(No Model.)

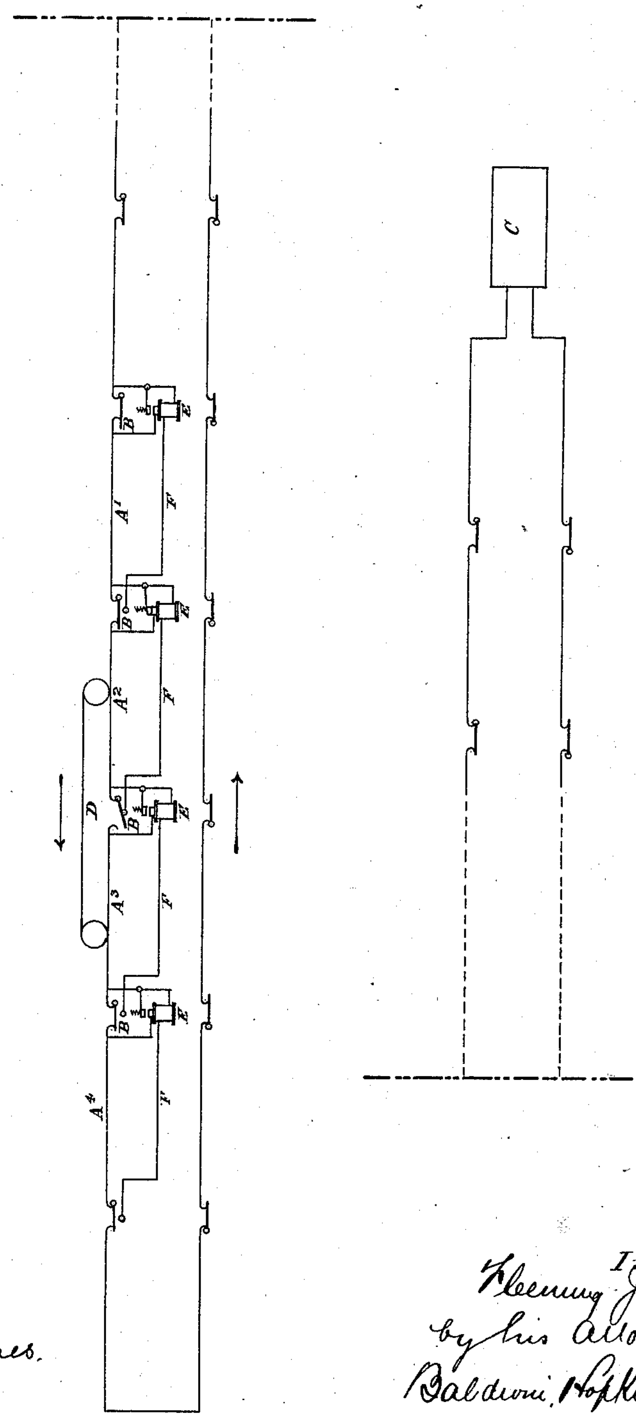
9 Sheets—Sheet 1.

F. JENKIN.

MECHANISM FOR THE ELECTRICAL TRANSPORTATION OF GOODS, &c.

No. 305,194. Patented Sept. 16, 1884.

Fig: 1.



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(No Model.) 9 Sheets—Sheet 2.

F. JENKIN.

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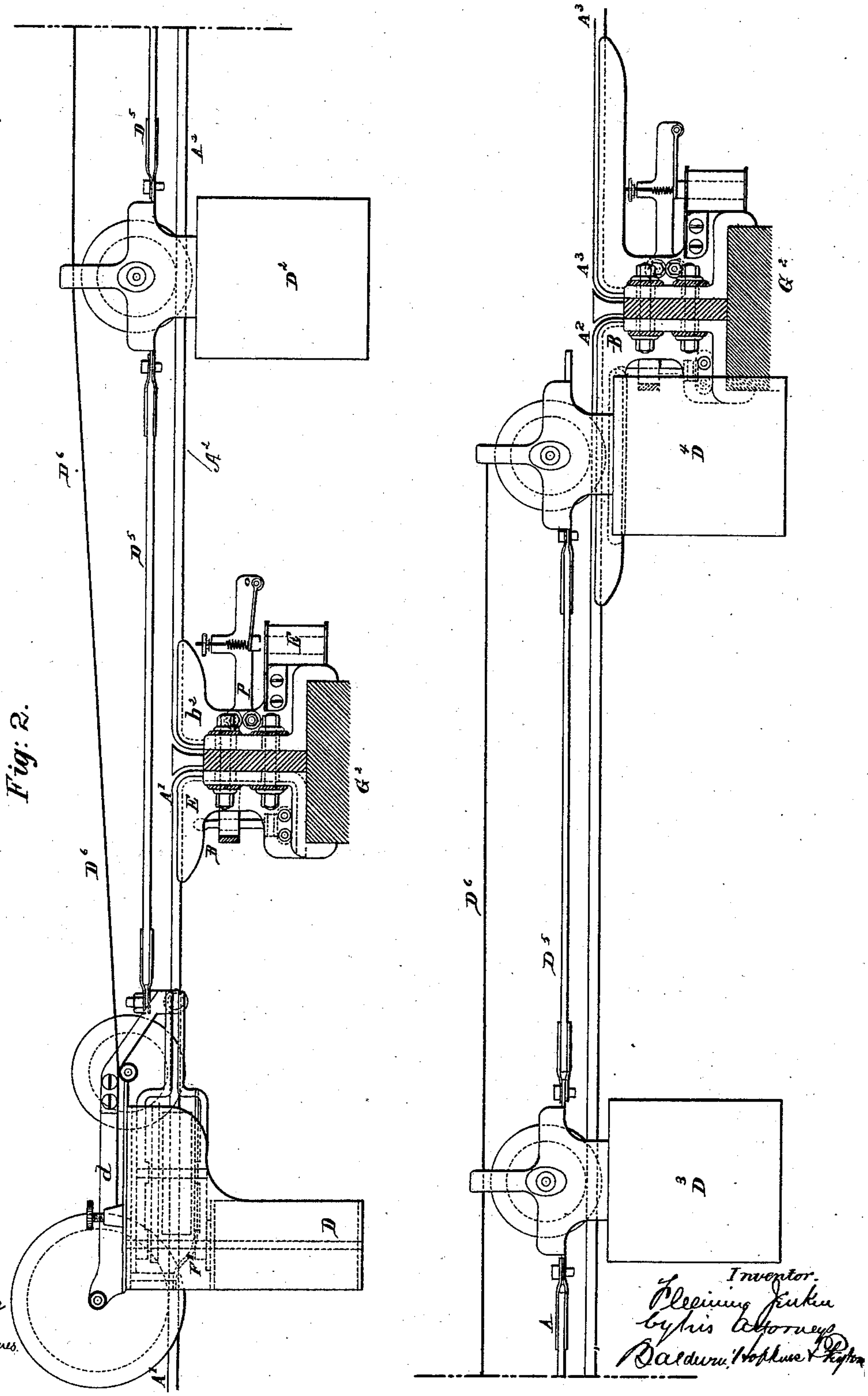

