THE PECULIAR FEATURES OF THE ATMOSPHERIC RAILWAY SYSTEM

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ATMOSPHERIC RAILWAY SYSTEM.

BY

GEORGE BERKELEY, Assoc. Inst. C. E.

WITH AN ABSTRACT OF THE DISCUSSION UPON THE PAPER.

EXCERPT MINUTES OF PROCEEDINGS

OF THE

INSTITUTION OF CIVIL ENGINEERS.

LONDON.

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INSTITUTION OF CIVIL ENGINEERS.

April 15, 1845.

SIR JOHN RENNIE, President, in the Chair.

No. 716. "The peculiar features of the Atmospheric Railway System." By George Berkeley, Assoc. Inst. C.E.*

When it is considered expedient to appoint a Committee of the House of Commons, to report upon the merits of the atmospheric system, it is fit that such facts relating to it, as have been clearly ascertained, should be presented to, and be discussed by the leading Members of the Institution, in order that the body of the profession may form a correct estimate of its real importance; and that the discovery and the development of truth may be promoted, by the influence of a more generally prevailing opinion amongst them.

The introduction of so important and comprehensive a subject, by so young a member of the profession, may be thought to require an apology, but the author having been connected with the early progress of the invention, under the late lamented Mr. Jacob Samuda, (Assoc. Inst. C. E.) and having since, in conjunction with Mr. Marshall, been entrusted by Mr. Robert Stephenson, with the responsibility of carrying out his instructions, in trying the series of experiments for his Report, will it is hoped acquit him of presumption.

It is proposed in this paper, to submit to the consideration of the Members of this Institution, questions and facts which are generally received, and whilst abstaining from giving any personal opinion, to induce a discussion among the senior members of the profession.

* The discussions upon this paper extended over three evenings, but an abstract of the whole is given consecutively for the sake of facility of reference.

Before entering directly upon this subject, it is necessary to free it from the influence, which has been used to insure the belief of its great advantages, and its general adoption, by the fact of two eminent engineers being connected with it.

It may be asked whether these gentlemen are pledged to support its general adoption.

It is certain, that by one (if not by both of them), its application has only been sanctioned to lines of railway, presenting peculiar features, and at the same time, it is recommended, that the gradients, weight of rails, &c., should be such, that if from any cause, it should be necessary to revert to the locomotive system, facilities should be presented for doing so.

If they have so completely decided in its favour, why should they so partially adopt it, and sacrifice some of those which are termed its chief advantages?

The mechanical difficulties in the application of the atmospheric system, are perhaps the least important for consideration, as it may be assumed, that the experience and ingenuity of mechanics will overcome them; but as the late discussion* was terminated, before these were fully discussed, they should be briefly noticed, in order to elicit further remarks on the subject, as well as some description of the means now being adopted for overcoming these difficulties.

Some uncertainty and difference of opinion appeared to exist, with regard to the facilities of working the traffic, both in terminal and intermediate stations, and the necessary arrangements at level crossings.

At terminal stations, where the goods or mineral traffic is large, a locomotive engine is now required to do the work, but it is also usefully employed as a "pilot" engine on the main line.

Some kind of power will still be necessary at such stations, but if different from the power employed on the main line, it cannot be there used with equal convenience or economy.

At intermediate stations, the waggons are now "shunted" to their proper places, in a siding, by the engine which has propelled them along the main line.

Can this be effected by the atmospheric system? If not, must not additional power be here employed, either in the form of manual labour, horse, or engine power? and this, in addition to the risk of accident, from leaving waggons in the main line?

One of the patentees stated in the late discussion, that at level

* Vide Minutes of Proceedings, 1845, p. 143.

crossings, by means of a cylinder and piston, a barrier would be raised;* from this it may be presumed, that the cylinder and piston and barrier are connected by mechanism.

It has been proved by experience, that little inconvenience, and no danger, exists at level crossings, when a man is employed, and he has only to open and shut a gate; but it is doubtful whether this would be equally true, when, between his intention and the effect, there is the efficient working of a train of mechanism, which probably he does not understand.

Again, this complex arrangement, to effect what is usually done by the most simple means, will be costly.

In many instances, level crossings have been avoided by some of those who have sanctioned the system, at the cost of a bridge with approaches, which is a great addition to the expense of the construction of the line.

Some other important points naturally suggest themselves, which, as they are cited by some, as advantages belonging to the new system, and are not admitted, as such, by others, may be beneficially discussed.

Running trains much more frequently, has been considered essential to secure the advantages of the atmospheric system.

On long lines of railway, the distance each person travels, is as important as the number of travellers.

There is always some uncertainty, as to the number that will be found at the various stations.

Each train must be equal to convey all.

Will not therefore the gross weight be increased in a greater proportion than the nett weight of passengers? From this a loss of power must arise.

Would the running of very frequent trains, on long lines, be a convenience equivalent to the loss and increased expense consequent upon it?

The case is different on short lines, where the number of passengers is large, and the character of the traffic simple.

It must be granted, that the increased number of trains would be, and are justified, and that great convenience results from them.

It has been stated by the advocates of the atmospheric system, and has been admitted by some who do not adopt it, that a greater speed has been attained by its adoption, but with the attendant contingency of greater cost.

The greatest speed observed during the series of experiments, pub-

* Vide Minutes of Proceedings, 1845, p. 143.

lished in Mr. Robert Stephenson's Report, was between 36 miles and 40 miles per hour, with a train of 26·5 tons. It is known that locomotives, with trains of double this weight (though on better gradients), have attained velocities varying from 50 miles to 55 miles per hour.

