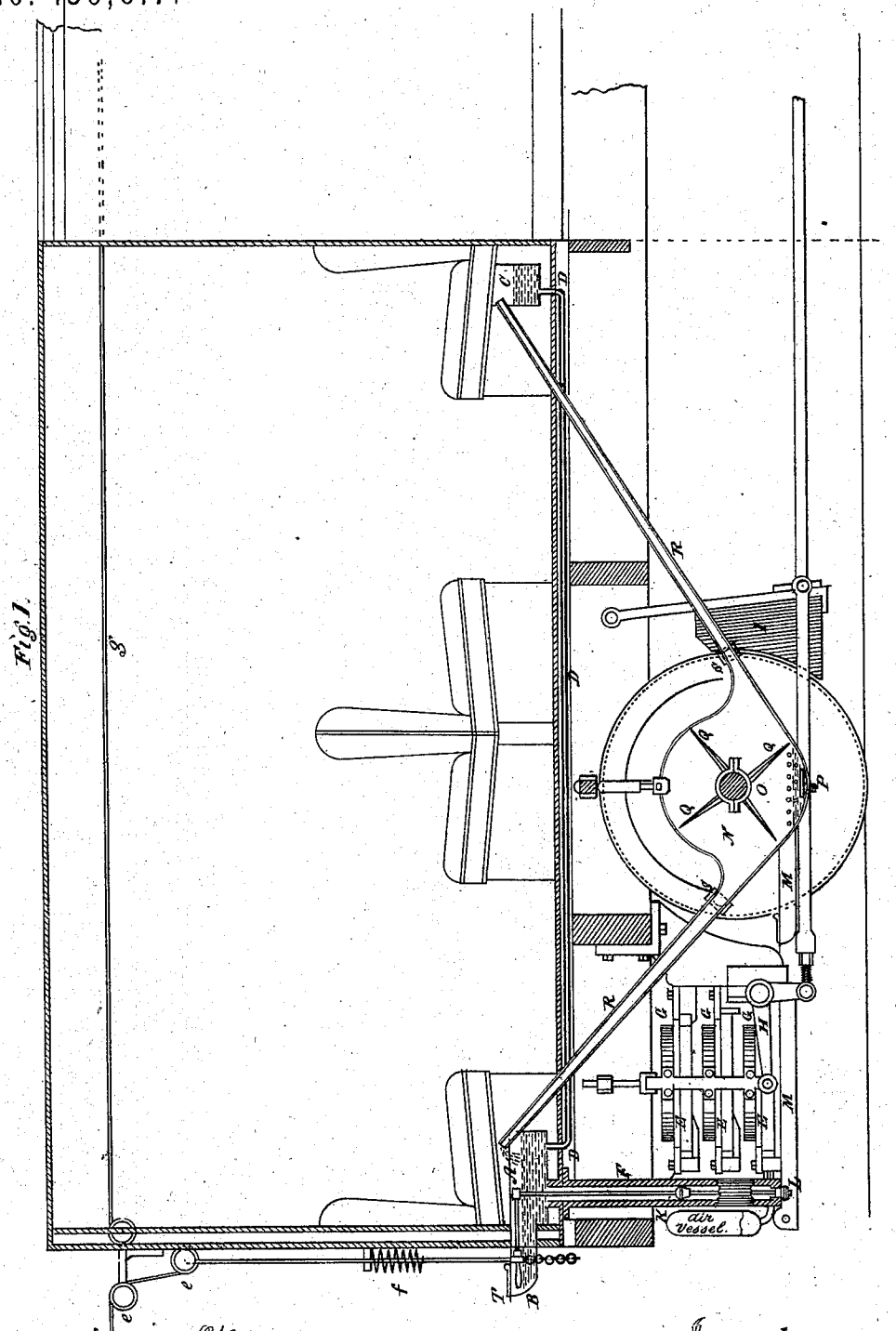
2 Sheets--Sheet 1.

G. P. RENSHAW.

Hydraulic Railway-Brakes.

No. 136,617. Patented March 11, 1873.