Fig: 2.

Witnesses
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9 Sheets—Sheet 3.

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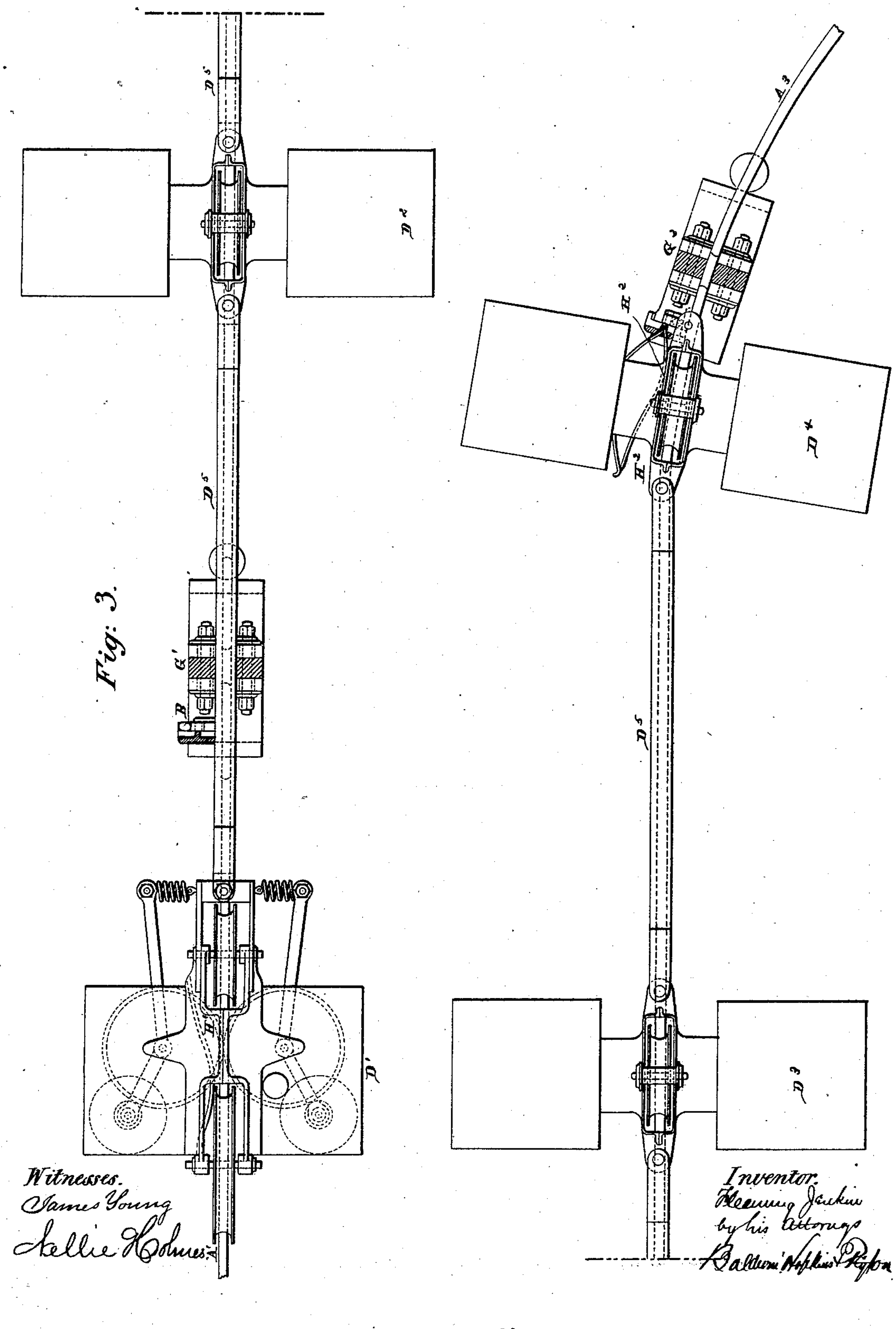

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(No Model.)

