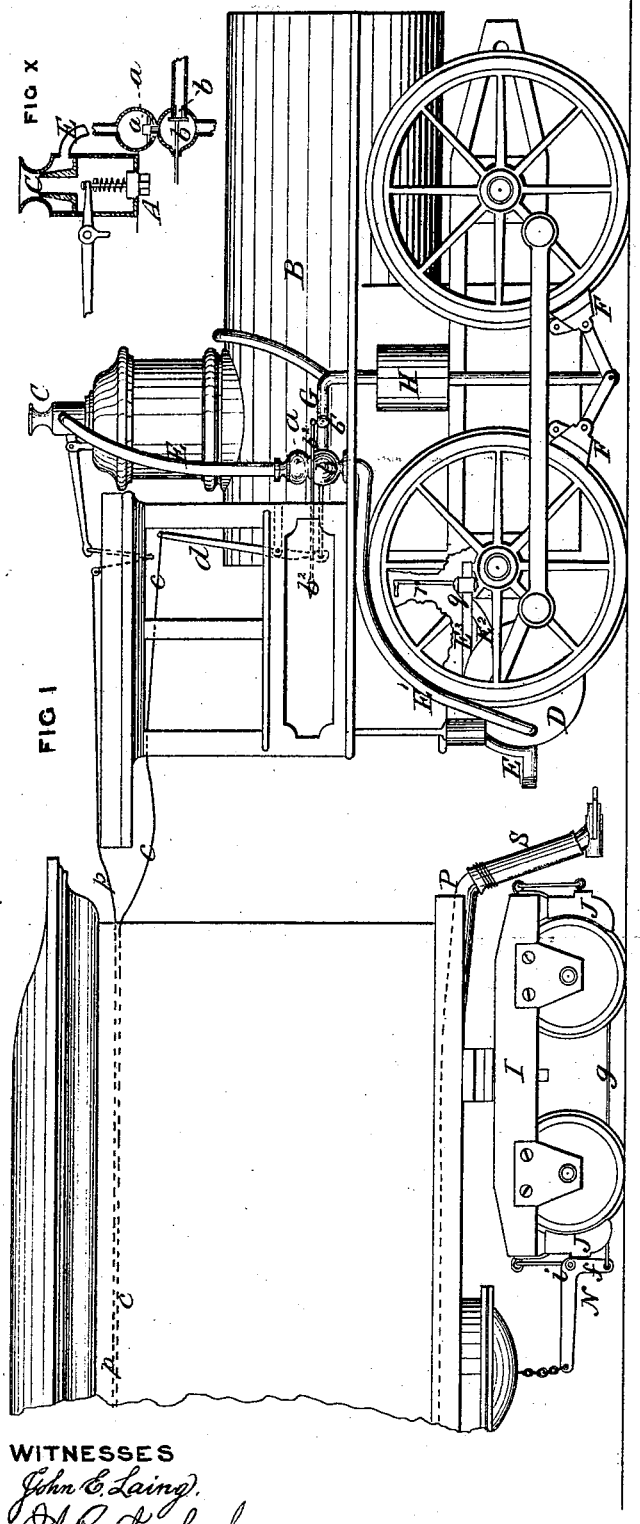
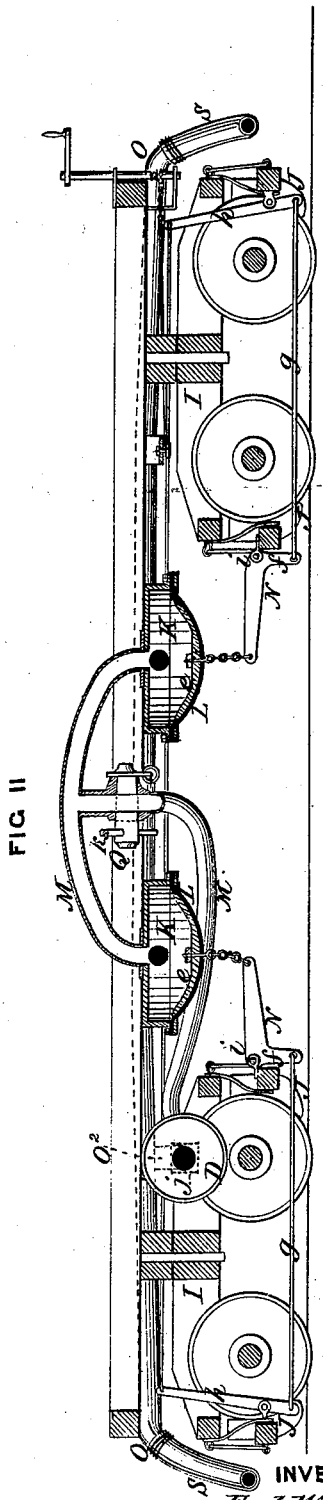
2 Sheets--Sheet 1.

