F. H. SHEPARD.

AUTOMATIC BRAKING OR SIGNALING SYSTEM.

APPLICATION FILED FEB. 20, 1906.

910,590.

Patented Jan. 26, 1909.

Fig. 1.

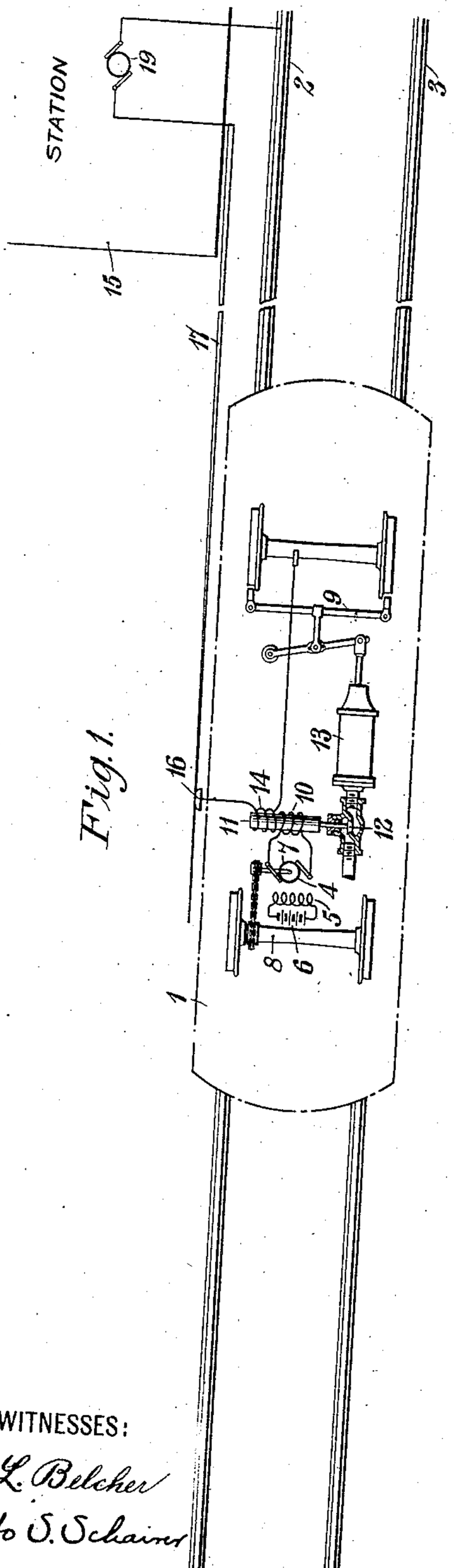
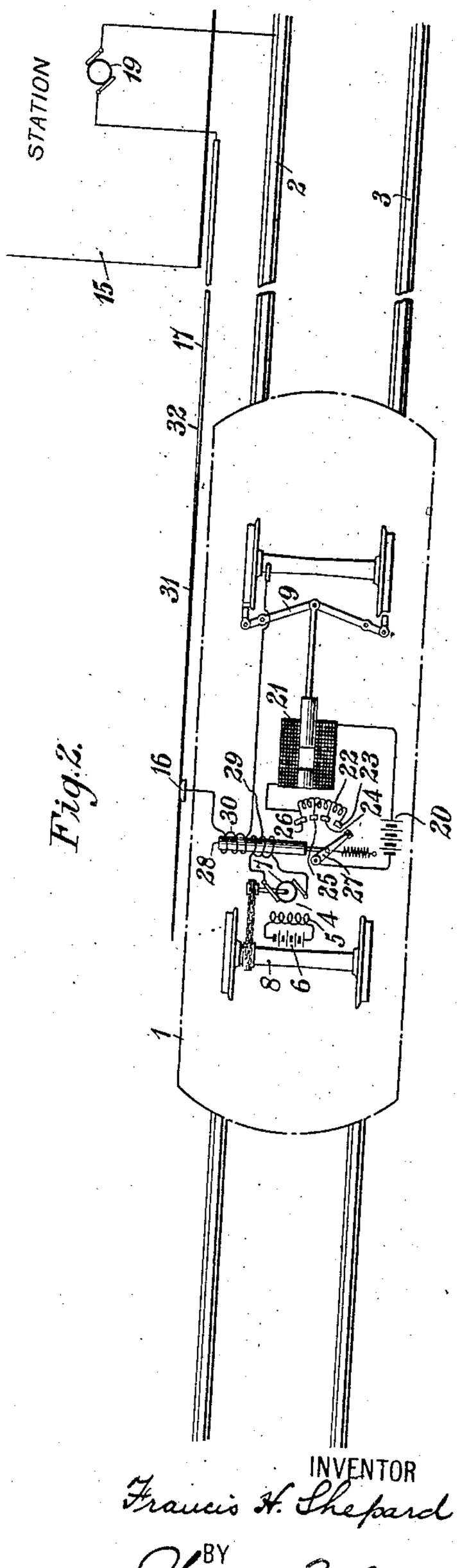


Fig. 2.