9 Sheets—Sheet 4.

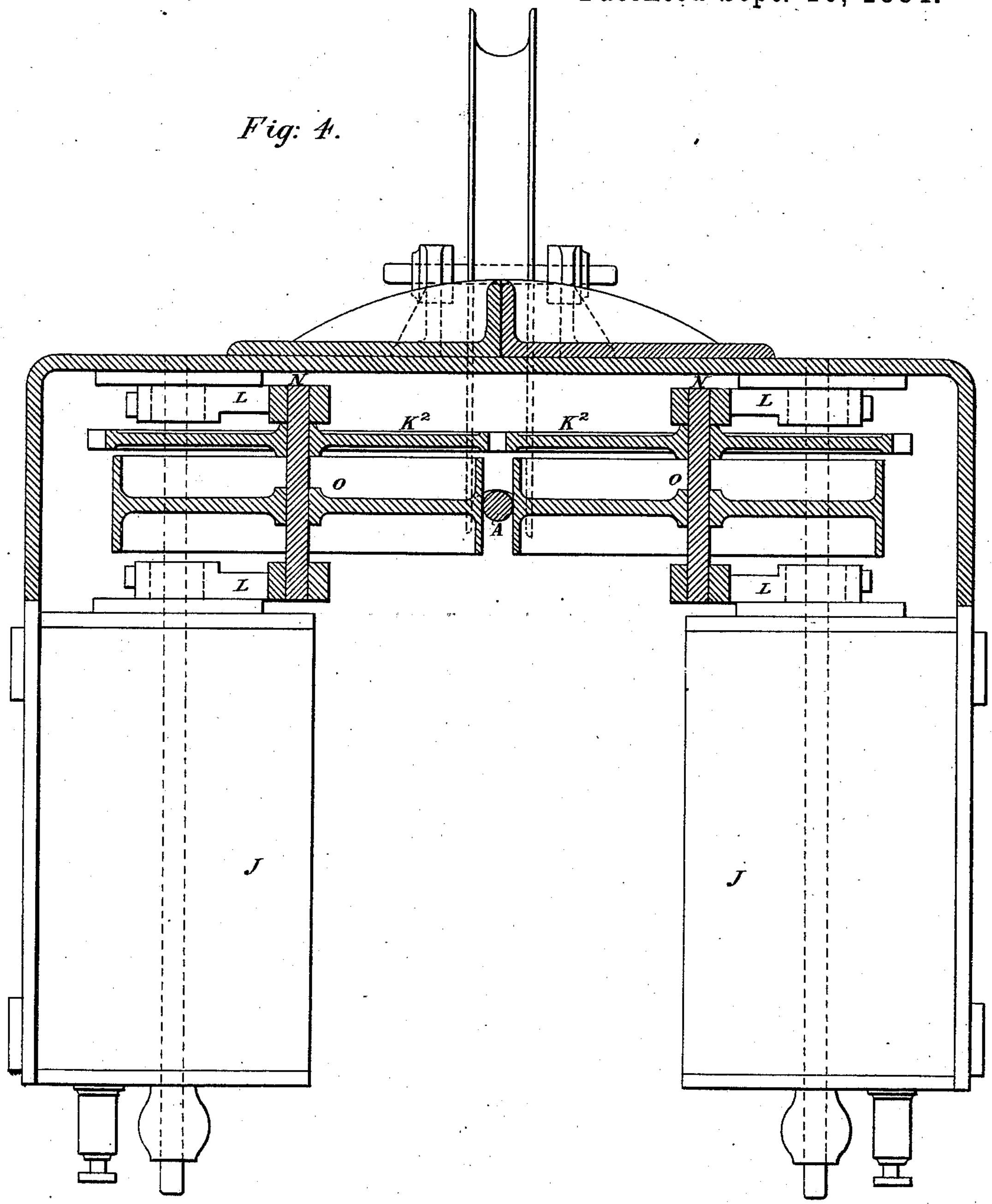
F. JENKIN.

MECHANISM FOR THE ELECTRICAL TRANSPORTATION OF GOODS, &c.

No. 305,194.

Patented Sept. 16, 1884.

Fig: 4.



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9 Sheets—Sheet 5.