F. W. EAMES.

Vacuum Car-Brake.

No. 167,750. Patented Sept. 14, 1875.





WITNESSES

John C. Laing.

J. H. Rutherford

INVENTOR

Fred W. Eames

By Johnson & Johnson

his Attorneys

2 Sheets--Sheet 2.

F. W. EAMES.

Vacuum Car-Brake.

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FIG III

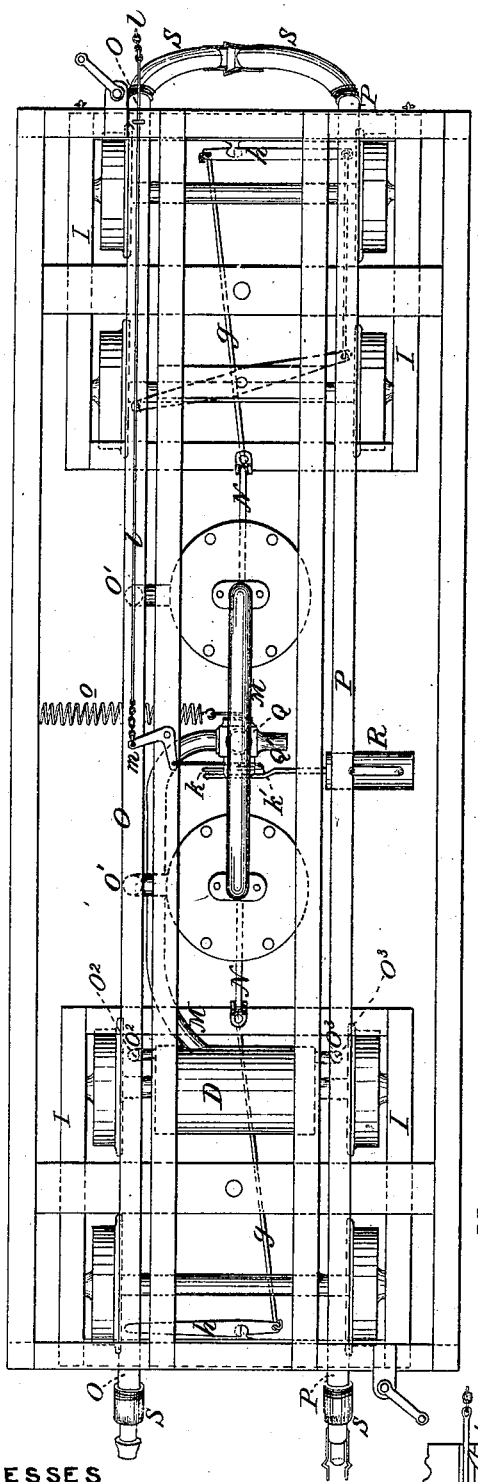


FIG VIII

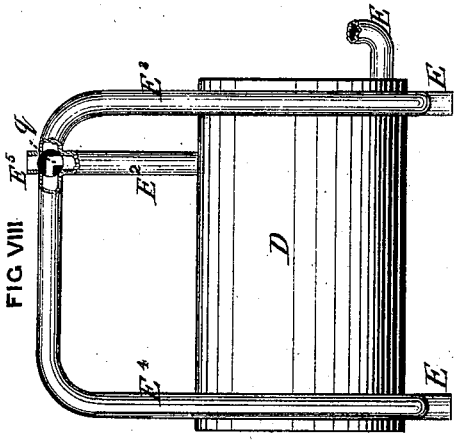


FIG IV

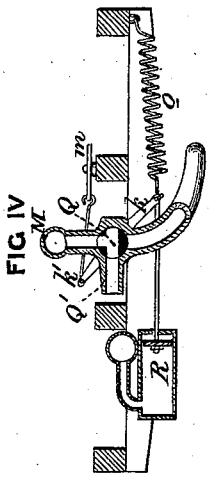


FIG V

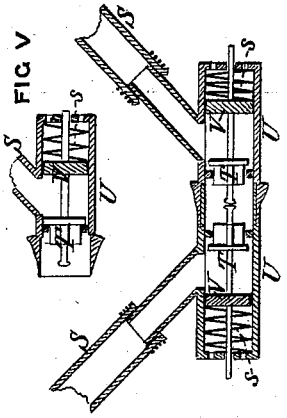


FIG VI

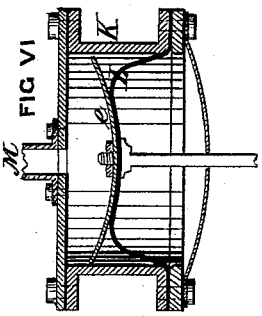


FIG VII

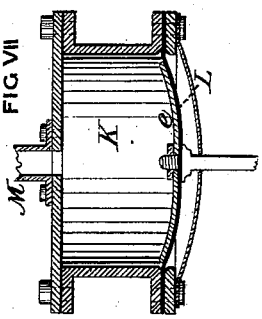
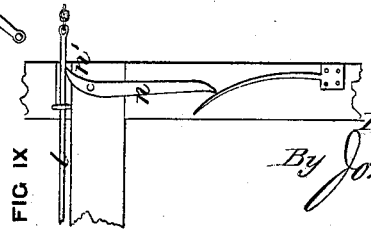


FIG IX



WITNESSES

John E. Laing.
J. H. Rutherford

INVENTOR

Fred. W. Eames
By Johnson & Johnson
his Attorneys

UNITED STATES PATENT OFFICE.

FREDERICK W. EAMES, OF WATERTOWN, NEW YORK.

IMPROVEMENT IN VACUUM CAR-BRAKES.

Specification forming part of Letters Patent No. **167,750**, dated September 14, 1875; application filed November 30, 1874.

To all whom it may concern:

Be it known that I, FREDERICK W. EAMES, of Watertown, in the county of Jefferson and State of New York, have invented certain new and useful Improvements in Vacuum-Power Car-Brakes; and I do hereby declare that the following is a full, clear, and exact description thereof, which will enable others skilled in the art to which it pertains to make and use the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to brakes for railway-cars in which the power to operate the brakes is produced by vacuum derived from the pressure of the atmosphere, and applied through the medium of connected chambers on the train which said vacuum is created.