WITNESSES:

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AUTOMATIC BRAKING OR SIGNALING SYSTEM.

No. 910,590. Specification of Letters Patent. Patented Jan. 26, 1909.

Application filed February 20, 1906. Serial No. 302,116.

To all whom it may concern:

Be it known that I, FRANCIS H. SHEPARD, a citizen of the United States, and a resident of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Automatic Braking or Signaling Systems, of which the following is a specification.

My invention relates to means for effecting operative relations between relatively moving parts, such, for instance, as the control of a moving vehicle by instrumentalities located along a railway track, and it has for its object to provide novel and improved means of the character indicated.

The general plan of my invention is to employ two or more electromotive forces, one carried by the moving vehicle or body and the other located along its path or route, and, by varying and correlating the same, to secure a resultant force of such value as to set mechanisms in operation for producing any required prearranged result.

My invention is especially useful for and may be conveniently described in connection with the operation of brakes for railway trains, although it will be understood that it may have many other applications, and that the specific use described is not to be regarded as restrictive.

In operating a railway train such, for instance, as those used in the New York subway, much time is lost at the stations by the stopping of the trains, the engineer being compelled to estimate the distance within which he can bring the train to a standstill in order to avoid accidentally running past the station. In so doing, the engineer usually errs upon the safe side and not only commences to stop the train sooner than is necessary, but graduates the stop unevenly and consumes considerable time in moving slowly along the platform through a considerable distance before the final stop. It is also a well known fact that large amounts of energy are wasted in braking trains and that, in systems where frequent stops are made, this waste of energy may represent no inconsiderable portion of the total energy required to operate the system. It can easily be shown that the amount of energy required to operate a train is a minimum when the acceleration in leaving one station and the retardation in approaching another are uniform and the maximum that is consistent with the comfort of passengers; that is, the least amount of power is consumed in accomplishing a given schedule speed when the difference between the maximum and the schedule speeds is a minimum. Means have heretofore been applied in the control of trains for automatically causing maximum and uniform acceleration, with marked results in the saving of power. According to my present invention, means are provided whereby maximum and uniform retardation may also be effected automatically, and regardless of the speed of a train, when the brakes are applied, and also whereby a train may be stopped at a prescribed place, such as a station platform, without such losses of time as are at present experienced.

Figure 1 of the accompanying drawing illustrates diagrammatically a system embodying my invention, and Fig. 2 is a modification of the system shown in Fig. 1.

My invention may be conveniently applied to a railway vehicle 1 that operates upon track rails 2 and 3 and upon which is located an electric generator 4, having a constant magnetic field produced by a winding 5 and a constant potential exciter therefor, such as a storage battery 6, or by any other suitable means, such, for example, as a permanent magnet and the armature 7 of which is operatively connected to an axle 8, whereby its speed and consequently the electromotive force of the generator are caused to vary with the speed of the vehicle. The electromotive force of the generator 4 may be utilized in controlling the application of brakes 9 of the vehicle, and as shown in Fig. 1, it is applied to a winding 10 of an electromagnet 11 that controls the position of a valve 12 whereby the supply of fluid-pressure to a braking cylinder 13 is governed, or it may control any other suitable means for applying the brakes. The magnetizing effect of the winding 10 is insufficient, of itself, to open the valve 12 and for that reason it is supplemented by that of another winding 14 when the vehicle approaches a station 15 or any other regular stopping place. One terminal of the winding 14 is adapted to be connected to the track rail 2 and a contact shoe 16 serves to connect the other terminal to an auxiliary rail 17 that parallels the track rails at the approach to a station, the rails 2 and 17 being supplied with energy from any suitable source, such as a generator 19. The

auxiliary rail 17 extends outward from the station such a distance that, by the application of the brakes, a train may be brought to a stop from its maximum speed at the station. The track circuit is so arranged that the difference of potential between the rails 2 and 17 decreases as the distance from the station increases, the length of the conductor or variation in its cross-section or any other suitable means being depended upon to produce such reduction in the potential difference.

