. The diaphragms *m n* are connected by a rod upon which is mounted a valve *a*, and the diaphragms *p q* are connected together by means of a hollow rod $p^{\times}$, in which is fitted a check-valve *s*. To this hollow rod is also fixed another valve *f*. The upper side of the diaphragm *p* and the lower side of the diaphragm *q* are in free communication with the external atmosphere. When the full pressure is turned into the brake-pipe, the compressed air from the main reservoir is admitted through the opening *b* into a space between the diaphragms *n* and *p*. It passes thence through the hollow connecting-rod $p^{\times}$, and, lifting the valve *s* therein, enters by a passage *l* the auxiliary reservoir, and also fills the space between the valve *a* and diaphragm *n*, which diaphragm, thus submitted on both sides to very nearly equal pressures, will retain the valve *a* to its seat, and the diaphragm *p*, being about equal in area to the diaphragm *q* of the valve *f*, will also rest on its seat, but without much pressure. Whenever the pressure is reduced in the brake-pipe, the valve *s* in the hollow connecting-rod will be pressed against its seat, and the compressed air contained in the auxiliary reservoir, acting on the outer surface of the diaphragm *q*, will cause the valve *f* to rest heavily on its seat, while the pressure of the air on the under surface of the diaphragm *n* will cause the valve *a* to be lifted and allow the air to pass thereunder and through the passage Y to the

brake-cylinder, and the brakes will be applied. The introduction of pressure in the brake-pipe will cause the valve *a* to return to its seat and the valve *f* to be raised in such a manner as to let out into the atmosphere, through the exhaust-outlet *d*, the compressed air which had worked in the brake-cylinder, and thus the brakes will be removed.

Fig. 3 is a sectional view illustrating a modified construction of distributing-valve when working with air-pressure brakes. It consists of two independent pairs of pistons *m n* and *p q*. The rod which connects the pair of pistons *p* and *q* is carried upward, and a valve *f* is fastened to it to close when required the exhaust-passage *d* from the brake-cylinder to the atmosphere. The other rod, which connects the pair of pistons *m* and *n*, carries a valve *a*, of such a diameter that with a small lift it will provide a sufficient opening for the passage of the air from the auxiliary reservoir to the brake-cylinder. The pistons *m*, *n*, *p*, and *q* are all provided with leather packings, the edges of which are turned, as shown in the drawings. The valve *a* is at least of equal area to that of the piston *q*, so that the closing of the valve *f* can always be insured before the valve *a* is lifted up. As long as the brakes are not to be applied the compressed air enters the distributing-valve through the opening *b* and passes around the pistons *p* and *n* into the reservoir by the passage *l*. At the same time the pressure, acting under the piston *q*, raises the valve *f* and keeps the exhaust of the brake-cylinder open. The air-pressure also acts upon the valve *a*, thereby keeping the passage from the reservoir to the brake-cylinder closed. When the air-pressure is reduced in the main pipe, the air contained in the reservoir presses the leather packings of the pistons *p* and *n* against the valve-casing, causing the said pistons to move inward and the valve *f* to close the exhaust-passage of the brake-cylinder, and at the same time causing the valve *a* to be lifted up so as to allow the air contained in the reservoir to enter the brake-cylinder by the passage Y and apply the brakes. A lever Z, attached to the spindle of the valve *f*, may be acted upon by means of wires $m^{\times}$ and $n^{\times}$ to raise the valve *f*, so as to allow the brakes to be released from any suitable part of the train when they have been applied automatically.