Fig. 1.



Witnesses.
John C. Thornton
Charles E. Stewart

Inventor.
George P. Renshaw.
By his Attorney
John Kent

2 Sheets--Sheet 2.

G. P. RENSHAW.

Hydraulic Railway-Brakes.

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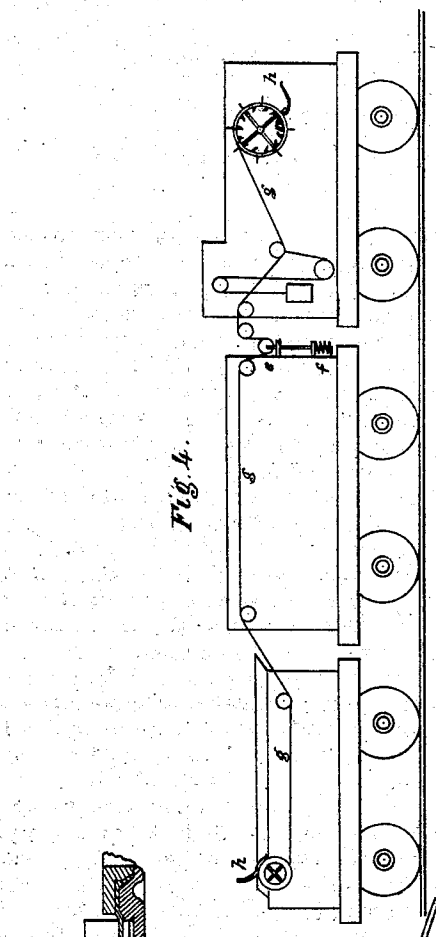

Fig. 4.

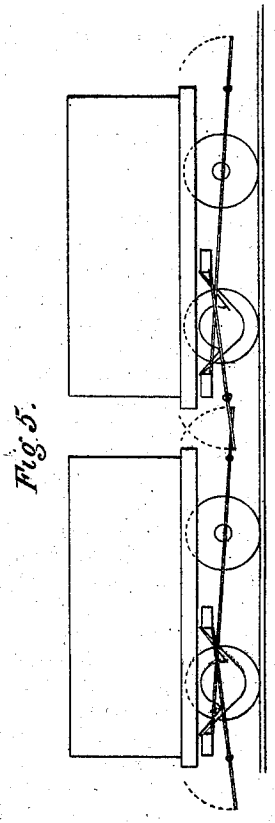

Fig. 5.

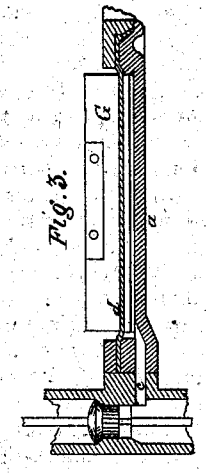

Fig. 3.

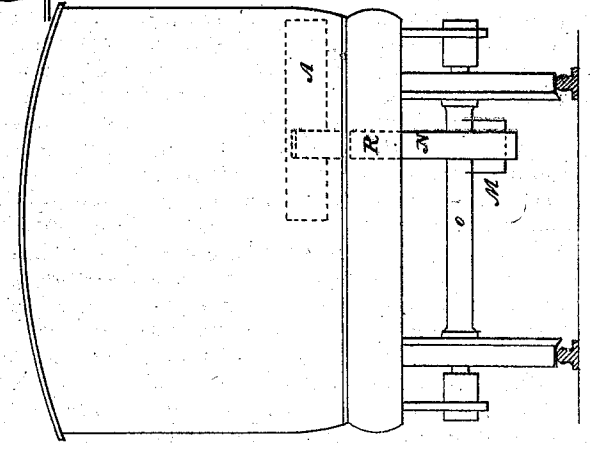

Fig. 2.

Witnesses.
John S. Thornton
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Inventor:
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By his Attorney
John Kents

UNITED STATES PATENT OFFICE.

GEORGE PEARSON RENSHAW, OF PARK VALLEY, ENGLAND.