For purposes of illustration, it may be supposed that; in order to open the valve 12, an aggregate of one hundred and twenty volts must be applied to the windings 10 and 14 and that when the train is operating at a speed of forty miles per hour the voltage applied to the winding 10 is one hundred volts. Then, if the vehicle approaches the station at the rate of forty miles per hour and the contact shoe 16 engages the auxiliary rail 17, the valve 12 will not be opened and the brakes will not be applied until twenty volts are derived from the rails 2 and 17 and applied to the winding 14. If the train approaches the station at a greater speed than forty miles per hour, the voltage applied to the winding 10 will be more than one hundred and it will then be necessary to apply less than twenty volts to the winding 14 in order to cause operation of the valve, and consequently the brakes will be set at a greater distance from the station than when the train is operating at forty miles per hour. If the vehicle approaches the station at a slower speed than forty miles per hour, the voltage of the generator 4 will be less than one hundred and that applied to the winding 14 will not be sufficient to make the aggregate one hundred and twenty volts until the vehicle has approached closer to the station than when it was traveling at the speed of forty miles per hour. It is evident, then, that the potential existing between the rails 2 and 17 along the route may be so adjusted that the brakes will be applied automatically at just the proper distance from the station to bring the vehicle to a standstill at the prescribed position.

It has been found in practice that the application of a constant force to the brakes of a vehicle will cause varying rates of retardation, depending upon the speed of the vehicle at the time the brakes are applied; that is, the force which will produce the desired rate of retardation when operating at forty miles per hour, for instance, will not cause the same rate of retardation if applied when the train is operating at sixty miles per hour. As has already been pointed out, the greatest efficiency of operation is secured and the least time is wasted in bringing a train to a stop when the rate of retardation is uniform, as well as the maximum consistent with the comfort of passengers. For this reason, I further propose to vary the force applied to the brakes in accordance with the speed of a vehicle at the time the brakes are applied in such a manner as to secure substantially uniform retardation.

Referring to Fig. 2, the amount of current which may be supplied from a suitable source, such as a storage battery 20, to an electro-magnet 21 may be varied by means of a rheostat 22, whereby the force with which the brakes 9 are applied may be caused to vary accordingly. The rheostat comprises a plurality of conducting segments 23, 24, 25 and 26 and a switch arm 27 that is adapted to engage therewith and that is operated by means of an electro-magnet 28. Two windings 29 and 30 are provided for the electro-magnet 28, to the former of which a voltage is supplied from the generator 4, that is proportional to the speed of the vehicle and to the latter of which a voltage is supplied from the rails 2 and 17 that is dependent upon the position of the vehicle. The winding 29, even when the vehicle travels at its highest speed, is incapable, by itself, of moving the switch arm 27 into engagement with the segments 23 to 26, inclusive, but when its magnetizing effect is supplemented by that of the winding 30, the switch arm will be moved into engagement with the conducting segments, the extent of movement of the arm and the amount of resistance introduced into the circuit of the magnet 21 being dependent upon the speed of the vehicle and its position with reference to the rail 17; that is, upon the voltage of the generator 4 and the difference of potential between the rails 2 and 17 along the route. In order to secure these conditions of operation, the difference of potential between the rails 2 and 17 should increase at a slower rate than the voltage of the generator 4 decreases. Let it be supposed again that the vehicle approaches a station at the rate of forty miles per hour, under which conditions the magnetizing effect of the winding 29 is not supplemented by that of the winding 30 by a sufficient amount to cause operation of the switch-arm 27 until the vehicle arrives within a predetermined distance of the station 15; that is, not until it reaches such a point as 31, for instance. The switch-arm may then be brought into engagement with conducting segment 25. If the vehicle approaches the station at a slower speed, the magnetizing effect of the winding 29 will be less and, consequently, that of the winding 30 must be greater than when the vehicle is traveling at the rate of forty miles per hour to cause operation of the switch-arm 27, and consequently the brakes will not be applied until the train has arrived within a shorter distance of the station 15, such as a point 32, for instance. The switch-arm may then be

brought into engagement with conducting segment 23, the amount of resistance included in circuit with the magnet 21 thus being less and the force exerted thereby upon the brakes being greater than under the previous conditions. If the vehicle approaches the station at a greater speed than forty miles per hour, the magnetizing effect of the winding 29 will be greater and, consequently, the winding 30 must supplement it by a smaller amount than when the train travels at a speed of forty miles per hour in order to cause operation of the switch-arm. If the potential existing between the rails 2 and 17 is properly adjusted, as before indicated, the brakes will be applied with a greater force and at a greater distance from the station than when operating at forty miles per hour.

While I have shown and described specific embodiments of my invention, it will, of course, be understood that it is capable of wide variation and modifications in its application. The means here shown for applying and controlling the brakes are only illustrative of operative devices and in either or both cases described they may be operated electro-pneumatically or electro-magnetically or in some other manner by suitably constructing and arranging the parts. The invention may be utilized to control or operate other devices than brakes, such, for instance, as signals which indicate to the engineer when the brakes are to be applied.

While it has been stated that the drop of potential along the auxiliary rail may be varied appropriately by varying its length or cross-section, it will be understood that it may also be adjusted by dividing it into sections and introducing resistances between the sections, or, if desired, the sections may be supplied from sources of variable voltages. The potential of the auxiliary rail may also be caused to increase as the distance from the station increases, and the electromotive forces applied to the controlling mechanism may be caused to supplement each other, as here described, or it may be arranged so that operation of the mechanism will occur when the voltages applied to the windings are equal or bear any other suitable relation to each other.