The several features which constitute the subject-matter of this patent consist, first, in the combination, in a vacuum power-brake for railway-trains, of a steam air-ejector, and an automatically-operating valve, whereby the waste steam, escaping from over-pressure in the boiler, is utilized as a braking power; second, the combination, in a vacuum power-brake, of an automatically-operating steam air-ejector, with a storing vacuum chamber or chambers, and the connecting brake-pipes, whereby the vacuum is made and retained directly in the chambers of the train; third, in the combination of a steam air-ejector and an automatically-operating ejector-valve connected therewith, with a vacuum chamber or chambers and an intermediate check-valve, whereby a storing of power upon the locomotive is made by the direct action of the steam escaping automatically through the valve to relieve the boiler from undue pressure; fourth, in the combination of a steam air-ejector and an automatically-operating valve connected therewith, with a vacuum-chamber arranged upon the locomotive, and a vacuum chamber or chambers located upon each car, the brake-pipes and a two-way cock on the locomotive, whereby the chamber upon the cars can be made to operate the brakes upon the disablement of the locomotive-chamber, or the several chambers made to co-operate for joint action; fifth, of a flexible piston, provided with a re-enforcing-plate which has no circumferential or edge attachment with said flexible piston, in combination with the vacuum-chamber, whereby the said plate serves as a shield to receive and support the flexible piston as it is forced up against said plate by the pressure of the air acting upon the entire area of said flexible piston, for, as the flexible piston must have free surface movement in the cylinder from the piston-stem to its connection with the cylinder, so must the re-enforcing-plate be free to perform its functions properly at the time the flexible piston most requires its support, and allow said piston entire freedom from the outer edges of said plate when the vacuum is destroyed; sixth, in the combination, with the flexible pistons, having free re-enforcing-plates, of the steam air-ejector, the locomotive and car vacuum-chambers, and a brake pipe or pipes uniting these parts, whereby the brakes may be applied either from the locomotive or each car; seventh, in the combination, with separate flexible pistons connected by a pipe, of the brakes of each separate truck, so that one piston will operate each set of brakes, whereby the unequal adjustment or brakage of one set of brakes or levers will not affect the working-efficiency of the others; eighth, in the combination, with the flexible pistons, of the bell-crank connecting-levers, pivoted to the brake-beams by a swiveling joint, whereby both the trucks and the levers may have a joint lateral movement or deflection, without interfering with the proper movements of the flexible pistons; ninth, in the combination of the cock-shifting piston, the three-way cock, and its spring, with the brake-pipe, locomotive vacuum-chamber, and the steam air-ejector, whereby the cock may be opened and closed, for the purpose of applying or relieving the vacuum, at the will of the engineer; tenth, in the combination, with the three-way cock, the vacuum-chamber, and the brake mechanism, of a continuous rod or chain uniting the several cars of the train, whereby the cock of each car may be opened at once throughout the train by the accidental separation of the train at any point, to apply the brakes to all the cars; eleventh, in the combination, with the three-way cock, the car vacuum-chamber, the braking mechanism, the

connecting rod or chain of the train, of the automatic griping or locking device, whereby the said cock is held open after the separation, to maintain the pressure on the brakes; twelfth, in the combination, with a valve in the brake-pipe connections, of a piston which is open to the atmosphere, and of a larger diameter than said valve, to keep the latter closed by the pressure of the outer air.

In the accompanying drawings, Figure 1 represents an elevation of a portion of a locomotive and a car embracing my invention; Fig. 2, a vertical longitudinal section of the same; Fig. 3, a top view of a car truck and frame embracing my invention; Fig. 4, a detail view, showing the three-way cock closed to close the communication between the vacuum-chamber and the brake apparatus; Fig. 5, views of the coupling for the flexible brake-pipes; Fig. 6, a vertical section of the flexible piston connecting with the vacuum-chamber, showing the piston raised; Fig. 7, a similar view, showing the flexible piston down; Fig. 8, a top view of the locomotive vacuum-chamber and its connecting-pipes and the two-way cock; Fig. 9, a top view of the automatic griping or locking device for the rod or chain connecting with the three-way cock; and Fig. 10, Sheet 1, a section showing the automatic valve of the air-ejector, the check-valve, and the valve for closing the locomotive brake-pipe.