IMPROVEMENT IN HYDRAULIC RAILWAY BRAKES.

Specification forming part of Letters Patent No. **136,617**, dated March 11, 1873.

To all whom it may concern:

Be it known that I, GEORGE PEARSON RENSHAW, of Park Valley, in the county of Nottingham, England, have invented certain new and Improved Hydraulic Railway Brakes; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawing forming a part of this specification, and to the letters of reference marked thereon.

My invention relates to an improved mode of applying hydraulic power to the working of continuous brakes for railway rolling stock, for the prevention of accidents from collision, and for the more economical working of the railway plant, in such a manner that each carriage fitted and provided with my improvements shall give its own proportion of brake-power to the train, and shall be capable of exerting such power independently of the accidental failure of the brake apparatus of one or more of the other connected carriages by negligence or otherwise; also, so that the train shall admit of being divided, and in which case the brakes in each part will act separately. The nature of my invention consists, first, in the application of the natural pressure resulting from the superposition of a head of water to actuate the brakes of railway-carriages, by means of water admitted to cylinders or chambers with flexible diaphragms, bellows, or other equivalent apparatus; secondly, in the subsequent raising of the water so applied, by means of fans or arms secured upon the revolving axles of the carriages, whereby the water, after having actuated the brakes, can be returned to the reservoir or transferred to the tender or feed-tank of the boiler; and, thirdly, in constructing and arranging the valves which operate the brakes in such a manner that by means of cords or other flexible connections they shall be under the control of either the guard or the engine-driver, or both, and so as, in the event of breakage of the connecting couplings of the train, to cause the brakes to act instantaneously and automatically.

In order that my invention may be fully understood, I will now proceed to a more particular description thereof, referring to the accompanying drawing, in which—

Figure 1 represents a longitudinal sectional elevation of an ordinary railway passenger-carriage with my improved hydraulic brake attached; Fig. 2, an end or transverse elevation of the same; Fig. 3, a detail sectional view of one of the chambers or cylinders. Fig. 4 shows the arrangement of the cord or chain for operating the valve so as to admit water to the chambers, and Fig. 5 shows one mode which I employ for returning the water to the feed-tank or tender.

The same letters of reference indicate corresponding parts in all the figures.

A is a cistern or reservoir, supplied when necessary with water through the nozzle or spout B. This cistern A may be placed beneath the carriage-seat, as shown, or, at option, it may be fixed on the carriage roof or back, or in any other position, as desired; but always at a sufficient elevation above the moving details of the brakes to secure hydrostatic power. The cistern A is connected with a small receiver, C, by means of a pipe, D, and also with one or more pressure-cylinders or diaphragm-chambers, E E E, by the pipe F. One of these cylinders or chambers is shown in detail section on a larger scale at Fig. 3, and is hereinafter more fully described. The cylinders or chambers E are firmly attached to the framing of the carriage by an intermediate framing, and on their tops are corresponding disks or covers G G G, which are lifted through a small space when water from the cistern A is admitted to the cylinders or chambers E through the supply-pipe F. Between the upper surface of each of the cylinders or chambers E and the under surface of the corresponding disk G a diaphragm of India rubber strengthened with cloth, or of leather or other flexible material impermeable to water, is placed to prevent leakage. The disks G act on the lever H, which is connected with one or more brake-blocks, I I, through the intermediate coupling rods or links shown in Fig. 1; but, if desired, the pressure cylinders or chambers E may have their axes horizontal, and so act directly on the brake-blocks I without the intervention of the lever H. I prefer, however, the first arrangement. It will also be obvious that the disposition of the pressure cylinders or chambers E with their attaching framing, and of the other adjacent parts, severally, may be varied to suit the general ar-