It will be also understood that my invention is not restricted in its application to railway or other vehicles, but that it is capable of application to the control of other relatively movable bodies.

I claim as my invention:

1. The combination with a movable body and a source of electromotive force carried thereby, of a source of electromotive force along the path of the movable body and means that are dependent in operation upon the relative values of the electromotive forces.

2. The combination with a movable body and a source of electromotive force carried thereby, of a source of varying electromotive force along the path of the movable body and means that are dependent in operation upon the relation of the electromotive forces.

3. The combination with a movable body and a source of electric energy carried thereby, the electromotive force of which is dependent upon the speed thereof, of a source of electromotive force along the path of the movable body and means carried by the movable body that are dependent in operation upon the resultant of the electromotive forces.

4. The combination with a movable body and a source of electric energy carried thereby, the electromotive force of which is dependent upon the speed thereof, of a source of varying electromotive force along the path of the movable body and means carried by the movable body that are dependent in operation upon the resultant of the electromotive forces.

5. The combination with a movable body and a source of electric energy carried thereby, the electromotive force of which is dependent upon the speed thereof, of a source of electromotive force along the path of the movable body and means that are dependent in operation upon the resultant of the electromotive forces.

6. The combination with a movable body and a source of energy carried thereby, of a source of electromotive force along the path of the movable body and means actuated by said electromotive forces and dependent in operation upon the speed and the position of the movable body.

7. The combination with a movable body and a source of electric energy carried thereby, the electromotive force of which is dependent upon the speed thereof, of a source of electromotive force along the path of the movable body and means that are dependent in operation upon the position of the movable body.

8. The combination with a movable body and a source of electric energy carried thereby, the electromotive force of which is dependent upon the speed thereof, of a source of varying electromotive force along the path of the movable body and means that are dependent in operation upon the resultant of the electromotive forces.

9. In a railway system, the combination with a station, and a vehicle, of brakes upon the vehicle, and means for causing application of the brakes at varying distances from the station that are determined by the speeds at which the vehicle approaches the station.

10. The combination with a movable body and a source of electromotive force carried thereby, of a source of electromotive force

along the path of the movable body and means that are operated at varying positions of the body and that are dependent in operation upon the resultant of the electromotive forces.

11. The combination with a movable body and a source of electric energy carried thereby, the electromotive force of which is dependent upon the speed thereof, of a source of electromotive force along the path of the movable body and means that are operated at varying positions of the body and that are dependent in operation upon the resultant of the electromotive forces.

12. The combination with a movable body and a source of electric energy carried thereby, the electromotive force of which is dependent upon the speed thereof, of a source of varying electromotive force along the path of the movable body and means that are operated at varying positions of the body and that are dependent in operation upon the resultant of the electromotive forces.

13. The combination with a movable body and a source of electromotive force carried thereby, of a source of electromotive force along the path of the movable body and means for exerting forces that are dependent in value upon the relations of the electromotive forces.

14. The combination with a movable body and a source of electromotive force carried thereby, of a source of variable electromotive force along the path of the movable body and means for exerting forces that are dependent in value upon the relations of the electromotive forces.

15. The combination with a movable body and a source of electromotive force carried thereby, of a source of electromotive force along the path of the movable body and means for exerting forces that are dependent in value upon the relations of the electromotive forces and upon the positions of the movable body.

16. The combination with a movable body and a source of electromotive force carried thereby, of a source of variable electromotive force along the path of the movable body and means for exerting forces that are dependent in value upon the relations of the electromotive forces and upon the positions of the movable body.

17. The combination with a movable body and a source of electric energy carried thereby, the electromotive force of which is dependent upon the speed thereof, of a source of electromotive force along the path of the movable body and means for exerting forces that are dependent in value upon the resultant of the electromotive forces.

18. The combination with a movable body and a source of electric energy carried thereby, the electromotive force of which is dependent upon the speed thereof, of a source of electromotive force along the path of the movable body and means for exerting forces that are dependent in value upon the position of the movable body.

19. The combination with a movable body and a source of energy carried thereby, the electromotive force of which is dependent upon the speed thereof, of a source of electromotive force along the path of the movable body and means for exerting forces that are dependent in value upon the speed of the movable body.

20. In a railway system, the combination with a station, and a vehicle, of brakes upon the vehicle, and means for automatically causing application of the brakes at varying distances from the station and with varying forces, both the distances and forces being dependent upon the speeds at which the vehicle approaches the station.

In testimony whereof, I have hereunto subscribed my name this 31st day of January, 1906.

FRANCIS H. SHEPARD.

Witnesses:

WESLEY G. CARR,

BIRNEY HINES.