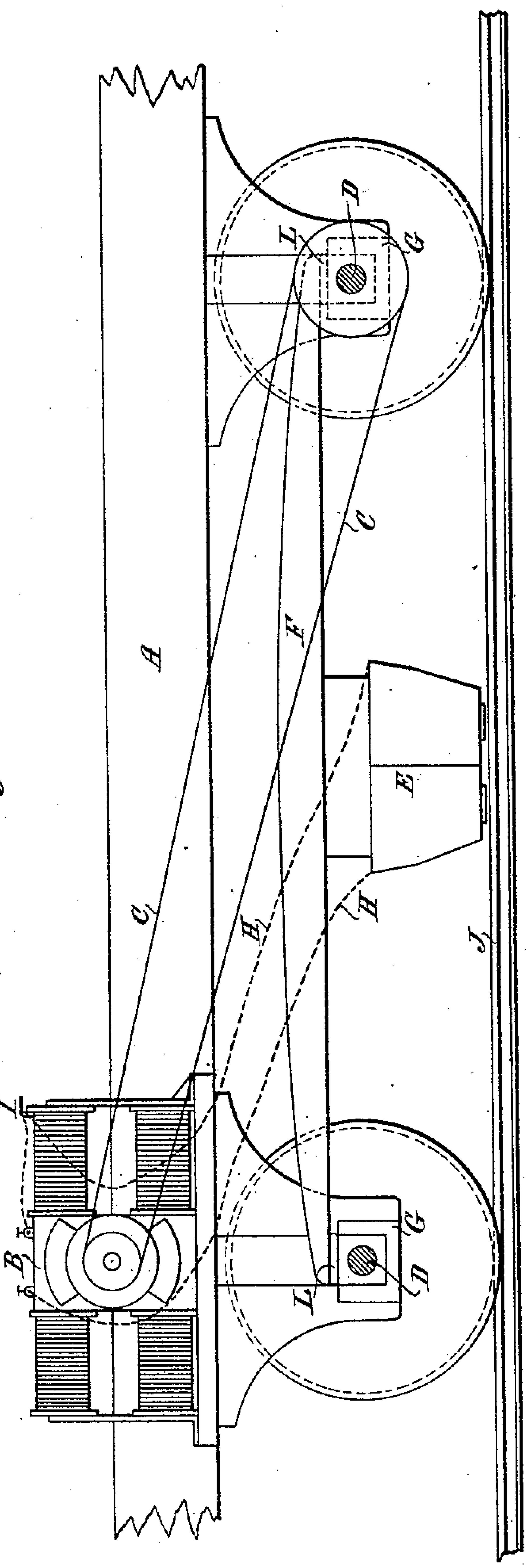
(No Model.) 2 Sheets—Sheet 1.

# H. E. WALTER.

## ELECTRO MAGNETIC BRAKE.

No. 467,243. Patented Jan. 19, 1892.

Fig. 1.

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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

(No Model.) 2 Sheets—Sheet 2.

# H. E. WALTER.

## ELECTRO MAGNETIC BRAKE.

No. 467,243. Patented Jan. 19, 1892.

