ON THE RETARDATION AND STOPPAGE OF RAILWAY TRAINS.

The general principle of railway-carriage breaks, namely, that of retarding or stopping the revolution of the wheels by the pressure of break-blocks against their peripheries, is limited in its application to the single carriage, in which the power is applied by the guard's hand; and looking at the present greatly-increased velocities of trains, and their probable acceleration, it becomes a very important question, whether some more powerful and speedy control is not required over the motion of the train than can be obtained by the ordinary plan of a break upon one or two guards' vans, and upon the tender.

Many plans have been proposed during the progress of the railway system for the accomplishment of this desirable object, and amongst them may be mentioned, as one of the most practical, a plan invented some years since by Mr. Robert Heath, of Moss Side, near Manchester, which consisted of break-blocks fixed in slide-bars in each carriage, and worked by a lever with a weight upon the end of it, adjusted to give the requisite pressure upon the wheels. When the pressure of the breaks was required to be taken off, the ends of the levers were lifted by means of a tension-bar and chains, which extended the whole length of the train, and were worked by a rack and pinion within reach of the guard. The peculiar feature in this break, distinguishing it from the ordinary hand breaks, was the employment of a weight to put on the pressure of the breaks, independent of the power of the man's hand, and simultaneously in every carriage of the train, giving an important advantage in the great increase of power available for stopping the train, and the promptness of its action, the guard having only to release a catch in order to put on all the breaks at once, and employing his own power only in lifting off the breaks afterwards, by means of the rod and chain communicating with each carriage. In a practical trial of these breaks in 1848, with a train of five carriages and a van, all fitted with the breaks acting together, and the tender-break also used, the following results appear to have been obtained :—

Speed of Train when Breaks were applied.	Descending gradient.	Distance run after Breaks were applied.
40 miles per hour.	1 in 100	148 yards.
45 ,, ,,	1 in 100	163 ,,
50 ,, ,,	1 in 82	232 ,,
55 ,, ,,	1 in 200	264 ,,

Numerous other plans have been suggested, and tried at different times, for the purpose of arresting the motion of railway trains, within shorter distances than can be effected by the ordinary hand breaks ; but none of them appear to have answered the purpose satisfactorily, or effected any material change in the breaks in general use.

The next improvement requiring particular notice, is the break recently invented by Mr. James Newall, of Bury, the more immediate subject of the present paper.

The immense extension of railway communication, and the number of persons conveyed, involve considerations of such vast importance, as to render any attempt to obtain increased security a subject of deep interest, in whatever form or direction that security can be effected. If the causes are considered of the railway accidents which from time to time take place, they may, in many instances, be traced to those arising from the inability to bring a train from a state of motion to a state of rest, or in other words, to absorb the momentum of the train within a given distance of space, and that without injury to the carriages, or endangering the safety of the passengers. This has always been a defect in railway travelling, and many of the serious accidents arising from collisions of one train running into another, have occurred from the want of power to stop the train in motion before it arrived at the point of contact.

This to some extent has been accomplished by Mr. Newall's break, and from the results of the experiments made on the East Lancashire Railway, on the 7th November last, as described subsequently, this break appears to bid fair to accomplish that object, or at all events to become the precursor of further improvements, giving increased security to railway travelling.

The following is a description of Mr. Newall's break, which is shown in Plate 39 :—

