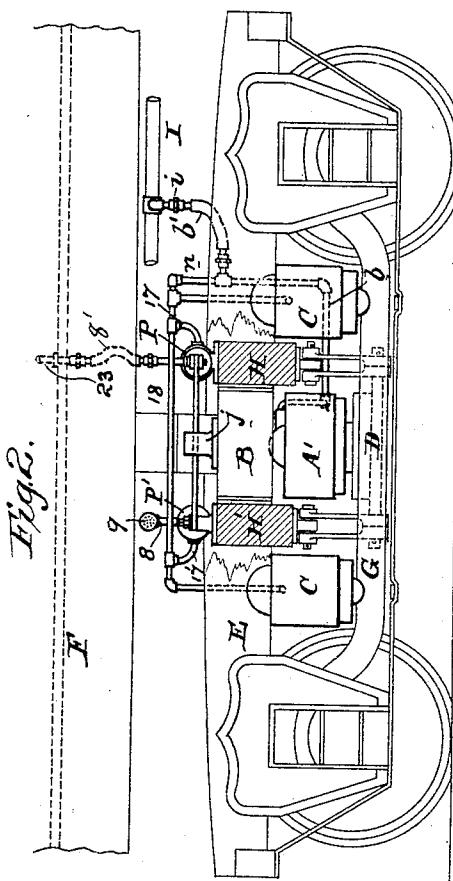
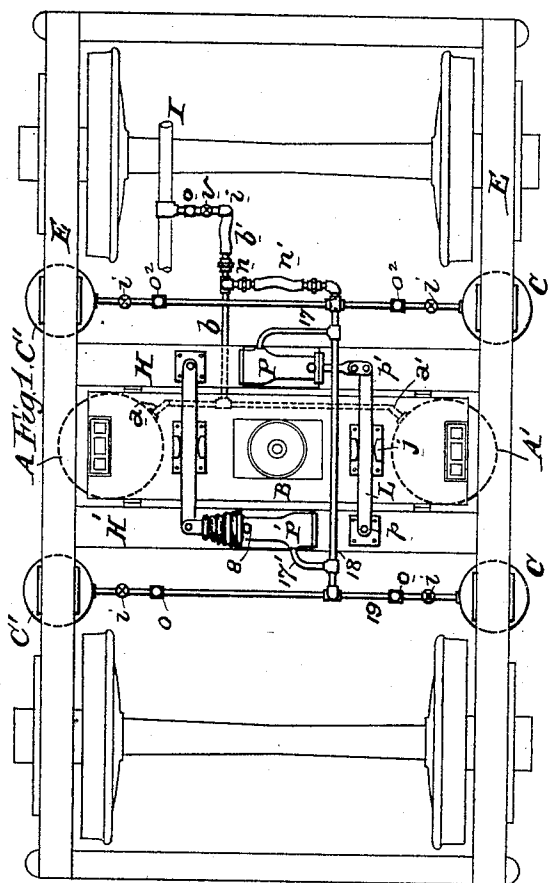


No. 779,858.

PATENTED JAN. 10, 1905.

S. M. LILLIE.
SPRING FOR RAILWAY CARS.
APPLICATION FILED SEPT. 5, 1903.

2 SHEETS—SHEET 1.



WITNESSES:

M. J. Eyre
Wm. Rooney

INVENTOR
Samuel Morris Lillie

BY *[Signature]*
ATTORNEY.

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2 SHEETS—SHEET 2.

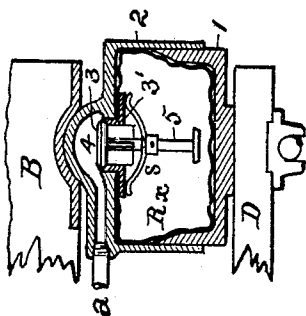


FIG. 5

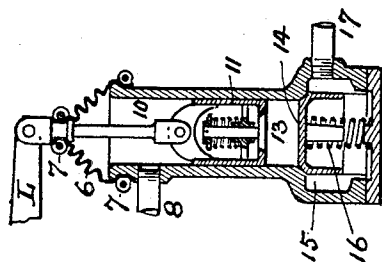


FIG. 4

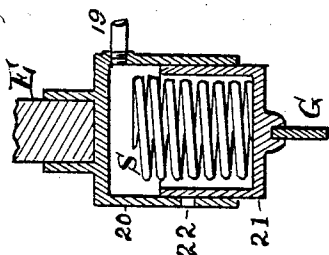


FIG. 3

WITNESSES:

R. M. Kelly.
M. J. Egan.

INVENTOR

Samuel Morris Lillie

BY

McGowan

ATTORNEY.