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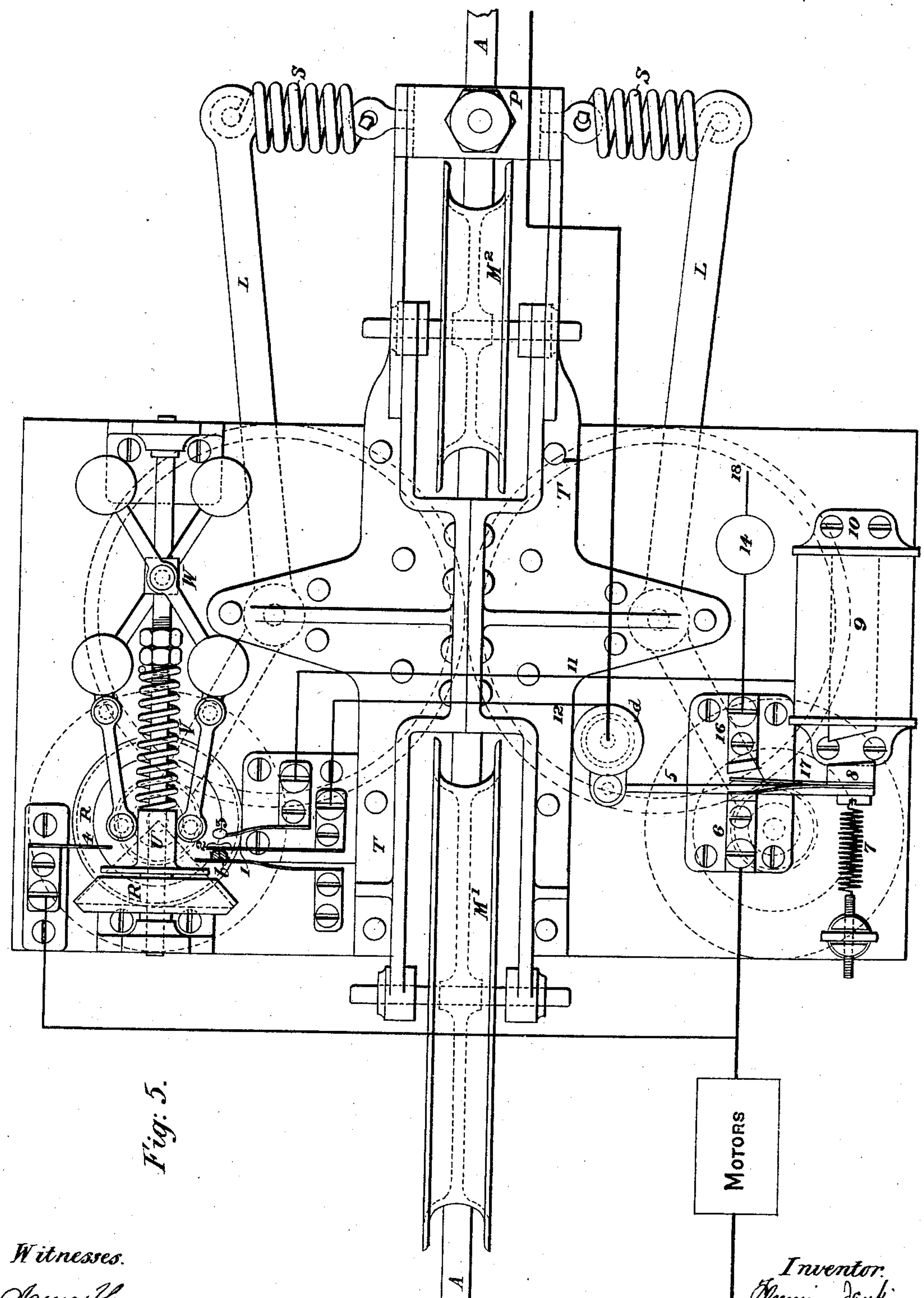

Fig: 5.

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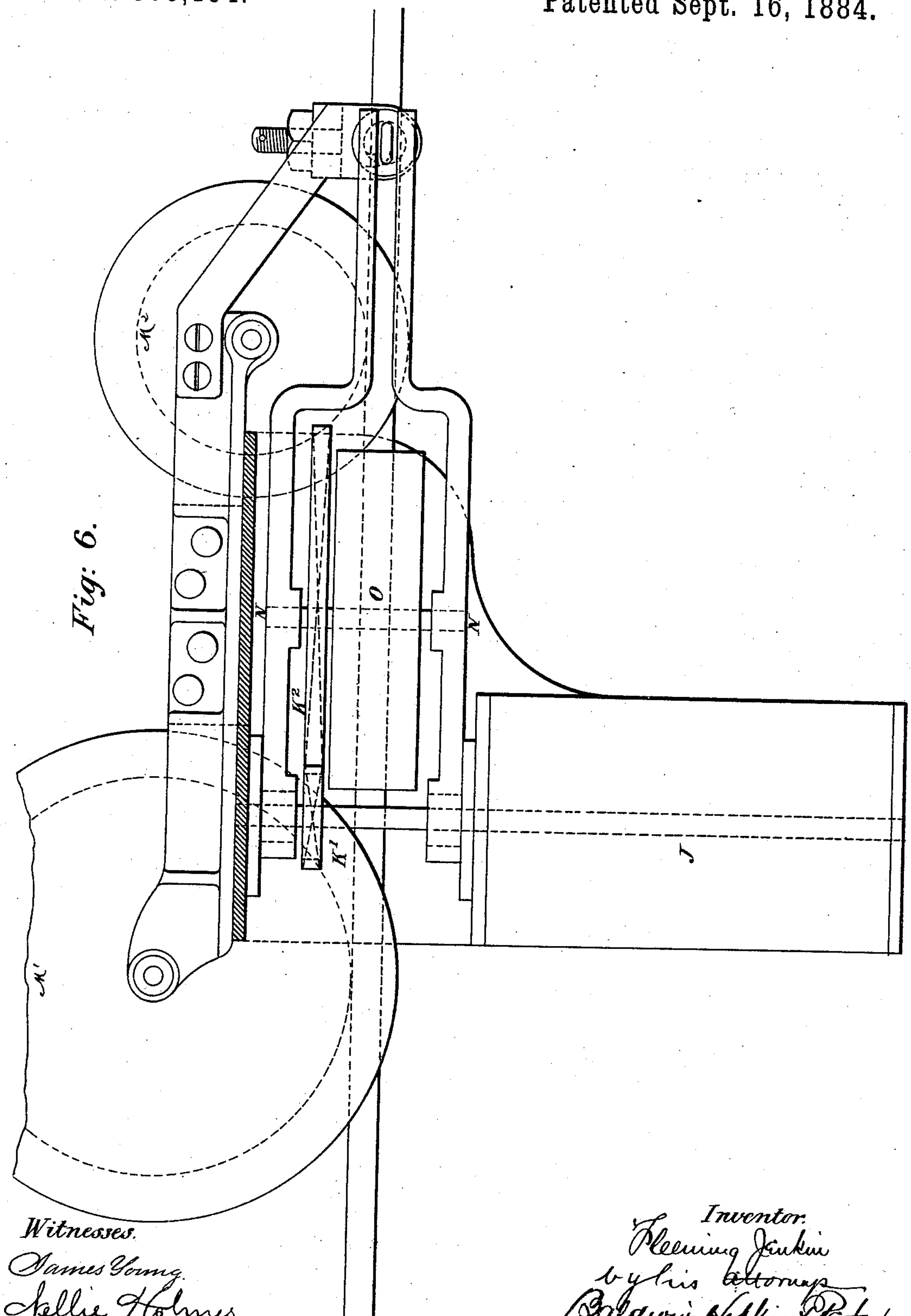

Fig: 6.