The locomotive has the usual safety-valve A, Fig. 10, Sheet 1, which performs its usual function of relieving the boiler B from excessive pressure by letting off the surplus steam. For the purpose of carrying out my invention I utilize this waste steam to create, from time to time, a vacuum to operate the brakes, by combining with such valve A an air-ejector, C, and a chamber or chambers, D, to retain the vacuum, carried at any convenient point upon the train. I prefer to employ for this purpose one of the usual puppet safety-valves upon the steam-dome, the requirement of the valve so employed being that it shall be graduated to allow it to open at a slightly-less pressure than the other dome-valve, in order that this valve shall be made the one through which the bulk of the steam passes; but this result may be obtained through a valve located at any point upon the body of the boiler, so long as its function is automatic for the purpose designed.

Now, in order to retain the vacuum formed in this manner until such time as it is desired to use it, and to prevent its application to the brakes when not required, I employ a chamber, or a series of chambers, D, to retain this vacuum. These are fitted with valves, and may be arranged in any convenient number upon any part of the train; but I prefer to locate one upon the locomotive and one upon each car, as shown in the drawings.

These vacuum-chambers D may be put in communication with the automatically-operating ejector C by a pipe, E, leading thereto. I have, for convenience of construction, however, combined this pipe E with the ejector-nozzle C of the safety-valve A, which constitutes the ejector, such connection of the pipe E being made above the valve, as shown in Fig. 10. The pipe E, connecting the ejector C with the vacuum-chamber D of the locomotive, is provided with a check-valve, *a*, arranged in any convenient part thereof, the function of which is to retain the vacuum created by the opening of the safety-valve.

The operation of the safety-valve, above described, has reference only to its automatic action produced by an increase of the pressure of the steam in the boiler.

There is another important function of this valve A in connection with the operation of the brakes, which will be hereinafter described.

For the purpose of safety I provide the locomotive with automatic brakes, F, operated from the vacuum-chamber D thereon by means of a pipe-connection, G, closed by a valve, *b*, Fig. 10, and which valve is opened by a cord, *c*, running throughout the train, and serving to open the said valve *b* by the tension exerted upon the cord *c* and its lever *d* by the separation of any portion of the train, thereby utilizing any such accident to the train as a direct means for applying the brakes to the locomotive-wheels. The chief feature of this part of my invention consisting in combining, with the locomotive-brakes F, a valve, *b*, operated in any suitable manner by a direct attachment or connection with the train, so that the accidental severing of the train will at once apply the braking-power to the front end of the train, and thereby stop it before it shall have left the rear part of the train, thus preventing many accidents growing out of the accidental separation of the cars.

The connection of the train-cord *c* with this controling-valve *b* may be made as shown by the lever *d*, which is designed also to be within reach of the engineer for his control in cases of emergency.

The locomotive-brakes may be connected to pistons working in a cylinder, H, in any suitable way and by any proper means, the only requirement being that the communication between the brake-cylinder and the vacuum-chamber or vacuum-producing power shall be that the communication is opened by the accidental separation of the cars.

The releasing of the locomotive-brakes is effected by a cock, b^1, in the cylinder-pipe G, and which is controlled by the engineer by means of lever b^2, attached to said cock, as shown in Fig. 1.

The car-trucks I are of the usual construction, and the wheels are provided with any approved kind of brakes, J. To the floor-sills of each car I secure the chamber D, within which the vacuum is automatically formed by the operation of the ejector, and it is preferably located between two chambers, K, containing

flexible pistons L, and located one near each truck, and with which the vacuum-chambers D are connected by pipes M, in such manner that the communication will be above the flexible pistons. The vacuum-chamber, however, may be arranged near either end of the car.

Each flexible piston L has, by this arrangement, a single direct and separate attachment to the brake-levers of each separate and independent truck, so that the brakes of one truck are independent of those of the other, in order that any unequal adjustment, wear, or breakage of either will not destroy the efficiency of the others.