UNITED STATES PATENT OFFICE.

SAMUEL MORRIS LILLIE, OF PHILADELPHIA, PENNSYLVANIA.

SPRING FOR RAILWAY-CARS.

SPECIFICATION forming part of Letters Patent No. 779,858, dated January 10, 1905.

Application filed September 5, 1903. Serial No. 172,127.

To all whom it may concern:

Be it known that I, SAMUEL MORRIS LILLIE, of the city and county of Philadelphia, State of Pennsylvania, have invented an Improvement in Springs for Railway-Cars, of which the following is a specification.

My invention has reference to springs for railway-cars; and it consists of certain improvements which are fully set forth in the following specification and shown in the accompanying drawings, which form a part thereof.

Springs for railway-cars have hitherto been made of solid resilient material, as of rubber or steel in various forms. I employ as the resilient agent compressed air—obtained, for example, from the air-brake system of a railroad-train in cases where my system is used with a train of cars so equipped. I purpose also using these air springs or cushions in connection with the car-springs usually employed, the air-springs when in service supporting the car-bodies, the ordinary springs serving when the air-springs are not in service.

My invention further includes, in combination with the apparatus of the pneumatic springs, a suitable air compressor or compressors actuated by the motions of the car while running and serving to keep the pneumatic springs supplied with air or to make up the leakage from the same of air supplied from another source. One arrangement of these compressors which I propose is such that they will be operated by the transverse oscillations of the car, and thereby serve also as buffers or springs to lessen the shocks which naturally accompany these oscillations. The compressors may also be operated by power taken from the wheels or axles of the car.

My invention as applied to cars equipped with the air-brake system is illustrated in the accompanying drawings, of which—

Figure 1 is a plan of an ordinary four-wheel car-truck equipped with my invention. Fig. 2 is a side view of the truck—i. e., looking at the outer side faces of one of its pair of wheels, the near “wheel-beam” E being broken away to show the ends of the “transoms” H H' and the end of the “swing-beam” B. Fig. 3 is a vertical axial section of the combined

pneumatic and spiral spring C. Fig. 4 is an axial section of an air-compressor which is operated by the oscillations of the car-body, and Fig. 5 is a vertical axial section of a pneumatic spring A.

Referring now to the drawings, at opposite sides of the truck, respectively, located between the swing-beam B and the spring-plank D, are two of my pneumatic springs A A'. One of these springs is shown in vertical axial section in Fig. 5, and on each side of the truck are two combined pneumatic and spiral springs C C', located between the wheel-beam E and the equalizing-bar G, supporting the former upon the latter. One of these springs is shown in vertical axial section in Fig. 3. The body of spring A, Fig. 5, as illustrated, consists of a cup-shaped piston 1 fitting into the cup-shaped cylinder 2. The piston rests upon the spring-plank D, while upon the top of the cylinder 2 rests the swing-beam B. The spring-body A contains a bag R, made of flexible material—rubber, for example—sufficiently capacious when expanded to entirely fill A when extended to the limit imposed by the construction of the truck. The mouth of the bag is suitably fastened air-tight against the top of the cylinder 2 around a valve opening at 3' through the same.

The springs A A' are supplied with compressed air respectively through the branch pipes *a a'* of the pipe *b*, which connects through a flexible pipe *b'* or other suitable connection with the branch pipe *i* of the main air-supply pipe I—for example, the “train-pipe” of the air-brake system of a railroad-train. The pipe *i* is fitted with a hand-valve *v*, by which communication may be made or severed between the train-pipe I and the pneumatic-spring system, and it is also fitted with a check-valve *o*, which opens away from the train-pipe I and closes toward the same, thereby permitting air to flow from the train-pipe into the spring system when the air-pressure in the former preponderates, but preventing flow of air from the spring system into the train-pipe when the pressure is the greater in the spring system. The pipe *b* has a branch pipe *n*, which connects by a flexible tube *n'*

or other suitable connection with piping supplied with air by the air-compressors P P', hereinafter to be described.

