CALCULATIONS

AND

REMARKS,

TENDING TO PROVE THE PRACTICABILITY,

EFFECTS AND ADVANTAGES

OF

A PLAN

FOR THE

RAPID CONVEYANCE

OF

GOODS AND PASSENGERS

UPON AN IRON ROAD

Through a Tube of 30 *Feet in Area,*

BY THE

POWER AND VELOCITY

OF

AIR.

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CALCULATIONS, &c.

THE great velocity of Air through an aperture, or tube, has hitherto been but little noticed, although the effect, from the extreme lightness of that body, and the well-known laws of motion, must have been manifest by observation or the least reflection upon the subject.

It may be made manifest by an experiment with a pair of common bellows, by comparing the quantity of Air that escapes in a given time with the aperture through which it passes, by which it will appear, that Air may be driven with a velocity of 200 feet in a second by the pressure of the hand. And if an experiment is made with due precision by an instrument contrived for that purpose, it may be proved that Air will pass through a tube with a velocity of 200 feet in a second, by a pressure of 134lb. per square foot,

and 73 feet in a second, or 50 miles per hour, by a pressure of 250 ounces per square foot.

Of the power of Air in forcing heavy bodies through a tube, there is abundant proof; it may be clearly seen and very strongly exemplified in the air-gun, and still more forcibly in a piece of artillery, where balls of immense weight are instantaneously forced into such rapid motion, merely by the strength of the Air, a velocity that is more than twenty times greater than is required for this purpose, and for which the force of the Air, in so small a tube, must be at least 40,000 times greater than what is necessary to drive a ton weight by a regular impulse fifty miles in an hour, through a tube of 30 feet area.

In order to apply this principle to the purpose of conveying goods and passengers from place to place, an hollow tube or archway must be constructed the whole distance, of iron, brick, timber, or any material that will confine the air, and of such dimensions as to admit a four wheeled carriage to run through it, capable of carrying

passengers, and of strength and capacity for large and heavy goods. The tube must be made air tight, and of the same form and dimensions throughout, having a pair of cast iron wheel-tracks securely laid all along the bottom, for the wheels of the carriage to run upon. And the carriage must be nearly of the size and form of the tube, so as to prevent any considerable quantity of Air from passing by it.

If the Air is forced into the mouth of the tube behind the carriage, by an engine of sufficient power, it will be driven forward by the pressure of the Air against it; and as the Air will be continually driven into the tube, the pressure against the carriage, and consequently its motion, will be continually maintained through the whole length.

The interior dimensions of the tube to answer the purpose of internal conveyance effectually, should be 6 feet high, and 5 wide, 30 feet in area. This will admit a carriage sufficiently large for passengers, and in general for all portable goods.

And in order to convey both ways at the same time, it will be necessary to have two tubes of the same form and dimensions, one to convey constantly one way and one the other.

There will be no necessity for the carriage to fit very precisely to the tube, so as to be worn away by the friction against it, or to increase the resistance of the carriage; for if there is one inch of open space all round, between the carriage and the sides of the tube, the quantity of Air that will escape through that opening will not exceed the twenty-fifth part of the whole that is forced in, and which may effectually be compensated by increasing the power of the engine in the same proportion.

A carriage, running upon wheels that are accurately fitted upon their axle, and truly circular, having an even and horizontal iron road for the wheels to run on, will be driven by a force that is equal to one twentieth part of its own weight; therefore, if a loaded carriage weigh three and a half tons, it will be driven by a force that is equal to 392lb. which, in a tube of 30 feet area,

is 209 ounces per square foot; consequently, if the road rises above the horizontal line one foot in twenty, it will require a double force; and all intermediate degrees of inclination will require a proportional increase of force; and therefore, if the road rises 100 feet in a mile, the impelling power upon the carriage must be equal to 536lb. which, in a tube of 30 feet area, will be 286 ounces per square foot.

If the tube is six feet high within side, it will admit of the carriage wheels to be 5 feet 10 inches in diameter, which must turn four times round in a second to go fifty miles per hour; and if they are truly circular, and accurately fitted upon their axis, and the iron road clean, even, and regular, the motion of the carriage, without the aid of springs, will be nearly as smooth and steady as a boat upon a canal, and consequently a less degree of strength and weight will be required in the carriage than what is necessary for carriages that run upon a common road.

The force necessary to drive the Air 73 feet in a second, or 50 miles an hour, being 250 ounces

per square foot, it will be 469lb. in a tube of 30 feet in area; and the force necessary to impel a carriage of the weight of three and and a half tons, upon an horizontal line, being 392lb. the impelling power must be equal to 861lb. and the quantity of Air driven into the tube to move fifty miles per hour will be 2200 cubic feet per second.

An impelling power of 861lb. moving 73 feet per second, is equal to the continual power of 180 horses, and will be maintained by a steam engine, consuming twelve bushels of coals per hour, and therefore three tons weight of goods will be conveyed fifty miles for twelve shillings, which is something less than one penny per ton per mile, and the time required to go that distance will be one hour.

A tube of these dimensions, with engines sufficiently powerful, will be capable of conveying 700 tons of goods each way in twenty-four hours; and if the carriages carry three tons of goods each, they may proceed after each other at five miles distance. If the impelling engines are placed on the road at ten miles distance from each other, their power to impel this weight of goods

must be equal to 260 horses upon each tube, equal to the consumption of seventeen bushels of coals per hour, which will amount to something more than a halfpenny per ton per mile, for the greater the quantity of goods conveyed, the less will be the proportional expense of conveyance.