*Fig. 2.*

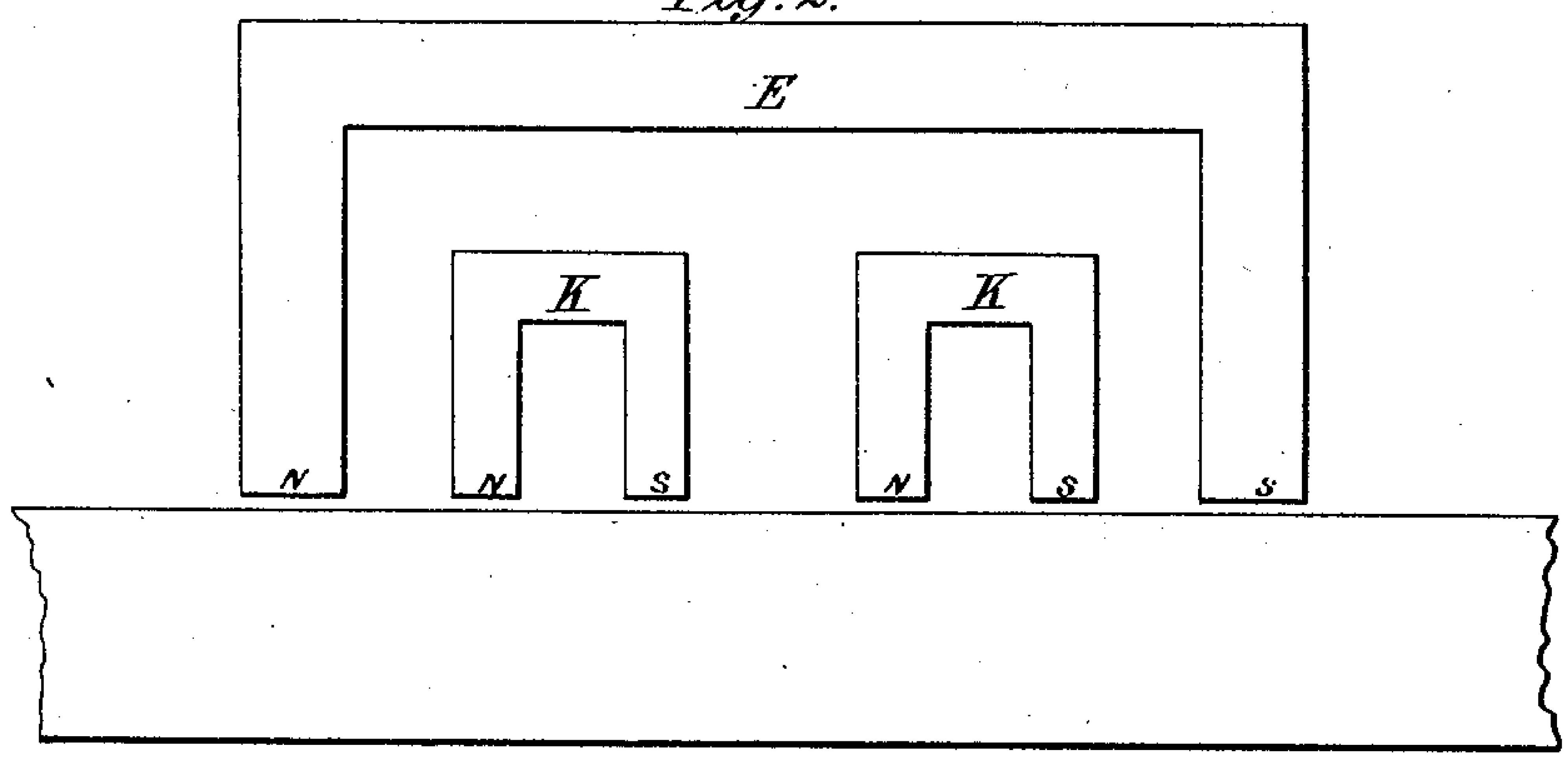



*Fig. 3.*

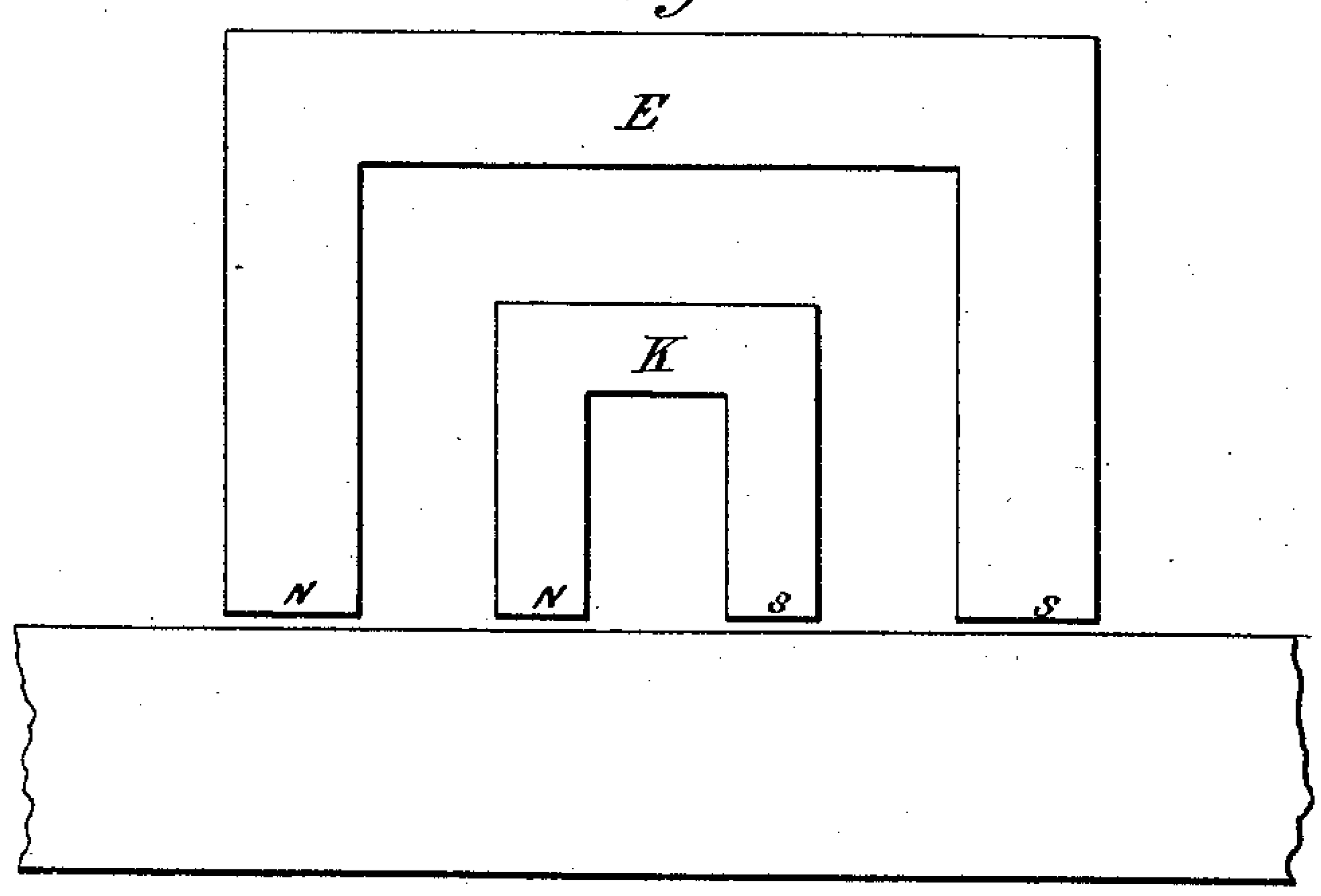



*Fig. 4.*

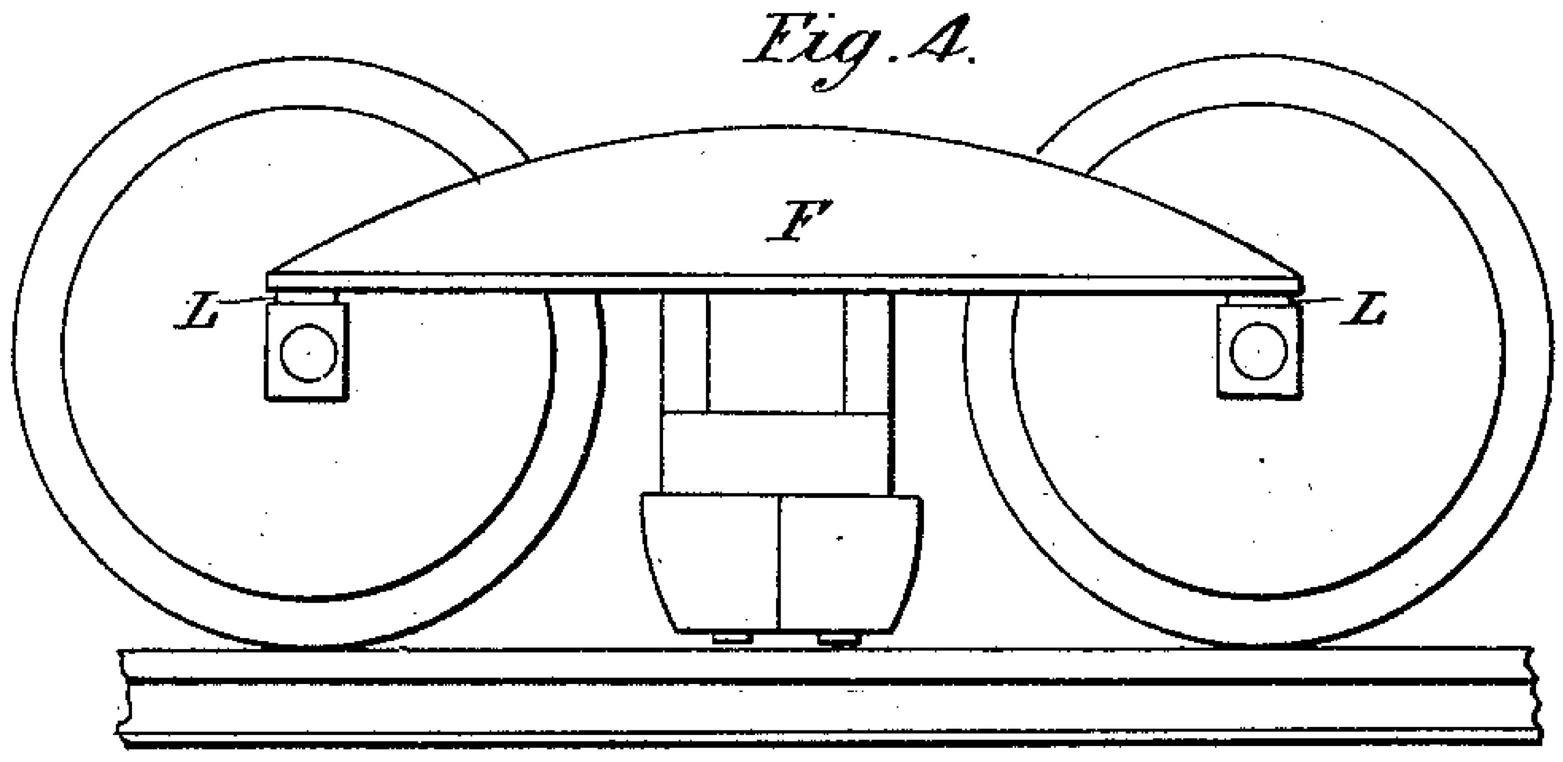



*Fig. 5.*

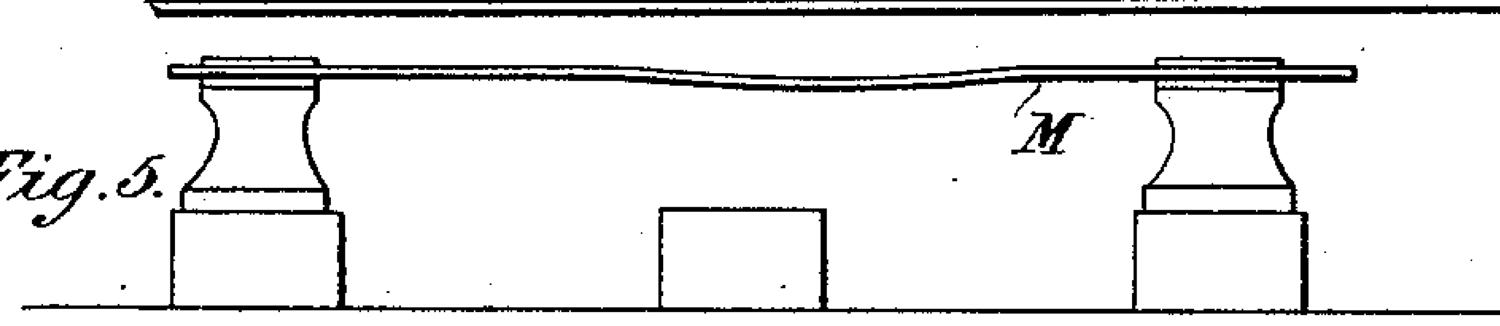
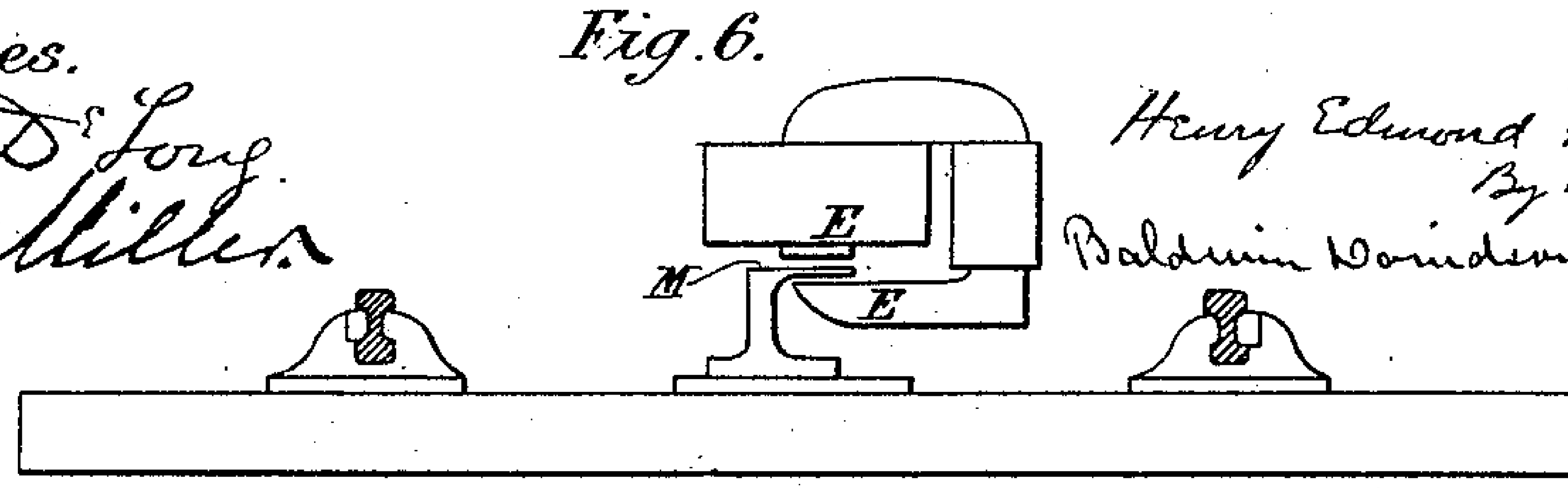



*Fig. 6.*

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Baldwin Davidson & Wight.

# UNITED STATES PATENT OFFICE.

HENRY EDMOND WALTER, OF LONDON, ENGLAND.

## ELECTRO-MAGNETIC BRAKE.

SPECIFICATION forming part of Letters Patent No. 467,243, dated January 19, 1892.

Application filed April 3, 1891. Serial No. 387,577. (No model.)

*To all whom it may concern:*

Be it known that I, HENRY EDMOND WALTER, electrician, a subject of the Queen of Great Britain, residing at 3 Prince's Mansions, Victoria Street, in the county of Middlesex, England, have invented a certain new and useful Electro-Magnetic Brake for Railways for Reducing High Speeds, of which the following is a specification.