In case of each of the springs A and A' the
 5 air enters its cylinder through a valve shown at 3, Fig. 5. This is a check-valve and is seated horizontally above an opening 3' through the top of the cylinder. The valve opens by a vertical motion into the chamber
 10 4, with which the air-pipe *a* communicates, and closes by a downward motion. Projecting downward from the valve into the cylinder and bag of A is a stem 5, sufficiently weighted, as by a spring *s*, to insure its closing when
 15 not opened by the rod being forced up by the piston 1. The stem 5 is of such a length that it is lifted from contact with the piston, thus permitting the valve 3 to close and stop influx of air when the cylinder or cup 2, and
 20 with it the swing-beam B, has been raised to a predetermined height, which should be such as to afford a sufficient air-cushion and still be somewhat short of the limit of motion upward imposed upon the swing-beam B by the
 25 construction of the truck. Assuming the normal air-pressure in the train-pipe to be more than sufficient when applied in the air-spring A to raise its cylinder 2 against the pressure imposed upon it by the weight of
 30 the car-body and its contents, then if there be normal pressure in the train-pipe and the valve *v* in the pipe *i* be opened air will flow into and expand the bag R in the spring and force the cylinder 2 upward, the valve 3 gradually closing until it is allowed to completely
 35 close and stop the influx of air by its stem 5 being lifted from contact with the piston below. The check-valve *o* in the pipe *i* prevents any flow of air back into the train-pipe from the
 40 air-spring both when the pressure of air in the train-pipe is lowered by the act of setting of the brakes and when the pressure in the spring-cylinder becomes perhaps momentarily greater than the normal in the train-pipe, due to the
 45 jolting of the car, which the air-spring is intended to neutralize. This jolting of the car by pressing down the cylinder 2, and thereby bringing the lower end of the rod 5 into contact with the piston 1, so as to open the valve
 50 3, may allow spurts of additional air to enter the spring, which when there is no jolting will cause the cylinder 2 to take a position which brings the lower end of the rod 5 some distance from contact with the piston, as indicated in Fig. 5. The parts should be so
 55 proportioned that the edge of cylinder 2 will rest on the spring-plank D before the valve 3 will strike the top of chamber 4 or some other means of limiting the approachment of the
 60 plank D and beam B to this end. The expansible body or casing formed by the cups 1 and 2 supports the bag R against the compressed air within it, which tends to disrupt the bag, and, on the other hand, the presence
 65 of the bag prevents the escape of air between

the walls of the cups 1 and 2. It is to be noted that the inner edge of the rim of the piston-cup 1 is rounded or beveled off to reduce its likelihood of abrading the walls of the bag. Again, the bag R may be supported
 70 against the air-pressure by other containing constructions than the cup-like cylinders shown, or the walls of the bag may be made strong enough to withstand the pressure without other aid. If the bag R were not employed in the spring construction, as in Fig.
 75 5, suitable air-tight packings should be provided between the walls of the piston 1 and those of the cylinder 2. The greater the volume of air subject to compression by the jolting of the car the more gentle will be the
 80 neutralizing of the individual jolts and the easier will the car ride. This volume may be increased by an air-chamber communicating with the interior of the spring.

The air-compressors P P', hereinbefore referred to, are single-acting trunk-piston pumps containing a few special features, which are indicated in Fig. 4, an axial section of one of the compressors—viz., P'. The
 90 compressors are respectively secured longitudinally on the upper faces of the transoms H H'. Referring to Fig. 4, 10 is the barrel or cylinder of the pump, in which moves the trunk-piston 11, which is reciprocated
 95 through the connecting-rod 12 by the lever L', which in turn is reciprocated by swing-beam B and the transverse oscillations of the car-body. The compressor P' is fastened longitudinally upon the top of the transom H'.
 100 The lever L' is pivoted at *p*² to the upper face of the other transom, H. It extends above and across the swing-beam B and is pivoted to the connecting-rod 12 at *p*'. It passes between a pair of jaws *j*', which are fastened to
 105 and project upward from the upper face of the swing-beam B. The jaws project far enough upward so that they will still inclose the lever L' when the vertical vibrations of the spring-beam with respect to the transoms
 110 reach their limit. It is apparent that horizontal oscillations of the swing-beam parallel with the transoms oscillate the lever L' and give to the connecting-rod 12 and piston 11 of the compressor P oscillations or strokes
 115 twice as long as its own, assuming the line of contact between the jaws *j*' and the lever L' to be midway between the pivot centers at the ends of the lever. The piston of the compressor P on the transom H is oscillated
 120 in a similar manner by the beam B, acting through the jaws *j* and lever L, pivoted at one end to the transom H' and at the other attached to the connecting-rod of the compressor. The induction-valve of each compressor is located in the head of its piston
 125 (see 13, Fig. 4) and needs no special description. When closed, its face is flush with the face of the piston. The eduction-valve 14 is the head of the cylinder and when opening
 130