The object of this invention is to work as many of any description of breaks as the weight of a train may require, either from the engine or guard's van, or from any of the carriages in the train. A lever, A, is fixed to the centre shaft of the break, under each carriage, to extend to the end of the carriage; the length of this long lever, as compared with the short arms which apply the break-blocks to the wheels, is about 11 to 1. A cylinder, B, is fixed to the end of each carriage, containing a spiral spring, which will shut up inside the cylinder to 14 inches length when compressed; under this spring is placed a cross-head, C, which projects out of the cylinder at each side, and is acted upon by the spiral spring; this cross-head is connected to the end of the lever A, and the spring gives a pressure of about 56lbs. at the end of the lever, which multiplied by the leverage, 11 to 1, gives a pressure on the four wheels of about 616 lbs ; this pressure is found sufficient for ordinary stoppages. Two upright racks, DD, are connected to the cross-head, C, and they are acted upon by a pinion, E, fixed on the main shaft at the top of the carriages; only one of these racks is in action at a time, but two racks are used, because when a carriage comes to be connected, and is the wrong end about, one rack can then be thrown out of gear, and the other into gear, so as to reverse the motion, which is done by sliding the frame carrying the pinion E, by means of a small lever at the top of the carriage. The connecting shaft F is carried on to each carriage, and on to the tender at G; and if the guard's catch is on, in his van at H, the engine-driver, by giving a lift at the handle G, as if taking the breaks off, liberates the guard's catch, and so *(vice versa)* all these catches are made to fall back from the ratchets by balance weights (as shown enlarged in Fig. 5), on the weight being taken off them; as soon as the catch is fallen back, the guard or driver lets go the handle, and the breaks apply themselves by the pressure of the springs, but the guard or driver can apply as much more pressure as he thinks fit by giving the handle a few extra turns. The coupling of the shaft F between the carriages is effected by a spring catch T, similar to a brace and bit, as shown in Fig. 3. A man can couple and uncouple six carriages in as many minutes; each coupling is made to offer either end by means of a swivel joint, so as to couple with the next carriage, whichever end may be put to it. Five or six turns of the handle on the tender or van are sufficient to apply the breaks, or take them off, and one guard can work six of them easier and quicker than one of the ordinary breaks. After the train is marshalled in the usual way, the porter drops all the breaks on, and then mounts the carriage and couples each; in addition to the spring stud on the opposite side of the coupling, a thumb-screw is used as an additional safety. When all are coupled together the apparatus can be worked from any portion of the train, or from the tender; the shaft T which passes along the top of the whole train is made of 2½in. iron tubing, about ¼in. thick, and revolves in light cast-iron pedestals, and on each carriage it is made with an expanding slide M of 1¼in. square iron, working in a steel square, welded in the end of the other tube; the steel square is about 2½in. long, and the square bar 6ft. long. If the shackle becomes broken this square bar is drawn out of the tube, and the breaks instantly are liberated and apply themselves. Double ball-and-socket joints NN are provided at each coupling, to allow for differences in the heights of the carriages, and curvature of the trains.

In addition to the advantage of being able to stop the trains in so much shorter a time, a saving of 70 per cent. is stated to be found in the wear of the tyres; this saving in wear is effected by not having to skid or stop the revolution of the wheels, so as to cause them to slide on the rails. Trains are being also fitted up with the connections running under the carriages, but the principle is the same; the connection underneath being sometimes preferred as more convenient for carrying it past carriage-trucks, horse-boxes, &c.; if the connection is to be carried over the tops, the carriage-trucks require a frame at each end to support the rod: the connection can easily be taken over the horse-boxes. The breaks need not be applied to every vehicle in the train, if desired, the coupling-rod only being required to be continued throughout the train, which then acts as a perfect signal for communication between the guard and engine-driver when there is danger of a collision.

The following objects are proposed to be obtained in this break :—

1st.—A direct communication between the engine-driver and the guard ; and it has to be observed that this communication is always available by either party, in the event of a sudden and unexpected discovery of danger or obstruction upon the line, and this accomplished, not by ringing a bell or blowing a whistle, where time is lost before the break can be applied, but by an instantaneous application of the break itself, or rather the whole of the breaks, which in every case is the first intimation of the presence of danger, and the remedy to avert its occurrence. This appears to be an important feature in the plan, it is easy of application, and probably the best signal that can be made between two officers of such responsibility as the driver and guard. In the experimental trial of this break, this was an important feature, and one that could not be mistaken at the moment the breaks were liberated ; the check (it could not be called a shock), was so distinctly felt, as to arouse the attention of less vigilant persons than guards and drivers, who are, or should be, constantly on the look-out.