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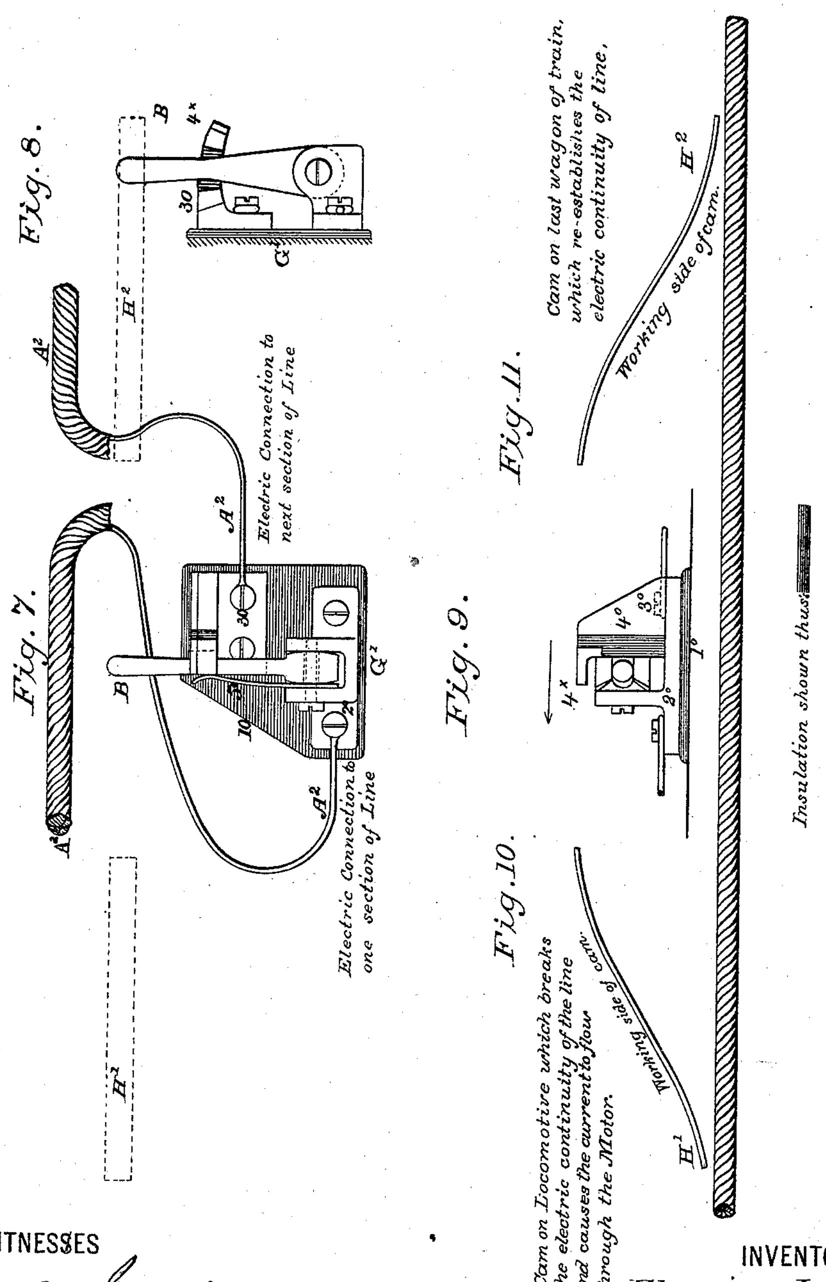

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MECHANISM FOR THE ELECTRICAL TRANSPORTATION OF GOODS, &c.

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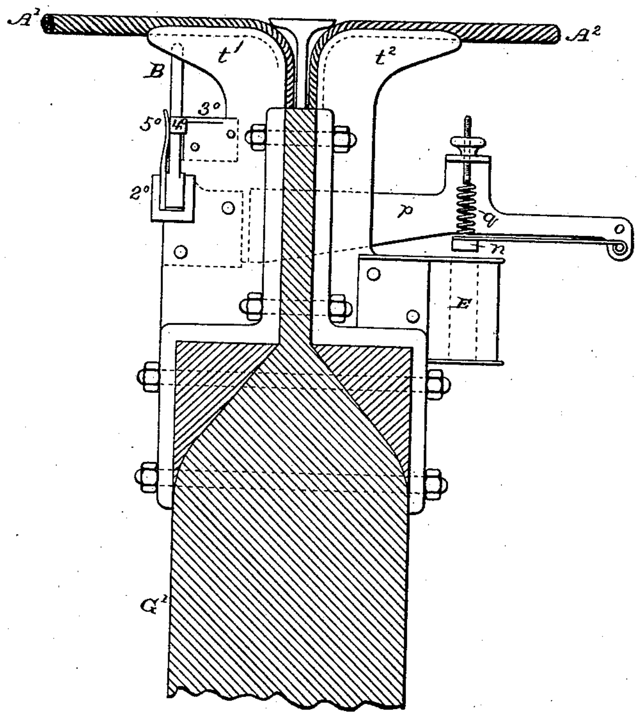
Fig. 12.