The piston-chambers K are formed of cylinders or cases, secured to the floor-sills of the car, with its lower end open to the pressure of the atmosphere, and having secured to its open end a flexible piston, composed of a metal plate, *e*, which is attached to the casing by some flexible material, L, which must be impervious to air. This metal plate *e* is secured simply through its center to the flexible head L by means of a short bolt or stem passing through the flexible head, and clamped or screwed to the plate. The circumference of the plate *e* is, therefore, free from the flexible head, but travels with it, and serves to re-enforce it by giving it greater strength. The separate flexible pistons are connected each to a separate bell-crank lever, N, the upper end of the short arm *f* of which is pivoted to the inner brake-beam, while the lower end of said short arm *f* is connected by a rod, *g*, to the lower end of an arm, *h*, Figs. 2 and 3, pivoted to the outer brake-beam of each truck, and controlled by separate and independent pistons, located near the inner end of said truck, above the line of the same, and out of the way of snow and other obstructions. The upper end of the short arm *f* of each bell-crank lever N is united to the brake-beam by a swivel-joint, *i*, for the purpose of allowing of the lateral or swinging movement of the truck.

This method of connecting the bell-crank levers to the brake-beams has the advantage of dispensing with a fixed fulcrum, and brings the brake-shoes J with equal pressure against both ends of the truck without regard to the unequal wear of the brake-shoes, which is a matter of very great importance.

This construction and connection of the bell-crank levers has another advantage by reason of their more rapid and least powerful movement at the beginning, and more powerful and least rapid movement at the time when the power is most required. This effect is obtained by reason of the upper connected end of the short arm moving backward, and the lower end moving inward and upward, producing a sort of toggle-joint action.

This arrangement will apply equally well between the wheels, provided the lower end of short arm be attached to the inner brake-beam, and the upper end of said arm attached by the connecting-rod *g* to the outer brake-beam.

The employment of the separate and independent pistons L in connection with separate and independent trucks has the important advantage of rendering a total disablement of all the brakes of a car almost impossible, for if one piston or any part of its attendant mechanism should become inoperative from any cause the other will remain intact and operative. This arrangement renders the brake-connections more effective, less expensive, and largely avoids any liability to derangement of the brake mechanism.

I have described the vacuum-chambers D as connected with the chambers of the flexible pistons, and the object of such connection will be presently stated.

In connection with the vacuum-chamber D and the chambers of the flexible pistons L, I employ two separate and distinct pipes, arranged upon the car-frame, extending throughout its entire length, and connecting with the pipes E. One of these pipes, O, Fig. 3, has an open and perpetual communication with the chambers of the flexible pistons by means of the branches O^1, and a valved communication by the branch O^2 with the vacuum-chamber, and connected with the vacuum-chamber D of the locomotive. The communication O^2 is closed by an outwardly-opening check-valve, *j*, Fig. 2, with the vacuum-chamber upon each car, while the other pipe P connects with the vacuum-chamber only by the branch O^3, Fig. 3, the object of which I will now describe. The first-mentioned pipe O is for the purpose of applying the brakes directly from the vacuum-chamber upon the locomotive, and by means of the vacuum within it whenever a communication shall be opened between said chambers on the locomotive and the flexible pistons, in a manner to be presently described. The communication of said pipe O with the vacuum-chamber D of the car is for the purpose of utilizing any surplus vacuum employed in stopping the train to exhaust the air from the said car vacuum-chamber, thereby accomplishing the double and simultaneous operation of stopping the train and creating a reserve force for an emergency, or an auxiliary power, as will be, also, more fully described hereinafter. The second pipe P communicates with the vacuum-chamber of the car, as stated, for the purpose of utilizing the stored-up power of the car vacuum-chamber to apply the brakes by opening the communication between said chamber and the flexible pistons by a vacuum created directly from the ejector, or by the vacuum in the locomotive-chamber. This communication is made by means of a three-way or other suitable cock or valve, Q, arranged in the pipe M, connecting the car vacuum-chamber with the flexible pistons, as shown in Figs. 2, 3, and 4. This cock or valve Q is of such construction as to open a communication between the vacuum-chamber D and the flexible pistons L to apply the brakes, or a communication between the flexible pistons and the outer air by an