According to my invention I provide for reducing the speed of trains traveling at high speeds by means of the reaction produced by causing Foucault currents to be induced in a stationary line of metal or conducting-bar, which may consist either of one or both of the rails or of a separate bar or plate, by magnets carried by the train with their poles in close proximity to the line of metal. There are three principal objects in this: first, to obtain a retarding force on the train greater than that due to the coefficient of friction given by a brake-shoe on each wheel at maximum pressure, even without "skidding;" secondly, (at very high speeds,) the great heat produced does not take place in the carried braking part, but is left behind in the rail or line of metal; thirdly, there is no wear or tear to either magnets or rails.

I use two or more magnet-poles, preferably two poles of opposite polarity, set in a line parallel with and in close proximity to the rail or metallic bar parallel therewith, so that magnetic lines of force pass through the rail or bar from one magnet-pole to the other.

Figure 1 shows part of a railway-vehicle with a magnetic brake constructed according to my invention applied to it. Fig. 2 shows the poles of one large electro-magnet having its poles at a considerable distance apart and at a short distance above an ordinary railway-rail and with two other electro-magnets situated between the poles of the large magnet. Fig. 3 is a similar view, but with a single electro-magnet only between the poles. Fig. 4 shows an electro-magnet carried by a bar which at its ends rests upon the axle-boxes of a railway-vehicle and springs interposed between them. Figs. 5 and 6 show an electro-magnet arranged to act upon a bar parallel with the railway-rails.

In Fig. 1, A is a portion of a railway-vehicle; B, a dynamo mounted thereon and driven by an endless belt C from one of the axles D. E is an electro-magnet carried by a bar F, which is supported at its ends on the top of the axle-boxes G. The coils of the electro-magnets are connected by insulated conductors with the poles of the dynamo, as indicated by the dotted lines H, and the circuit can be broken or completed by suitable contact apparatus situated, say, at I. J is one of the rails on which the vehicle is running.

Assuming the vehicle to be traveling at a high speed—say sixty miles an hour—there would be an electro-motive force sufficient to induce very large currents around the rail. The work represented done by these currents is $\frac{E^2}{R}$, where E is the electro-motive force induced in the part of the rail that the resistance R is taken for as a circuit. E varies as the speed and the magnetism. Neglecting for the present the reaction due to the demagnetizing action of the induced currents on the magnets and assuming a constant magnetism then for a given magnetism, the work varies as the square of the speed if the resistance be constant. The resistance at any instant is that due to the section and length taken by the current induced, and this current is induced by the lines of force passing into the top of the rail and not out of the bottom. There must therefore be an electro-motive force in the top and none in the bottom, so that a current flows around the rail. As, assuming no reaction for the present, the lines are in a constant relative position independent of the speed, R is constant and we have work done on rail varying as the square of the speed; but force varies inversely as speed for a given work, so that with this brake the force varies directly as the speed, (remembering that the demagnetizing action of the current on the magnets is neglected for the present.) The reaction of the current in the rail produces a retarding force on the magnets, which constitutes the braking force; but it also has the effect of weakening the magnets, and now to overcome this a great deal of additional magneting force is used. At the limit of magnetizing force or current available for the magnets there would after a given speed be a given force and no more; but if at a speed of sixty miles per hour a brake-power can be obtained which is from three to four times greater than can be obtained from the ordinary brakes alone more would hardly be needed for any speed. If such a brake would reduce, say, from sixty or any amount more miles per hour to twenty-five or twenty miles or perhaps less, then the air-brake or some other form of brake must be used. In case of the necessity of stopping in a given distance the great object is to reduce the high speed, as from twenty miles an hour a train can be stopped in a very short distance with the present brakes.