The velocity that would be theoretically attained, with the apparatus at Dalkey, supposing no leakage or other loss to interfere, would be little more than the highest of these, or about 60 miles per hour.

Under these circumstances, it is clear, that to maintain higher velocities on the atmospheric, than with the locomotive system, more power must be employed than is now used at Dalkey, or about 200 H. P. for 1¼ mile.

The leakage, which influences the velocity of the train, will be greatly increased, by extending the length of the pipe to 3 miles or 4 miles, as proposed, and this will also augment the amount of power, that must be employed, before the advantage of greater speed can be realized.

Does this justify us in expecting, that greater velocities will be maintained by the atmospheric, than by the locomotive system, or are those who differ from this opinion, correct in stating, that it must be attended with an expense so inordinate, "that it is just as bad as being mechanically impossible?"

To obviate the enormous first cost of a double line of atmospheric apparatus, it is proposed and stated, as an advantage peculiar to the system, that a single line of rails may be adopted, and that such would prove sufficient.

The impracticability of this is clearly shown in Mr. Robert Stephenson's report, when applied to a line of 112 miles in length, with trains every half-hour, and a mean velocity of 30 miles per hour is maintained, by the fact, that "the total time of the journey would be increased to 10 hours," in consequence of the delays, occasioned by one train waiting, till it had met that which was coming in the opposite direction, and the pipe was exhausted so that it could proceed.

On shorter lines, perhaps these obstructions would not be so objectionable; but it would be as easy for locomotives to follow each other, with trains every half or quarter of an hour, and when arrived at a station, to wait till the train in the opposite direction had passed.

The only reply to this, is in the words of Mr. Brunel, who says, "I have no doubt that the atmospheric, upon a single line, is considerably safer than a locomotive on a single line, which I do not think safe."

With regard to the safety of single lines worked by locomotive power, the Yarmouth and Norwich Railway, which is a single line of 20 miles in length, has worked safely for nearly 12 months. The Northampton and Peterborough Railway also, which is a single line of nearly 50 miles in length, has been sanctioned by Committees of the legislature, under the strongest opposition of land-owners perhaps ever known.

There is no reason why the latter system should not be as safe as the former; the same agent (man) is employed in both cases. By the agency of the electric telegraph, an instantaneous and unerring communication is carried on.

Can it be supposed that a man who is responsible for the act, will start an engine to come in collision with another, which he has but a few seconds before, acknowledged is coming in the opposite direction and on the same line? or, will the engineman risk his own life by disobeying his orders? The experience, of the working of nearly 90 miles of single line, on the Eastern Counties Railway, has shown this to be scarcely possible, under ordinary circumstances.

If, therefore, the experience obtained of the working by locomotives of single lines, has given no cause to call them in any way unsafe, and if reason demonstrates, that they present almost perfect security, what is the foundation for this opinion of their insecurity?

With respect to the additional safety, arising from tieing down the carriage, in the centre of the line. The question suggests itself, will the carriage be tied down, when passing over points and crossings, where there is almost the only liability of running off? or if it be so, is it an advantage?

Is not the chance of collision at sidings, which are worked only by momentum, greater, than where there is the control of a locomotive engine? and are not these the places where the greatest, if not the only liability of such collisions, exist?

It is said, that the comfort of passengers will be enhanced, by the adoption of the atmospheric system; that they will not be annoyed by the dust and noise, which they now experience. That small portion only which is due to the locomotive engine will be got rid of, and how small that portion is, can be well estimated, on any line which traverses a sandy district.

The power of stopping the train is considered by some "greater on an atmospheric than on a locomotive line." Does not the power of stopping, as well as the momentum increase with the gravity?

By removing the engine and tender, the weight which is the most concentrated and therefore the most economically and efficiently

applied, is removed. In the case of the atmospheric railway, the moving power as well as the momentum must be overcome by the gravity of the train, which will be divided into many parts, and must therefore be applied by many hands, while with the locomotive, the moving power, as well as the more concentrated effect of gravity, will have to overcome only the momentum.

If, with the atmospheric system, a greater number of hands must be employed, to produce the same proportionate effect of adhesion, to overcome the momentum, where are the advantages in this respect?

Having thus briefly stated some of the principal points mooted in the working of railways, it is necessary to introduce the first cost of construction and the expense and facilities of maintenance.

The discussion of this part of the subject must be interesting, not only as it involves the most important subjects for consideration, but also, because those engineers who have let contracts for its application, to lines of railway, on which they are professionally engaged, will be able to afford information respecting its first cost; and others, who have had experience and are well informed of the cost and facilities of maintaining locomotive lines, can give opinions, which may be depended on, concerning the comparative advantages which will be afforded in this respect, by the application of the atmospheric system.

In a country where surface lines can be made, it appears to be agreed, that the application of the atmospheric apparatus occasions a considerable additional outlay; for instance, in the case of the Yarmouth and Norwich railway, the interest of the necessary additional outlay, would be nearly equal to the whole working expenses of the line, and would very considerably exceed the cost of locomotive power.

Before considering the first cost, when the system is applied in a country of a rougher character, it is essential to determine, what advantages it presents in overcoming worse gradients, than exist on locomotive lines; as it has been stated, that the saving by diminishing the works, (in consequence of good gradients not being required,) is equivalent to the extra cost of the apparatus.

Where bad gradients exist, on locomotive lines, the gravity of the engine and the train, due to the incline, has to be overcome, in addition to the friction and the resistance of the atmosphere.

The power of the engine is applied, as tractive force, to the train, by means of the adhesion of the periphery of the wheels to the rails, and when the gravity, due to the angle of the incline, is very great, the adhesion is not sufficient to overcome it; but as the present weight of the engines is great, and is all applied to produce adhesion, it is fully