rangement of the carriage, whether provided with brakes between the wheels requiring to be pressed asunder and in opposite directions, or with brakes (as shown in the drawing) which require to be pulled in the same direction. The hydraulic power may also be applied on either one or both sides of the carriage, and equally to what are known as "flap" or to "sliding" brakes. The admission of the water to the pressure cylinders or chambers E, and the consequent application of the brake-blocks to the wheels, is regulated and governed by an inlet-valve, K, and there is likewise an outlet-valve, L, located below on the same or a different rod, by which latter valve the water may escape from the pressure-cylinders or chambers E into the catch trough or troughs M when it is intended to cause the braking power to cease. The brake-blocks I are then removed from the wheels by the combined weights of the disks G and lever H, supplemented, if necessary, for that purpose. The valves K and L, if on the same rod, are made cylindrical on a portion of their length, and filling the orifices in their respective valve-seats, and in all cases so that the exit-valve L may not open until the inlet-valve K has closed in order to prevent a waste of water. From the catch-trough M the discharged water runs through small apertures in the side of the fan-casing N, which surrounds one of the running-axles O of the carriage. This fan-casing N is suspended at one end from a cross-bar which rests on the opposite axle-boxes by a rod made adjustable in length, and at the other end it is hinged to the supply-pipe F or other suitable part of the framing, so as to be able to rise and fall with the play of the springs. The fan-casing N may be of wood or other material imperfectly conducting heat, to prevent freezing in cold weather. It should also be put on the axle in two parts. A cock, P, is likewise provided, by which the water may be run off at such times as the carriage is required to stand in a siding or other exposed place. The constant agitation of the water, the normal state of emptiness of the pressure cylinders or chambers E, and the short time the water remains in the catch-trough M, however, will ordinarily be sufficient to secure immunity from injury to the action of the brake at ordinary temperatures, and in extreme cases it will be easy to introduce sufficient boiling water to prevent the working water from freezing. Within the fan-case N a fan or dash wheel, Q, is fixed by screw-clamps on the carriage axle O, and consequently revolves with the latter. This fan, by centrifugal force, throws the water up one or other of the inclined spouts R R, according to the direction of the motion of the train, and returns it to the original level in the cistern A and the connected supplementary receiver C; or, otherwise, the discharged water may be used to supplement the supply of feed-water in the tender or tanks, in the manner hereinafter explained; or it may be allowed to run to waste. S S are joints in the inclines, covered with India-rubber rings to allow for play. If necessary, the fan may be made to act as an ordinary centrifugal pump, raising the water up vertical pipes to the cisterns; but the inclines shown would seem more generally suited to the varying velocities of a railway train, and the usual arrangements of the carriages.

Fig. 3 shows one of the pressure cylinders or chambers before referred to in section, on an enlarged scale; *a* being the cylinder of cast-iron; G, the movable disk or cover; *c*, the connecting-passage for the water; and *d*, the flexible diaphragm. The surfaces between the latter are compressed and secured, and may be roughened by being turned with a coarse cut or left in rings in order to hold the flexible material more firmly.

Fig. 4 shows the arrangement of the cord or chain for allowing the valve K to admit water to the pressure cylinders or chambers E, and so apply the brakes at the will of the guard or driver. This cord or other flexible connection is passed over pulleys on the carriages from the guard's van in the rear of the train to the tender or engine at its front, in the same manner as the commonly used cord communicating between guard, passengers, and driver. If any carriage in the train is not fitted with the hydraulic brake, the cord is simply passed by it and on to the next.

The cord is shown passing under pulleys *e e*, working the valve-rods by means of levers, in such manner that when the cord is tense the inlet-valves K are kept closed, and consequently the pressure cylinders or chamber E empty, and the brake-blocks I off the wheels; and, conversely, when the cord is slackened, a spiral spring, *f*, or a suitable weight then causing the inlet-valves K to be opened; but all this arrangement may evidently be reversed, as the cylinders or chambers may be ordinarily filled with water, and the cord normally slack, though this alternative plan does not appear so expedient. The communicating-cord *g* is fastened at the one end around a wheel in the guard's van, by which it may be wound in to suit the length of the train, in the usual manner, while the other end is secured to the periphery of a light wheel on the tender or engine, and around which it is coiled, and either of these wheels is capable of being fixed or released at pleasure by a detent, *h*. A certain degree of tension or strain is kept on the cord *g* by means of a tension-weight and pulleys, as shown in Fig. 4, or other suitable arrangement in the guard's van, and the rapid opening of the inlet-valve K and closing of the outlet-valve L, and consequent operation of the brakes, are promoted by the spiral spring or weight at *f*. If the cord *g* be broken by any of the carriages becoming detached, the valves will necessarily be actuated, and the brakes applied automatically in the same manner as by the ordinary slacking of the cord by the guard or driver.