open branch, Q′, Fig. 4, to release them. The first operation is effected by turning the valve Q, as shown in Fig. 2, whenever the vacuum made in the pipe P is exerted upon a small piston, R, Fig. 4, or diaphragm connected with said pipe P and the handle *k* of the cock; or it may be made by means of a rod, chain, or cord, *l*, attached to the cock, and connected throughout the train, said connection serving to automatically open the cock when the train is accidentally disconnected. This connection is shown by a bell-crank, *m*, pivoted on the frame, and attached to the other end *k′* of the cock-handle *k*. In order to hold the cock Q open when the connection *l* is broken by the severing of the train, I arrange a griping device, Fig. 9, consisting of a lever, *n*, pivoted upon the frame so as to bear, by its short end *n′*, upon the rod *l* and hold it from moving back, and thus keep the cock open and the brakes applied; otherwise the opening of said cock would be followed by instantaneous closing. This automatic griping device I propose to arrange at any convenient place upon each car-frame, and its operation must be such as to allow the connection *l* to be applied forward to open said cock, and to immediately bite upon and hold or clamp said connection against the recoil of a spring, *o*, connected with the cock-handle *k*. When the car or cars are stopped the griping device is released by any of the train hands. When such vacuum in the pipe P is released the cock Q is turned to release the brakes by the recoil of the spring *o*, connected to the handle *k* of the cock, which closing of the cock draws the piston R forward by a positive movement, thus again restoring the communication of the flexible pistons with the outer air through the branch Q′, to allow them to descend by their own weight.

The brakes may be applied wholly and entirely without the aid of the vacuum contained in the car-chambers D by opening the communication directly between the vacuum-chamber under the locomotive and the flexible pistons of the cars; or, in the event of an accident to the locomotive-chamber, the brakes may be applied by the vacuum in the car-chambers; or, in the event of a great emergency, both these means may be employed to stop the train.

These vacuum-chambers have communication with each other throughout the train, wherein the vacuum formed in one is also formed in all, both automatically and at the option of the engineer.

I have described the ejector-valve A as being made automatic by the pressure of the steam; but this valve may be rendered automatic in another way—that is, by attaching to said valve a cord, *p*, Fig. 1, running throughout the train, which shall operate the valve A whenever any sufficient tension is put upon it.

The vacuum-chamber D of the locomotive is provided with a two-way cock, *q*, Figs. 1 and 8, operated by the engineer by means of a handle, *r*, and which serves to open communication between said vacuum-chamber and either brake-pipe, O or P, to apply the brakes in either manner described, or with the open air, to release them, said cock *q* being located in any convenient manner at the junction of the connecting-pipes F, Fig. 8. The pipe E^1 connects the vacuum-chamber D with the automatic valve A, and the pipe F^2 connects the branches E^3 and E^4, by means of the two-way cock *q*, while the pipes E^3 and E^4 are put into communication with the open air through the the open branch E^5, and it is by this arrangement of pipes with the cock that communication is made first with the flexible pistons through the pipes E^4 and O, to apply the brakes directly from the locomotive; second, to open the communication between the pipes E^4 and O and the open branch E^5, to release said brakes; third, to open the communication between the vacuum-chamber D and the pipes E^3 and P, to apply the brakes by means of the car vacuum-chamber; and, finally, to open communication between said pipes E^3 and P and the open branch E^5, to release said brakes.

The two-way cock *q* in Fig. 8 is shown in the position to apply the brakes through pipes E^4 and O.

I have described the brake-pipes O and P, and their connection with the braking mechanism, but these pipes terminate at the end of each car, and are provided with flexible pipes S, by which connection is made from one car to the other. The couplings of these pipes are of such construction as to allow of the coupling of the cars whichever of their ends may be brought together.

In the event of the separation of the train it is necessary to instantly and tightly close the ends of the flexible pipes. This is effected by means of a valve, T, Fig. 5, placed in each half of the coupling U, in such manner that the stem of each valve holds the other off its seat to allow the passage of air when the pipes are connected, but which will close as soon as they are disconnected, thereby rendering the braking mechanism of each car independent of the other.