moves back into a chamber 15, from which leads the compressed-air-conducting pipe 17. The valve 14 is pressed to its seat by the spring 16 in addition to the pressure of the air. The other end of the cylinder is closed and air supplied to it through the pipe 8, both as described farther on. The parts are so proportioned that the room for play of the valve 14 is such that it will yield to the piston through the greatest depth of stroke which maximum possible oscillations of the swing-beam B are able to impart to it. The parts are so proportioned and located that an oscillation of the swing-beam only a part of the maximum possible will give a full stroke to the piston 11 and bring its face into contact with the face of the valve 14. Any oscillation greater than this merely presses the valve back into its chamber against the pressure of air and of the spring 16, and on the return stroke the valve, actuated by the spring, follows the piston back until it (the valve) is seated. There is therefore little or no shock of contact between the piston and the head of the cylinder nor any clearance between the two so long as the oscillations of the swing-beam B reach or exceed said "part of the maximum possible," which latter may be so chosen that average oscillations will produce maximum pumping capacity. By adjusting the jaws *j* transversely on the swing-beam the path of the piston may be varied so that a greater or less oscillation of the swing-beam will give maximum pumping effect. It is apparent that when the motion of the swing-beam is to compress the air the compressor acts as a buffer to the swing-beam—*i. e.*, to the oscillation of the car-body to which the swing-beam is attached. It is also apparent that the compressors are so disposed that one acts as a buffer for the swing-beam when its movement is in one direction and that when the movement is in the opposite direction the other compressor acts as a buffer. To prevent excessive heating of the parts of the compressors, their bodies may be formed or provided with radiating vanes or ribs for delivering to the atmosphere the heat due to the compressing of the air. Two ways are indicated of closing the ends of the cylinders of the compressors. One is by a cap or head, as indicated in the case of compressor P, and the other, as shown in Fig. 4, is by a conical sleeve 6, of flexible material, which grasps the connecting-rod 12 air-tight at 7 and the outer edge of the cylinder at 7'. To lessen abrasion of the parts, the air going to the compressors should be as free from dust as possible. A screen, as 9, Fig. 2, on the air-supply connection of compressor P' will serve this end to a degree; but a more effective manner is shown in Fig. 2 in connection with compressor P, whose air-supply connection is extended upward through the floor F of the car-body by means of the flexible con-

nection 8' and pipe 23, which latter opens into the interior of the car at any suitable place and conducts air therefrom to the compressor. A pipe *i*, provided with a relief-valve O, is shown connecting the train-pipe I with the system of pipes supplied with air by the compressors. This relief-valve O opens toward the train-pipe and may be set to open when the pressure behind it becomes greater than some predetermined degree—that is, greater than that necessary for the operation of the pneumatic springs. By this provision the compressors are made contributors of air to the air-brake system of the car.

Springs embodying my invention are also shown between the wheel-beams E and equalizing-bars G—*viz.*, at C' C' and CC. One of these springs is shown in section in Fig. 3. The construction is similar to that of the springs A before described—*viz.*, two cups sliding in each other. Air is delivered within the cups by pipe 19, which connects with the air-supply system, as with pipe 18. The pipes 19 are provided with hand-valves, by which they may be disconnected from the system, and with check-valves O', which permit air to flow to their respective springs, but not from them. If the relief-pipe *i* and valve O are not provided, the outer cup 20 of the pneumatic spring may be pierced by a hole 22, so located that when the cup is raised by the air-pressure to a certain height, not to be exceeded, the hole is brought above the edge of cup 21 and permits air to escape, and thereby serves as a relief-valve for the air system of the pneumatic springs and prevents greater than a certain maximum predetermined pressure being developed in the system by the compressors P P'. In Fig. 3 a spiral spring S is shown in the interior of the cups. It extends above the edge of the lower cup and would serve as a spring between the beams E and G in case the pneumatic spring was inoperative. Fig. 3 illustrates the combination of air springs or cushions and the usual car-springs mentioned on page 2 of this specification.

While I prefer the construction shown, I do not confine myself to the details thereof, as they may be modified in various ways without departing from the spirit of my invention.

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

1. A vehicle or truck provided with pneumatic springs containing internal coil-springs, combined with means to supply air to said pneumatic springs to maintain their elasticity, whereby the coil-springs are normally out of use.

2. A vehicle or truck provided with pneumatic springs, combined with a train-pipe for compressed air, automatic means to supply air to said springs to maintain their elasticity,

and means for causing the excess of compressed air to flow from the automatic means and pneumatic springs into the train-pipe.

3. A vehicle or truck provided with pneumatic springs, combined with automatic means to supply air to said springs to maintain their elasticity, a compressed-air train-pipe, and a relief device to limit the elasticity of the spring by permitting the air to escape into the train-pipe in the event of an excess of pressure.