In order to enable the engineer to release the pressure in the brake-cylinder by degrees when the brakes are on, the valve *f* may be made as shown in Fig. 4, so that the whole of its lower face is submitted to the pressure in the cylinder, and to prevent the lifting of the valve *a* during the release and the lifting of the valve *f* during the putting on of the brakes it is only necessary to make the ratio $\frac{\text{area of } f}{\text{area of } p}$ smaller than the ratio $\frac{\text{area of } m.}{\text{area of } n.}$

Fig. 5 is a sectional view of a form of my distributing-valve as constructed for use with automatic vacuum-brakes. This valve is similar in construction to the last described, except that the edges of all the piston leather packings are turned in the reverse directions and the valves *f* and *a* are arranged to close when pressed upward instead of when pressed downward, as in Fig. 3. As long as a vacuum is maintained in the main pipe the brakes are off and the air is drawn from the reservoir, it passing around the edges of the leather packings of the pistons *p* and *n*, while the valve *a* is pressed against its seat by the outer pressure of air acting upon the piston *m*, the outer face of which piston is larger than its inner face. To apply the brakes, a certain amount of air is allowed to enter the main pipe, whereupon the piston *n* will be forced downward by the pressure of the air upon the upper face thereof and the valve *a* opened, thereby admitting air from the brake-cylinder into the reservoir until the vacuum above the piston *m* has become such as to cause the valve *a* to be again seated. At the same time, by the pressure beneath the piston *p* the valve *f* is closed, so as to cut off the communication between the brake-cylinder and the outside air. When the vacuum is restored again in the main pipe, the valve *f* is drawn downward and air enters the brake-cylinder past the valve *f*, so as to release the brakes.

Fig. 6 illustrates a modification of the distributing-valve for vacuum-brakes, in which, instead of the seat-valve *f*, a piston-valve *f* is fitted to slide in a cylinder and provided with leather packing, the edge of which is turned upward. When this piston-valve *f* is at the lower end of its stroke, the brake-cylinder communicates through the passage *d* with the outer air and the brakes are applied. As the lower face of the piston *f* is always submitted to the same vacuum-pressure as that existing in the brake-cylinder, the release of the brakes can be gradual, and in order to prevent the valve *a* from being removed from its seat during the release of the brakes and the valve *f* from opening during the setting of the brakes the $\frac{\text{area of } f}{\text{area of } p}$ should be less than the $\frac{\text{area of } m}{\text{area of } n.}$

In the distributing-valves hereinbefore described, both in working with air-pressure and with vacuum power, conical or flat valves, such as are shown at *a* and *f*, Fig. 3, are used in preference to sliding valves, so as to reduce to the smallest possible amount the volumes swept or generated by the pistons in the said distributing-valves. The reduction of such volumes is of importance, as thereby an increased quickness in the distribution of the reduction or increase of the pressure along the brake apparatus contained in a train is obtained, and consequently stoppages may be effected within a short distance and with less of a shock or jerk on the cars.