2nd.—The instantaneous and simultaneous application of the break to every carriage in the train ; and the immediate application of a retarding power to a body of such magnitude as a train in motion, and that without endangering its security, is an advantage of great importance in this plan. The breaks are not screwed against the peripheries of the wheels, as is done in the usual way by the guard in the carriages, and the fireman on the tender ; but the whole of the breaks (even if 30 in number), are dropped at once upon the wheels, and by the expanding force of the springs in the vertical tubes, the effect is such as to act as a signal from the driver to the guard, or *vice versa* from him to the driver ; no time therefore is lost, and the retarding force is in operation upon every carriage at one and the same time, and by this operation a few seconds only are required to reduce the velocity and absorb a considerable portion of the momentum of the train. This simultaneous action is therefore of the utmost importance, particularly in the event of a threatened collision, which by this means, if not totally averted will assuredly be greatly mitigated in its effects.

3rd.—The power which either the engine-driver or the guard have together or separately to sledge the train, or to increase or diminish the pressure on the breaks. In applying this plan of breaks to a railway train, particular care is required in the first instance when the train is marshalled, to regulate and adjust the breaks upon each carriage, so as to give neither more nor less than the required pressure. This it will be observed is a constant quantity, and the remaining pressure when required must be applied by the driver or guard; and as time is an element in this application there is the less danger of its being injuriously applied, even when extended to the limit of sledging the train, or stopping all the wheels. This power of application is however necessary, as the same amount of friction could not be applied with security to the train by the force of the spring, without incurring risk in the breakage of the wheels or axles.

The following are the particulars of the experiments made upon the East Lancashire Railway, to ascertain the retarding power of Mr. Newall's break, in stopping railway trains. The train in each case consisting of 10 carriages, besides the engine and tender, with a gross weight of 88 tons, including the engine and tender.

No. of Experiment.	Descending Gradient.	Speed of Train when Breaks were applied.	Distance run after Breaks were applied.	Remarks.
1	1 in 532	38 miles per hour	218 yards	Rails moist & slippery
2	Level	33 " "	100 "	Bury, rather doubtful
3	1 in 38	45 " "	430 "	Accrington Incline
4	1 in 40	48 " "	371 "	Ditto ditto
5	Level	48 " "	192 "	Blackburn, two wheels
6	Level	40 " "	138 "	Ditto, five do. [sledged
7	Level	50 " "	310 "	Ditto
8	Level	42 " "	620 "	Blackburn, 3 wheels sledged
9	Level	40 " "	800 "	Ditto

The experiments 1 to 7 were made with 8 of the carriages in the train fitted with Newall's break, besides the ordinary tender break; and the experiments 8 and 9 were made with ordinary breaks, 2 carriages being fitted with them in No. 8, and 1 in No. 9.

In the experiments 5 to 9, more particular care was taken to ascertain the speed by time and distance, and the moment at which the breaks were to be applied was marked more definitely by the explosion of a detonating signal at the point fixed.

The general result of these experiments appears very favourable to Mr. Newall's break, as to the efficiency of its retarding power compared with those in ordinary use. At 40 miles an hour, upon a level, with the improved break the train was brought up in a distance of 138 yards, but with the ordinary breaks, at 42 miles an hour, 620 yards was run over before the train could be stopped; or in other words a railway train can be stopped in one-fourth the distance.

Another plan has been proposed by Mr. Samuel Newton, of Stock port, for attaining the same object of putting on the breaks in the train by self-acting means. To accomplish this a friction-wheel, 2½ feet diameter and 10 inches broad, is proposed to be fixed on the centre of each axle; this friction-wheel is to be surrounded with an ordinary clamp break, such as is generally used in connection with cranes, consisting of an expanding steel ring, lined internally with wood. One end of this break-ring is fixed to the carriage frame, and to the other end is attached the short arm of a lever, so that when the long arm of the lever is raised the ring is by this motion enlarged a little in diameter to allow the friction-wheel to revolve within it without being touched. The long arm of the lever from the front axle approaches that from the hind axle, and both meet under the centre of the carriage; here the levers are joined by a bolt with a slide, so that they may rise and fall together. A weight is then attached, the tendency of which is to depress both levers, and to cause their respective short arms to collapse each break-ring tightly round the friction-wheel, and thus arrest its revolution, and with it that of the axle and wheels. This is proposed to be the arrangement for every carriage, the weight on the levers between each pair of wheels being about 120lbs. By force of gravity the breaks will apply themselves, and the power to be exerted must be for the purpose of taking them off. This is proposed to be done by the pull of the engine, by means of a metal rod with joints, which passes under all the carriages in a train, and is placed in connection with the weighted levers. The first end of this rod is to be joined to the tender, and when the engine starts it will draw out the rod so as to lift up all the levers, and thus release the breaks from the friction-wheels, and keep them clear so long as the engine continues its tension upon the draw-bar. By this arrangement it is contemplated by the inventor, that in order to stop the train it will simply be necessary to arrest the speed of the engine, and that the draw-bar will then slide backwards by the action of the weights, which will at the same time depress the levers and apply the breaks.