4. In a car-truck, the combination of the car-wheels and their connecting-frame, the car-body and its supporting-frame, and pneumatic springs interposed between the connecting-frame and the supporting-frame, a train-pipe, means to supply compressed air to the pneumatic springs, and a relief pipe and valve to permit excess of compressed air from the pneumatic springs to pass into the train-pipe.

5. In a car-truck, the combination of the car-wheels and their connecting-frame, the car-body and its supporting-frame, and pneumatic springs interposed between the connecting-frame and the supporting-frame, an automatic air-compressor operatively connected with the frame of the truck whereby it is operated by the vibrations of the truck, a train-pipe, connecting-pipes between the train-pipe air-compressor and pneumatic springs, and a check-valve to permit air to pass into the train-pipe but not from it.

6. A vehicle or truck provided with pneumatic springs, combined with means to supply air to said springs to maintain their elasticity, an air-supply line arranged along the vehicle or truck, and a valved connection to permit the excess of compressed air to exhaust into the air-supply line.

7. A vehicle or truck provided with pneumatic springs, combined with means to supply air to said springs to maintain their elasticity consisting of an air-supply line arranged along the vehicle or truck, an automatic air-compressor on the vehicle or truck to supply air to the pneumatic springs, and pipes connecting the air-compressor with both the pneumatic springs and the air-supply line whereby the excess of air compressed may escape into the air-supply line when not needed for the springs.

8. A vehicle or truck provided with pneumatic springs, combined with means to supply air to said springs to maintain their elasticity, and a metallic spring adapted to assist the pneumatic spring or support the load when the pneumatic spring is collapsed or not in service but in which the metallic spring is normally not operative to support the load when the pneumatic spring is fully expanded.

9. In a pneumatic spring for cars, the combination of cylinder and piston, an air-supply pipe connecting with the cylinder, means for preventing escape of air between the cylinder and piston consisting of an air-tight bag located within the cylinder and piston and into

which the air is supplied, and a compressor independent of the spring to supply compressed air to the air-supply pipe.

10. A pneumatic spring for cars, the combination of a flexible air-tight bag, an inclosing metallic collapsible casing to protect the bag, an air-compressor external to the spring, and an air-supply pipe opening from the compressor into the bag and connecting with the metallic casing.

11. In a car-truck, the combination of a swing-beam, a spring-beam, a pneumatic spring between the beams, a train-pipe for compressed air, and a flexible air-pipe connection between the pneumatic spring and train-pipe.

12. In a car-truck, the combination of a pneumatic spring, an air-compressor having a horizontally-reciprocatory piston carried by and operated by the lateral oscillations of the truck-frame, and an air-pipe between the compressor and pneumatic spring.

13. In a car, the combination of a pneumatic apparatus, an air-compressor having a horizontally-reciprocatory piston carried by and operated by the lateral oscillations of the car, and an air-pipe between the compressor and pneumatic apparatus.

14. In a car, the combination of two parts relatively movable transversely to the length of the car, an air-compressor having its cylinder secured to one of the parts of the car and its piston secured or connected to the other part whereby it acts as a buffer to lessen the lateral vibrations of the car, a train-pipe on the car, a pipe connection between the air-compressor and train-pipe, and a check-valve in the pipe connection.

15. In a car, the combination of two parts relatively movable transversely to the length of the car, and two independent air-compressors each having its cylinder secured to one of the parts of the car and its piston secured or connected to the other part whereby each compressor acts as a buffer to lessen the lateral vibrations of the car and the two compressors act in opposite directions whereby the oscillations in both lateral directions are cushioned.

16. In a car, the combination of the transom-frame, a swing-beam between them, an air-compressor secured to one transom-frame, a lever to operate the piston of the compressor pivoted to the other transom-frame, and a connection between the swing-beam and lever whereby the lateral swinging of the swing-beam is communicated to the compressor.

17. The combination of a car-body, an air-compressor under the car-body, an air-supply pipe leading from the suction part of the compressor upward into the interior of the car-body, and pneumatic springs supplied with compressed air by the compressor.

18. A car-truck provided with pneumatic springs, combined with an air-compressor operated by the vibrations of the truck and

adapted to supply air to the springs having a cylinder provided with an air-chamber at one end closed by a valve of full diameter of cylinder, a spring to close the valve, a piston
5 having an inlet-valve, a supply-pipe entering the cylinder above the piston, and a discharge-pipe leading from the air-chamber.

In testimony of which invention I have hereunto set my hand.

SAMUEL MORRIS LILLIE.

Witnesses:

LEONTINE A. ST. GERMAIN,
WILLIAM J. BRENNAN.