It is evident that the temporary applica-

tion of the brakes by the guard may be used by him as a signal to the engine-driver; and, also, if the cord be violently pulled down by an affrighted passenger, it may be made to cause a bell to strike similar to those fixed to give alarm by raising the tension-weight. Thus the same cord may serve for all purposes of intercommunication in the train. In certain cases a small stream of water may be diverted from the supply-pipe F onto the brake-blocks to prevent them firing in hot weather; or, with cast-iron brake blocks, the water may enter the hollow interior, and so keep them cool.

To illustrate the power of the brake, if we take the cistern A as containing seven gallons or seventy pounds avoirdupois of water, (and which will suffice for two consecutive actions,) and the average head of water (as the pressure will differ in the cylinders or chambers E) at two feet, and also the diameter of each of the three pressure-disks G at eighteen inches, the net pressure on the brake-blocks will be about twelve hundred-weight if the leverage at H is as two to one.

At T in Fig. 1 is shown a handle connected with the valves K and L in the supply-pipe F. This handle is to enable the porters or other attendants of the train to shut the inlet-valves K, and so prevent the operation of the brakes while separating carriages from or adding carriages to the train at stations, and the handle is capable of being fixed up by a pin and chain to keep the valve K shut and the brakes off.

Fig. 5 shows an arrangement by which the water raised up either of the inclines by the revolution of the fan runs from the one or the other receptacle into the catch-trough of the next carriage to be again lifted and so transferred and caused to flow on till it reaches the feed-tank or tender to be used to supplement the supply for replenishing the water in the boiler. The object of this arrangement is to supersede the necessity for a separate tender in certain cases. In short and what are called "local trains," made up of a very limited number of carriages, the brakes throughout the train may be worked from the feed-tank by means of flexible pipes connecting the several carriages in lieu of providing separate cisterns in the latter.

It will also be evident that some of the other details may be varied, according to circumstances, without affecting the general principle of their design—for example, bellows like the well-known hydrostatic bellows may be substituted for the cylinders or chambers with flexible diaphragms; or rams or pistons may be employed as used in hydraulic presses.

The principal special advantages secured by my invention are as follows: First, the brakes admit of being applied by either the guard or the engine-driver, and, while being simple in construction, and not requiring frequent attention to keep them in working order, they act powerfully and smoothly on the wheels of the carriages to retard and stop the train. Second, in the event of part of the train becoming detached by reason of the severance of the couplings connecting the several carriages, the whole of the hydraulic brakes at once apply themselves automatically to arrest the revolution of the wheels in the several and disconnected fractions of the train. Third, a given and preconcerted determinable pressure can be applied to each respective carriage-wheel so as to obtain the maximum useful retarding force, and this without the liability to wear and damage the tires by sliding or "skidding" on the rails, or the risk of "chilling" and fracturing steel tires in frosty weather. Fourth, in taking on carriages at junctions, carriages not fitted with these special brakes admit of being worked in conjunction with others so fitted.

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

1. The chambers E provided with the disks G and diaphragms *d*, operated by the pressure of a head of water through the medium of the cistern A and pipe F, in combination with the brake-block I, substantially as herein shown and described.

2. The fans Q clamped on the axle O, and operating within the casing N by the motion of the carriage, in combination with the inclined spouts R R, cistern A, receiver C, and pipe D, substantially as and for the purposes set forth.

3. The combination of the cords *g*, spring or weight *f*, and valves K and L with the chambers E and brake-block I, all being arranged and operated substantially as and for the purposes herein set forth.

GEO. P. RENSHAW.

Witnesses:

GEO. J. B. FRANKLIN,

JNO. GEO. PEARSON.