In another plan for accomplishing a similar object, recently proposed by Mr. Alfred Molson, of London, the application of the breaks is proposed to be effected by means of a break-bar sliding longitudinally under each carriage, acting on the levers of the break-blocks, and projecting at each end of the carriage as far as the buffers, so as to come in contact with the ends of the break-bars of the adjoining carriages.

On a check being given to the engine, and its speed being retarded by applying the break to the tender, the hindmost carriages of the train will press on those preceding them, and the springs of the ordinary buffers giving way, the train will be thereby shortened some inches while the break-bar of each carriage remaining of its original length, and resisting the advance of the carriages behind, it will follow that the last two or three carriages will have the breaks put on before even the guard in the van has turned the handle of his break.

The two latter plans not having been yet tried, except in models, no practical results can be given, and they have been named with the view of bringing under the consideration of the members the important subject of the prevention of collisions of railway trains, by increasing the retarding power of the breaks.

A large working model of Mr. Newall's Railway Break was exhibited and shown in action; also a model of Mr. Newton's Break.

The Chairman observed that he had been much struck with the very prompt and instantaneous action of Mr. Newall's break when he witnessed the recent trial of it upon the East Lancashire Railway; it would be an important auxiliary in preventing collisions if the means were always at hand for stopping the trains in so short a distance, and this break appeared well suited for the purpose, if it did not get out of order, and was not too expensive.

Mr. Perring said he had observed the working of these breaks during three months' daily work on the East Lancashire Railway, in which time they had travelled 9400 miles between Manchester and Colne, with 4811 stoppages, being stopped at a station every two miles. There had been no case of the breaks being out of order during this trial, and they had been found to work quite satisfactorily and efficiently; he had recently examined them and found the whole apparatus was standing well; the break-blocks were worn down much less than usual in the time, on account of the greater number of them that were in action at once, and the wheel tires were found to have worn only about 1-10th of an inch in the time, as shown by the templates of the tires exhibited. There were three trains running with these breaks on the East Lancashire Railway, and he should be glad to show them in operation to any of the Members who might wish to examine their action.

The Chairman inquired what would be the expense of applying Mr Newall's plan to the present railway carriages?

Mr. Newall replied that the cost of applying it to the present break-carriages would be about £9 per carriage; but he did not think the extra cost would exceed £5 per carriage in the case of building new stock.

The Chairman observed that the principle of the break had certainly a great advantage in the promptness with which the breaks in the train could be all put on simultaneously, either by the guard or the engineman in the moment of emergency, as the springs had only to be released at the moment the breaks were required, and there was always plenty of time afterwards for drawing them up again. The break handle also gave the means of direct communication between the guard and the engineman, free from interruption.

He inquired what would be the cost of Mr. Newton's break? and how he proposed to provide for backing a train without causing the breaks to be put on? He did not see how that could be accomplished by his plan.

Mr. Newton replied that he thought the extra cost would not exceed £3 per carriage. When the train was backed there would be a means required for holding the draw-bars so as to prevent the breaks being put on, also to give the guard the means of putting on the breaks; the plan had not been completed yet in this respect, but he thought it was practicable to accomplish the object.

Mr. Dyer remarked that there would be a disadvantage in having a weight instead of a spring for acting on the break, as there would be the weight to be carried, and its action would not be so steady as a spring.

He proposed a vote of thanks to the Chairman for his paper, which was passed; and to Mr. Newall and Mr. Newton for the models they had brought before the meeting.

Mr. Cowper proposed a vote of thanks to the Council of the Royal Institution for their kindness in granting the free use of their Lecture Theatre for the meeting.

The motion was seconded by Mr. Jones, and passed.

The meeting then terminated.