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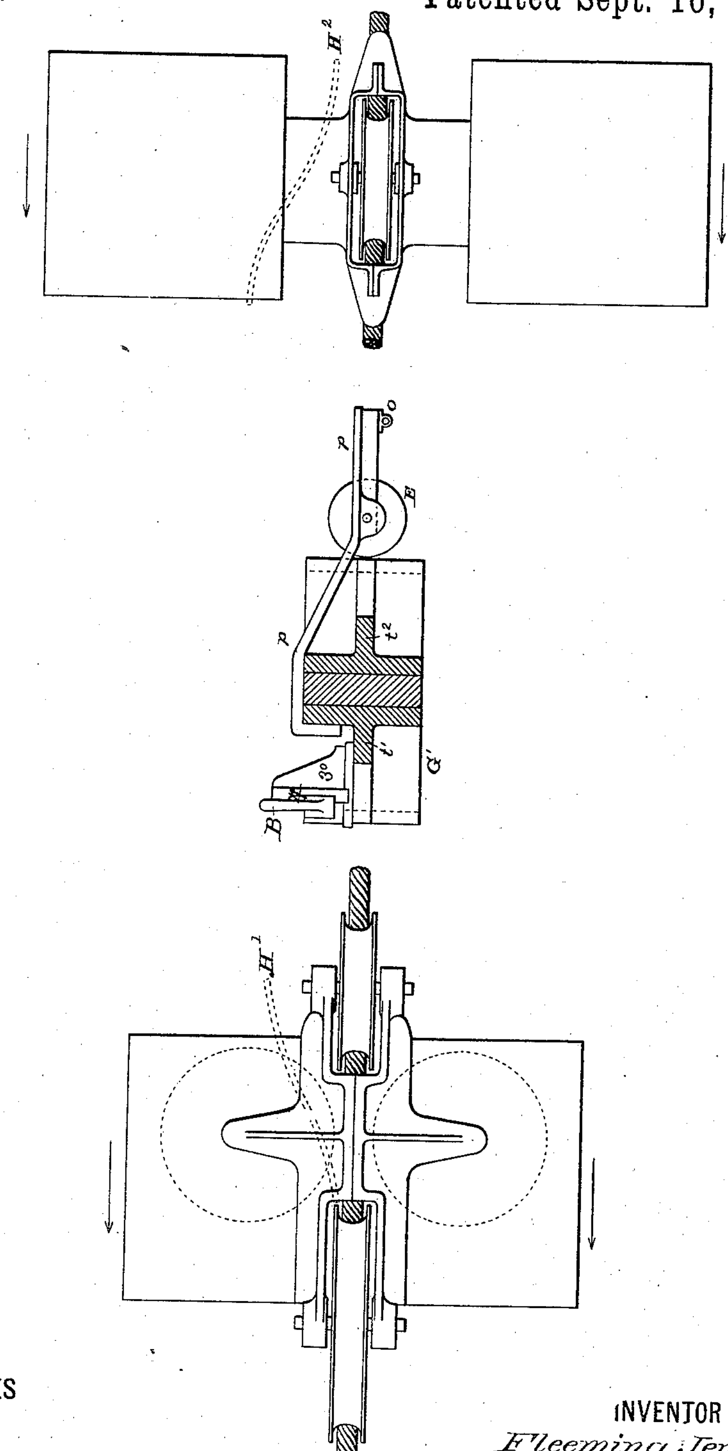

Fig. 13.

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UNITED STATES PATENT OFFICE.

FLEEMING JENKIN, OF EDINBURGH, SCOTLAND.

MECHANISM FOR THE ELECTRICAL TRANSPORTATION OF GOODS, &c.

SPECIFICATION forming part of Letters Patent No. 305,194, dated September 16, 1884.

Application filed February 1, 1883. (No model.) Patented in England April 17, 1882, No. 1,830; in France October 16, 1882, No. 151,584; in Germany November 1, 1882, No. 25,989; in Belgium December 20, 1882, No. 59,926; in Victoria February 8, 1883, No. 3,403; in East Indies May 22, 1883, No. 69; in Cape of Good Hope May 25, 1883, No. 468; in South Australia June 2, 1883, No. 365; in Natal June 5, 1883, No. 13; in Turkey June 30, 1883; in Canada August 13, 1883, No. 17,483; in Chili August 26, 1883; in Queensland October 3, 1883, No. 7; in New South Wales October 4, 1883, No. 1,320; in New Zealand October 31, 1883, No. 953, and in Austria February 5, 1884, No. 45,584.

To all whom it may concern:

Be it known that I, FLEEMING JENKIN, a subject of the Queen of Great Britain, residing at 3 Great Stuart Street, Edinburgh, Scotland, have invented certain new and useful Improvements in Mechanism for Electrical Transportation of Goods, &c., (for which I have received Letters Patent in Great Britain No. 1,830, dated April 17, 1882,) of which the following is a specification.