This closing of the valves T is effected by the pressure of the air upon a piston-valve, V, carried by the valve-stem beyond the point at which the flexible pipe S is connected with the valve-casing U, and which piston V, having a greater area than the valve T, must necessarily act, by the pressure of the air from the open end of the casing, to close and keep it closed with a relative force equal to the difference in the area of their surfaces presented to the pressure of the atmosphere.

To insure the instant action of this valve, a spring, *s*, is placed behind it, which serves to seat the valve, while the pressure of the atmosphere upon the greater surface of the piston holds the valve firmly upon its seat. Each car is provided with the usual devices for applying the hand-brakes.

I claim—

1. In a vacuum power-brake for railway-trains, a steam air-ejector, in combination with an automatically-operating valve, substantially in the manner and for the purpose herein set forth.

2. The combination, in a vacuum power-brake, of an automatically-operating steam air-ejector, C, with a storing vacuum chamber or chambers, D, and the connecting brake-pipes O and P, substantially in the manner and for the purpose herein set forth.

3. The combination of a steam air-ejector, C, and an automatically-operating ejector-valve, A, connected therewith, with a vacuum-chamber, D, or chambers, and an intermediate check-valve, *a*, substantially in the manner and for the purpose herein set forth.

4. The combination of a steam air-ejector, C, and an automatically-operating valve, A, connected therewith, with a vacuum-chamber, D, arranged upon the locomotive, and a vacuum-chamber or the chambers located upon each car, the brake-pipes O and P, and the two-way cock *q*, substantially as and for the purpose herein set forth.

5. The flexible pistons L, provided with a re-enforcing-plate, *e*, which is free from circumferential or edge attachment with said piston, in combination with the vacuum-chamber K, whereby the said plate serves as a shield to re-enforce the flexible piston under the action of the vacuum only in the cylinder, as herein set forth.

6. The combination, with the flexible pistons L, of the steam air-ejector C, the locomotive and car vacuum-chambers D, and the brake-pipe O, uniting these parts for joint operation.

7. The combination, with the flexible pistons L, of the steam air-ejector C, the locomotive and car vacuum-chambers D, and the brake-pipes O and P, uniting these parts for joint operation.

8. The combination of the separate flexible pistons L with each truck, one piston operating each set of brakes, whereby the unequal adjustment or brakage of one set of brakes or levers will not effect the efficiency of the others.

9. The combination, with the flexible piston L, of the bell-crank connecting-levers N, pivoted to the brake-beams by a swiveling joint, *i*, whereby both trucks and the levers may have a joint lateral movement or deflection, without injury to or interrupting the working of the flexible pistons.

10. The combination of the cock-shifting piston R, the three-way cock Q, and the spring *o*, with the brake-pipe P, the locomotive vacuum-chamber D, and the steam air-ejector C, whereby the cock may be opened and closed, for the purpose of applying or releasing the vacuum at the will of the engineer.

11. The combination of the three-way cock Q, the vacuum-chamber D, and the brake mechanism of a continuous rod or chain, *l*, uniting the several cars of the train, whereby the cocks of each car may be opened at once throughout the train by the accidental separation of the train at any point to apply the brake to all the cars.

12. The combination, with the three-way cock Q, the vacuum-chamber D, the braking mechanism, the connecting rod or chain *l* of the train, of the automatic griping-lever *n*, whereby the said cock is held open after the separation, to maintain the pressure on the brakes.

13. The combination, with the valve T, of a piston, V, which is open to the atmosphere, and of a larger diameter than said valve, to keep the latter closed by the pressure of the outer air, substantially as herein set forth.

In testimony that I claim the foregoing I have affixed my signature in presence of two witnesses.

FREDERICK W. EAMES.

Witnesses:

A. E. H. JOHNSON,

J. W. HAMILTON JOHNSON.