An important feature of this invention is that by the use of the differential pistons *m* and *n*, in combination with an independent piston or pistons controlling the valve *f*, the brake-power can be regulated at will by the engineer, and other important results can be obtained, as will appear from the following: Let S*n* and S*m* be the respective areas of the pistons *n* and *m*; P*p* and P*r* be the absolute pressures of the air in the main brake-pipe and the air in the reservoir, respectively, and P*a* the atmospheric pressure. Then the pressure P*f* in the brake-cylinder will be approximately $Pf=\frac{Sn}{Sm}(Pr-Pp)+Pa$ in both the air-pressure and the vacuum distributing-valves. Then if S*n* and S*m* are equal, or thereabout, the amount of pressure acting upon the brakes will be nearly equal to the amount of reduction produced in the brake-pipe, either in the air-pressure or in the vacuum, as the case may be. The engineer will consequently be enabled to regulate, as needed, the brake-power when provided with either a vacuum automatic brake or with an air-pressure automatic brake. When it is desirable to obtain a complete application of the brakes for a partial reduction either in the pressure or in the vacuum in the main pipe, I make $\frac{Sn}{Sm}>1$. When it is required to reduce to a maximum amount the pressure of the vacuum in the brake-cylinder, the said maximum to be inferior to the air-pressure or the vacuum in the reservoir, then I make $\frac{Sn}{Sm}<1$. Practically this latter case is useful only when working with air-pressure. When it is required to reduce in the brake-cylinder the air-pressure below what it is in the reservoir and at the same time to obtain a full application of brakes for a partial reduction of pressure in the main pipe, an auxiliary apparatus $S^{\times}$ is provided, as shown in Fig. 7, between the distributing-valve S and the brake-cylinder. This auxiliary apparatus contains two pistons *n'* and *m'* and a valve *a'*, like the pistons *m* and *n* and the valve *a* in the distributer; but while in the distributer I make $\frac{Sn}{Sm}>1$ I make in the auxiliary apparatus $\frac{Sn'}{Sm'}<1$, so as to agree with the sought-for expansion in the brake-cylinder. Compressed air from the main pipe enters the distributer through the passage *b* and thence past the leather packings of the pistons *n* and *p* and through the passage *l* to the reservoir. When the pressure is reduced in the brake-pipe to a given amount, the reservoir and auxiliary apparatus $S^{\times}$ communicate with each other freely and air flows into the brake-cylinder through the passage Y until the said vessel is filled with the air at the maximum pressure it is intended it should receive, after which the valve *a'* in the auxiliary apparatus $S^{\times}$ remains closed, whatever may be the subsequent reduction of the pressure in the brake-pipe. When brakes are to be released, pressure is reintroduced in the brake-pipe, which causes the valve *a* in the distributer S to be set against its seat and the valve *f* to be lifted up. Then the air which had gone into the brake-vessel to apply the brakes escapes into the atmosphere through the passage *d*, the valve *f* being raised.

In the distributer S the space above the piston *m* does not communicate with the escape-passage *d*, as in the case of Fig. 3. In the auxiliary apparatus $S^{\times}$ the spaces above the piston *n'* and below the piston *m'* communicate with the outside air.

Figs. 8 and 9 show how the improved distributing-valve can be modified in order to make it work, in combination with two main brake pipes, as a duplex brake—that is to say, as a plain brake or as an automatic brake—the plain brake pipe being connected with the distributing-valve at M in each construction. Two valves $a^{\times}$ and $b^{\times}$ are provided to close the outlet from the brake-cylinder, so that when working with the plain brake alone the cylinder cannot communicate with the outer air through the passage *d*, fitted with the valve *f*, hereinbefore referred to.

Fig. 8 shows the application of the plain brake pipe connection M to the construction of distributer shown in Fig. 3 for the automatic compressed-air system, and the connections of the distributers to the main pipe, brake-cylinder, and auxiliary reservoir being as described with reference to Fig. 3. In this case the valve $a^{\times}$ is normally held to its seat by a spring to close the connection M to the pressure-pipe for the plain compressed-air system, while at the same time the valve $b^{\times}$ on the same stem as the valve $a^{\times}$ is normally drawn away from its seat. Hence under ordinary conditions the distributer S is adapted to operate on the automatic system; but when pressure is supplied at M from the plain system brake pipe the valve $a^{\times}$ will be pushed back from its seat by the pressure, while the valve $b^{\times}$ will close the connection to the atmosphere and the compressed air will find its way to the brake-cylinder to apply the brakes.

Fig. 9 shows the application of the plain vacuum brake pipe connection to the construction of distributer shown in Fig. 5 for the automatic vacuum system, and the connections are as described with reference to Fig. 5. In this construction the valves $a^{\times}$ and $b^{\times}$ are on the same stem and are normally in the positions shown—that is, the former closed and the latter opened—and this continues so long as the device works on the automatic vacuum system; but when a vacuum is formed in the plain vacuum system piping connected at M the valve $a^{\times}$ is drawn back from its seat and the valve $b^{\times}$ is drawn to its seat to close the connection to the atmosphere. In either case when working as a plain

brake the valve $b^{\times}$ is closed against its seat, while when working as an automatic brake alone the valve $a^{\times}$ is applied against its seat, so as to prevent any communication between the brake-cylinder and the plain brake pipe.