The following paper, by Mr. Andrew J. Robertson, of London, was read at a previous meeting (see Proceedings, Institution of Mechanical Engineers, 1853, p. 72), but the publication has been delayed in consequence of the absence of the author from the country.

NEWALL'S RAILWAY BREAK.

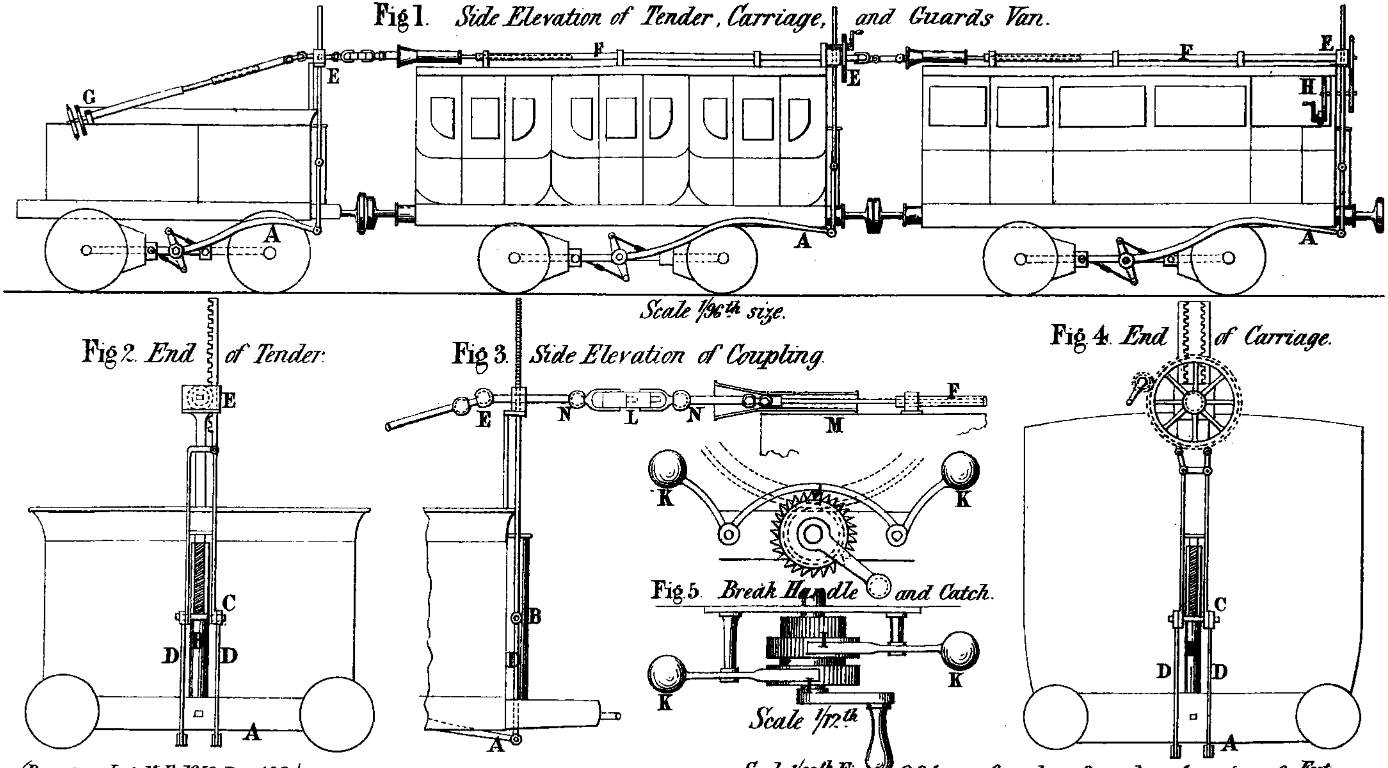

Fig 1. Side Elevation of Tender, Carriage, and Guards Van.

Scale 1/96th size.

Fig 2. End of Tender.

Fig 3. Side Elevation of Coupling.

Fig 4. End of Carriage.

Fig 5. Break Handle and Catch.

Scale 1/12th

Scale 1/48th Figs. 2.3.4. 0 1 2 3 4 5 6 Feet

(Proceedings Inst. M.E. 1853, Page 158.)