This invention has for its object improvements in mechanism used for transporting goods and passengers by the aid of electricity. I employ for this purpose strained cables or conductors, which serve both to suspend the load and to convey the electrical energy. Wheels are arranged to run along the cable or conductor, and the loads hang below, suspended from the axles of the wheels. In the simplest arrangement at each post or support there is a break in the electrical continuity of the cable or conductor, and the sections are insulated from each other and from the earth. The sections are, however, electrically coupled together by movable coupling-pieces. An electrical current is maintained throughout the system by a dynamo-electric machine driven by a steam-engine or in other convenient way. The loads are connected together in trains, and the length of a train is about that of a section of the cable or conductor. A train passing either of the movable coupling-pieces already referred to moves it and throws it out of action, and the current then passes by a conductor on the train itself. The current is conveyed through an electromotor, which drives the wheels and propels the train. The power provided is more than sufficient to maintain a maximum speed, and the train is provided with a governor, which, when the speed is sufficient, closes a shunt and allows the current to pass without traversing the coils of the electromotor. The governor further acts directly to check the train, if the speed should ever become excessive, by short-circuiting the electromotor or otherwise bringing electric-brakes into operation. To further insure that one train shall not overtake another, I provide automatic telegraphic communication along the line, and the trains in passing close and open the telegraphic circuits. This automatic telegraph actuates circuit-closers between the different sections of the main cable or conductor, so as to maintain connection between the sections for a certain distance behind the train quite independently, it may be, of the movable coupling-pieces. It is obvious that a following train entering upon a part of the line in which the sections are thus connected will have its speed checked, as the application of the power upon the train depends upon there being a break in the direct electrical connection between the two sections by which the train is for the moment supported.

From the above description it will be seen that the control of the trains in running is completely automatic and independent of attendants.

Some parts of my invention are applicable to the transport of goods or passengers when strained ropes are not used.

The transmission of vehicles by electricity to a distance independently of any control exercised from the vehicle I will call "telpherage." Telpherage is the main object of my invention, although parts of this invention are applicable to ordinary lines of railway worked from the vehicle. In telphering goods or passengers it is intended that the vehicles should be stopped, started, or shunted by persons who remain at the several stations. The systems hereinafter described give every facility for so doing; for if one of the breaks required to allow the train or vehicle to take the current for its electromotor be closed by a person at any point on the line the next vehicle arriving and all those behind it will be arrested, while the preceding vehicles will continue to be propelled. When the required operations at the station have been completed, such as adding to or subtracting vehicles, the removal of the short circuits will allow the whole series to proceed. The invention will allow a light form of substructure to convey an almost continuous stream of vehicles at uniform speed and at small cost.

Figure 1 is a diagrammatic view of the line adapted to long trains. Fig. 2 is a side elevation of the train with a portion of the line. Fig. 3 is a plan of the same. Fig. 4 is a cross-section of the locomotive. Fig. 5 is a plan, and Fig. 6 is a side elevation, of the same. Fig. 7 is a front elevation of the movable coupling-piece between the successive sections of the line. Fig. 8 is a side elevation, and Fig. 9 is a plan, of the same. Fig. 10 is a plan of the cam or instrument on the head of the train by which the coupling-piece is moved to electrically separate two successive sections of the line. Fig. 11 is a plan of the cam or instrument on the tail of the train by which the coupling-piece is moved to electrically connect two successive sections of the line. Fig. 12 shows in elevation and Fig. 13 shows in plan the arrangements at a post supporting the ends of two sections of the line. In Fig. 13, also, the first and last vehicles of a passing train are represented.

$A' A^2 A^3 A^4$, Fig. 1, are the separate sections of insulated conductor, and B B B are bridge-pieces which establish metallic connection throughout the series of sections, so that wherever there is no train upon the line the sections are coupled together, and are thus made to form part of a circuit.

C indicates a station where, by suitable known mechanism, a uniform current of electricity is caused to flow in the circuit, and this notwithstanding the variations in the resistance of the circuit which will result from a greater or less number of trains being on the line.

D indicates a train on the line. Its length is such that it always spans at least one of the intervals between the sections $A' A^2$, &c. The train as it enters upon a section removes the bridge-piece B, which connected this section with the section in rear. The current is then compelled to flow through a conductor upon the train itself, including one or more electro-motors by which the wheels of the train are propelled. Before the tail of the train leaves the preceding section it replaces the bridge-piece B, but not before another bridge in advance has already been opened. The current will pass in series through any number of trains there may be upon the line, and all are propelled thereby; but of course the heavier the work which has to be performed upon the line the greater the power which will have to be exerted at the station C to maintain a uniform flow of current in the circuit.

The bridge-pieces B B and the passing trains D are not the only instruments by which the sections $A' A^2$, &c., may be electrically connected. There are also circuit-closers operated by electro-magnets E E. From each magnet an insulated wire, F, passes forward along the line past one or more of the sections, as may be desired. The wire F is then brought to one of the bridge-pieces B, and the same movement which removes the bridge-piece connects the wire F with the main circuit. The wire F then diverts a small portion of the current to its electro-magnet E and this attracts its armature. Thereby connection is always maintained for a time between sections in rear of a train. This will be so notwithstanding the advance of a following train.

In fuller detail this mode of carrying out my telpherage system may be described as follows:

A wire rope, wire, or rail, supported from the earth at convenient intervals, serves as a rail on which electric locomotives and carriages run, and also as the conductor supplying the locomotives with the necessary electric energy. In general, communication between any two places would be maintained by two lines of rope—an up line and a down line—so that in this case the electric circuit would be completed through the two lines, or where, so to speak, a single-line railway were required the circuit could be completed through the earth or by a return-wire or its equivalent.

The trains may be made up of electric locomotives and carriages or of combined locomotives and carriages. The members of such a train would be connected by comparatively rigid coupling-rods, so that the weight of the train may be properly distributed throughout its length to prevent undue stress on the rope. The intervals between the sections into which the rope is divided occur usually at the places where the wire rope is supported from the earth. The electrical locomotive is in electrical contact through the wheels of the first vehicle with the wire rope on one side of the break or interval, and through the wheels of the last vehicle with the wire rope on the other side of the break or interval. The length of a train being somewhat longer than a wire-rope section, it is evident that at every instant the train is bridging a break and the electric current is passing through its electric locomotives.