And under these circumstances, the greatest impulse upon the carriage will be 26lb. per square foot, and the greatest density of the impelling Air within the tube will be to the atmosphere, as 2186 is to 2160, which is one eighty-third part greater, and is too small a difference to be felt with any inconvenience by persons within the tube.

All horizontal turnings of the road should be circular, that equal degrees of curvature may be made in equal distances.

And a carriage moving from a straight line through the arch of a circle, will leave the arch and proceed in a straight line that makes an angle with the first, equal to the angle sustained by the arch, and double the angle made by the chord of the arch and the first line of motion.

And if the weight of the carriage is three ton and a half, or 7840lb. and the motion 73 feet in a second, moving through the arch of a circle of 45 degrees and 73 feet in length, the carriage will impress upon every foot in length of the concave side of the tube successively, with a force equal to 122lb. and therefore, a small degree of strength in the side of the tube will be sufficient to change the direction of a carriage of this weight and velocity.

Carriages may be loaded and unloaded in the open air, and quite unconfined, and then drawn into the tube by a windlass or other mechanical means; and a carriage coming out at the end of the tube where it is intended to stop, and moving with a velocity of 73 feet in a second, will proceed upon an horizontal line in the open air 1100 feet before it will stop, and if it is made to ascend one foot in ten, it will stop in moving 470 feet; and a carriage being impelled by a tenth part of its weight, will acquire a velocity of 73 feet in a second in 48 seconds and in moving 1665 feet; and, therefore, they may be made to stop

to load and unload at any required distance with very little loss of time.

In many cases it will be practicable upon the same principle to form a tube so as to leave a continual communication between the inside and the outside of it, without suffering any part of the impelling air to escape, and by this means to impel a carriage along upon an iron road in the open air with equal velocity, and in a great degree possessing the same advantages as in passing withinside of the tube, with the additional satisfaction to passengers of being unconfined, and in view of the country.

Such a tube made of iron of twelve inches in diameter, having a moving box or piston to fit and move freely within side, and made to communicate by a particular contrivance through the side of the tube to the carriage without, it will be impelled with the same force and velocity as before described by the internal Air, when it acquires, by the power of the engine, the density of 3*lb.* 6*oz.* per square inch.

And the quantity of Air necessary to obtain this

degree of force and velocity in a tube of these dimensions, will be 121,887 cubic inches per second; and the power of the impelling engine must be one-fourth greater on account of the greater density of the Air in so small a tube.

In this case also the force and direction of the wind will have very considerable effect upon the carriage moving with such great velocity through the Air, which at times, with the same impelling power, may amount to as great variation in the motion as 4 to 1.

But where carriages are continually passing both ways at the same time, this variation will, in a great measure, be compensated, since the same body of Air that impels them one way may be applied again to impel them the other.

The quantity of Air required in this small tube being 121,887 inches or 70 cubic feet, is only the one thirtieth part of the quantity necessary in the large tube, and, consequently, only the one-thirtieth part of the power is necessary to impel the air through the tube: but this is no

advantage, for the same power that in the first case is requisite to impel the Air through the tube, must in the second be applied to impel the carriage through the atmosphere. And, upon the whole, the quantity of impelling power in this case, and, consequently, the expense of conveyance must be greater, and the difficulty of execution will be greater, and the regularity in point of time will be subject to greater variation; but at the same time this mode will admit of a very great advantage in convenience and accommodation.

Although the Air is not the first cause of the motion, in either case, as it must itself be forced through the tube by the power of the engine, but is the intermediate agent by which the carriage receives its motions, no other body in nature or any mechanical contrivance, is capable of being so advantageously applied to the purpose; as from its lightness, it is capable of such velocity by so small a force, and as it is always present in all places for the application, and is never impaired or rendered unfit for the performance; and because it will follow the moving body in all di-

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The principal advantages attending the mode of conveyance will be,

First. Passengers may be conveyed to the greatest distance through the country with ease and great safety at the rate of a mile in a minute, or fifty miles per hour upon an average, and at the expense of one farthing per mile.

Second. All kind of portable goods, merchandize, manufacture, and produce, will be conveyed with the same velocity, at the expense of one penny per ton per mile conveyance.

Third. The conveyance cannot be obstructed or impeded by frosts, snow, floods, or drought, nor endangered by robbery, by darkness, or the weather.

Fourth. No locks or other obstructions will be required in the passage, for the force of the impelling Air will be sufficient to gain an ascent of 100 feet in a mile continually.

Fifth. Artillery, troops, baggage, and stores, may be conveyed with the same rapidity, safety, certainty, and expense; and live cattle will be enabled to pass through the country without labour, and at a very small expense for carriage or for food.

Sixth. Fish may be brought from the coast in a perfect state, and all perishable goods will be brought to market from their native soil and in their native purity.

And the mails may be conveyed at a very small expense, for the weight of 200,000 letters will not exceed one ton, and they may be delivered twice a day at 400 miles distance.

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For the purpose of carrying this invention into execution upon a productive and suitable scale, Subscribers' names will be received and registered by the Inventor, G. MEDHURST. For raising a subscription of an adequate sum, in 50l. shares, to be appropriated to the purpose in a manner to be determined on by a meeting of one hundred of the first Subscribers, when the different plans and estimates will be submitted to their consideration.

THE END.

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