Fig. 10 is a section of another form of distributing-valve, in which n m are two pistons provided with leather packing and mounted on the spindle of the valve a. p is another piston, also provided with leather packing and mounted on the spindle or rod of the slide-valve f. A spring k presses against the valve f and tends to maintain it in position to establish a communication between the brake-cylinder and the outside air.

When full pressure is maintained in the brake-pipe, the compressed air enters the reservoir by passing round the packings of the pistons n and p, while the valve f, under the action of the spring k, will be in the position to establish a communication between the brake-cylinder and the outside air through X, and the pressure of the leather packing of the piston p against the cylinder in which it works will be practically nothing so long as full pressure is maintained in the brake-pipe. When a reduction of the pressure in the brake-pipe takes place, the leather packings of the pistons n and p will be forced against the sides of their cylinders by the pressure of the air in the reservoir, and the valve a will be raised from its seat, while at the same time the pressure, acting on the piston p, will move the valve f against the pressure of the spring k, so as to close the communication between the brake-cylinder and the outside air, and consequently the brakes will be applied.

According to another modification of the distributer (shown in Fig. 11) the chamber u^2 communicates with the brake-pipe at u, and the auxiliary reservoir is charged directly from the pipe and is provided with a retaining-valve k'. The brake-cylinder communicates at v with the upper side of the diaphragm or piston p, the rod of which carries the valve f, which, when the brakes are on, is pressed against its seat by the action of the pressure in the brake-cylinder and of a properly-adjusted spring f'. The brake-cylinder also communicates at v' with the space above the diaphragm m. Upon the reintroduction of pressure in the brake-pipe such pressure by acting on the under side of the diaphragm p will lift the valve f from its seat and cause the brakes to be released. Two other diaphragms or pistons n m are arranged to work in separate chambers beneath the diaphragm p, but connected together by a rod which is provided with a valve a to act in the same manner and for the like purpose, as described with reference to the previous constructions.

I wish it to be understood that in the claims hereinafter set forth I have used the term "piston" in a sufficiently comprehensive sense to include a flexible diaphragm, except in those claims in which the other elements of the combinations defined do not admit of this wide meaning, and I further wish it to be understood that I use the term "brake-cylinder" as applicable to any well-known form of such cylinder or vessel, whether having a piston or diaphragm and whether operating by pressure or vacuum.

I claim as my invention—

1. A distributer for pneumatic brake systems, having two separate valves, one controlling the communication between the auxiliary reservoir and the brake-cylinder, and the other controlling the communication between the brake-cylinder and the atmosphere, with independent pistons to operate said valves independently, substantially as described.

2. A distributer for pneumatic brake systems, having two separate and independent valves, one controlling the communication between the auxiliary reservoir and the brake-cylinder and the other controlling the communication between the brake-cylinder and the atmosphere, with a pair of differential pistons to operate the first-named valve, all substantially as described.

3. A distributer for pneumatic brake systems, having a valve controlling the communication between the brake-cylinder and the atmosphere, in combination with an independent valve controlling the communication between the auxiliary reservoir and the brake-cylinder, and two pairs of pistons, each pair operating one of the valves, and each pair of pistons being connected to each other, but independent of the other pair, all substantially as described.

4. A distributer for pneumatic air-brake systems, having two independent valves, one controlling the communication between the auxiliary reservoir and the brake-cylinder, while the other controls the communication between the brake-cylinder and the atmosphere, in combination with independent pistons carrying the independent valves, the pistons which are open to the main brake pipe, having cup-leather packing to allow the air to pass around the pistons in one direction, but not in the other, all substantially as described.

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

LÉON SOULERIN.

Witnesses:

ROBT. M. HOOPER,

J. B. BOURNE,

Both of Paris, France.