In ordinary railway-rails a great portion of the energy developed occurs in the upper part or head of the rail. In order to utilize this without having to magnetize the web and lower part with every magnet, a brake can be constructed, as in Figs. 2 or 3. Where the outer magnet E, after developing currents in the upper part, magnetizes as fully as possible the web and lower part and the intermediate one, two or more magnets K only develop enough magnetism to about fill the head. This arrangement also tends to reduce the leakage, as two similar poles occur together. The magnet-poles are marked N and S in these figures. In order that the magnets may be brought very near to the rail, but still have a definite clearance, these magnets could be attached between two pairs of wheels not far apart, either on bearings of their own embracing the axles or attached to the axle-boxes, as shown, but not to the carriages, on account of the springs. It would be economical to run within about one-fourth of an inch of the rail. In fastening the ends of the bar F, which carries the magnets, to the axle-boxes a piece of india-rubber L or other spring arrangement could be interposed between the ends of the bar and the axle-boxes, as shown at Figs. 1 and 4, to be compressed down to a stop when the magnetic brake is used by the attraction of the magnets to the rail, thus giving the magnet, with its winding, a spring, except just when being used, and at the same time saving the strain of extra mass (of material) directly on the wheels. The magnets will take a good deal of energy to charge for this purpose, and although storage-batteries on the train could be used it would be less weight to have a dynamo in the guard's van or on the engine. The work required of the dynamo would be only when it is required to stop, so that there would not be any waste of power, except that to run the dynamo free on open circuit. Again, in the case of an electric railway the magnets might be charged by the current used for driving.

In place of using magnet-poles to set up currents in the rails they might be used to set up currents in a separate metallic plate, which may be of copper or other good conductor, placed, say, in the middle of the track, as illustrated in Figs. 5 and 6. In these figures E are the magnet-poles, and M the metallic plate. With a suitable plate of copper much less total weight of magnets, less energy, and a smaller dynamo to charge them will be required, even if the plate be very thin, or else a braking force at much lower speeds could be obtained. In some cases it may be advantageous to form the magnets with laminated pole-pieces.

If the magnets are arranged to act on the rails, a magnet or magnets should be used to act on each rail. Preferably, also, the magnets are applied to every vehicle in a train and their coils supplied with current from one dynamo on one or other of the vehicles.

What I claim is—

1. An electro-magnetic brake for railways, composed of electro-magnets carried by the vehicles, with the magnet-poles in close proximity to a fixed longitudinal conducting bar, plate, or rail, but retained by spring-stops on the vehicle from coming into contact with them, and a dynamo for supplying the coils of such magnet or magnets with electrical current when the speed at which the vehicle is traveling has to be diminished.

2. An electro-magnetic brake for railways, composed of electro-magnets carried by the vehicles, with both poles of each magnet in close proximity to and in a line parallel with a longitudinal conducting-bar, but retained from coming into contact with it, and means for supplying the coils of such magnet or magnets with electrical current when the speed at which the vehicle is traveling has to be diminished.

3. An electro-magnetic brake for railways, composed of electro-magnets carried by the vehicles, with the poles of each magnet on opposite sides of a fixed metallic conductor, the poles being kept in close proximity to the bar, but restrained from coming into contact therewith, and means for supplying the coils of such magnet or magnets with electrical current when the speed at which the vehicle is traveling has to be diminished.

4. An electro-magnetic brake for railways, composed of one or more electro-magnets carried by the vehicles, with both poles in proximity to a fixed longitudinal conducting-bar, but retained from coming into contact with it, and with both poles situated between the poles of another electro-magnet, all the poles being in one line parallel with the bar, substantially as described.

5. An electro-magnetic brake for railways, composed of electro-magnets carried from the axles or axle-boxes of the vehicles in such manner that both magnet-poles are in a line with a fixed longitudinal conducting-bar and in close contiguity to it, substantially as described.

6. An electro-magnetic brake for railways, composed of electro-magnets carried from the axles or axle-boxes of the vehicles in close contiguity to a fixed longitudinal conducting-bar, and with spring-stops interposed between the magnets and the axles or boxes, which allow the magnets to move nearer to the conducting-bar when current is passed through the magnet-coils, but stop them at the proper distance therefrom, substantially as described.

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