The drawings, Figs. 2 to 6, show one method of carrying out this system of telpherage. Fig. 2 is an elevation, and Fig. 3 a plan, of a train and three sections of the wire rope $A' A' A^2 A^2 A^3 A^3$. $A' A'$ is a part of a section of wire rope. $A^2 A^2$ is a complete section, permanently mechanically fastened to the contiguous sections $A' A'$ and $A^3 A^3$ by means of insulating-supports G' and G^2, which pass to the ground. Every support—such as G'—is provided with a switch-lever or bridge-piece, B, which, when in its normal position, establishes electrical communication between the sections $A^2 A^2$ and $A' A'$, the lever then bearing against a piece of metal which is in electrical connection with one section, while the lever itself is through its axis in connection with the other. The first vehicle of each train is fitted with a cam, so arranged as to catch each lever as it passes and throw it over into a position such that electric communication between A′ A^2 is severed, and at the same time a portion of the main current diverted through the lever B and the new contact which it now makes into the auxiliary telegraph-wire F.

The train shown in the general drawings, Figs. 1 and 2, consists of an electric locomotive, D′, and three carriages, D^2 D^3 D^4. The vehicles are connected together by the light coupling-rods D^5 D^5 D^5. They may be constructed of thin rods of tough wood united to the carriages by metal pins and end pieces, as shown in the drawings. On the leading vehicle, which in this case is the locomotive, is placed a cam, H′, which pushes aside from the normal position every switch-lever B of every insulator. The cam H^2 on the last vehicle restores every switch-lever over which it passes to the normal position.

The details of the movable coupling-pieces and the cams or instruments by which they are moved are very clearly shown by Figs. 7, 8, 9, 10, 11, 12, and 13. In these figures, 1° is a block of insulating material. It is fixed upon the support, say G. 2° is a metal bracket fixed to the block 1°, and electrically connected by a wire with the section A′ of the line. 3° is another metal bracket fixed to the block 1° and electrically connected with the section A^2. The metal bracket 2° carries a metal pin or axis, on which the lever or bridge-piece B is able to turn. The lever B is consequently always in electrical connection with the section A′. 4° is a horn of vulcanite or other insulating material. $4^\times$ is a piece of metal at the end of this horn connected with the insulated wire F, against which the lever B may rest without making electrical contact. The normal position of the lever B is, however, in contact with the bracket 3°, against which it is held by the spring 5°. The sections A′ and A^2 of the line are then electrically connected. When a train comes along the line, the cam, Fig. 10, moves the lever B away from 3°, along the horn 4°, and so severs the connection between the sections A′ and A^2 of the line. The lever B remains in this position until it is replaced by the operation of the following cam, Fig. 11.

Figs. 10 and 11 show the cams H′ and H^2 in plan in their proper positions relative to the center line of the rope, which is also indicated in the same figures. In Fig. 8 the cam H′ is also shown in position. A bracket fixed on the leading vehicle of the train carries the cam H′. The cam H^2 is similarly fixed upon the last vehicle of the train. These cams are simply plates or pieces of metal curved as the drawings indicate. The leading end of the cam H′, when it comes up to the lever B, strikes it on the inner side and thrusts it outward or away from the rope along which the train is traveling, and so it brings the lever to such a position as to sever the electrical connection between A′ and A^2 and to establish electrical communication between A′ and through the piece $4^\times$. The cam H^2 on the last vehicle acts against the outer side of the lever B and thrusts it inward toward the rope or back to its normal position. The wheels of the train running upon the metallic wire strand or rope which forms the roadway are in electrical connection with the sections of the roadway on which they stand, and so are the metal axle-boxes and framing; but the rods D^5 D^5 in Fig. 2, by which the carriages of the train are coupled, are not of a conducting material. Electrical communication along the train is, however, provided by the insulated conductor D^6. The end of an insulated conductor, D^6, is metallically connected to the frame of the last carriage, and the conductor is led along the train to the main binding-screw *d* on the locomotive. From thence the current is led through the electric motors on the locomotive, and finally reaches the frame, which is in metallic contact with the rope. Since the locomotive has passed over G′ the switch-lever has been moved from the normal position, and there is no electrical communication through it from A^2 to A′, and as the last carriage has just passed over G^2 the switch-lever there is in the normal position, and the current is free to pass from A^3 to A^2. The whole of the current now passes from the section A^2 A^2 to the section A′ A′, through the train so propelling it along, until a new section is reached and the process of opening by the front vehicle and closing by the last is repeated.

A suitable locomotive is shown in detail by Figs. 4, 5, and 6. Fig. 4 is a cross-section, Fig. 5 is a plan, and Fig. 6 a side elevation. It consists of two electromotors, J J, mounted vertically in a frame on opposite sides of the rope, and so arranged as to clear the insulators with safety and admit of the locomotive remaining on the wire rope A in stable equilibrium. Keyed on the shafts of the motors are the pinions K′ K′, which gear into the toothed wheels K^2 K^2, gearing with each other across the wire rope. Those wheels are keyed on the spindles N N, on which also are keyed the gripping-pulleys O O. The spindles carrying the gripping-pulleys and wheels K^2 K^2 run in bearings in the arms of the double-armed levers L L, centered on bosses concentric with the motor-shafts, and pulled inward by the spiral springs S S, which are connected together by the rider P, fastened to the frame. The teeth of the spur-wheels are of the involute form, so that they gear accurately, although the thickness of the rope should vary within the limits to be expected in practice. The weight of the locomotive is borne principally by the larger pulley M′, and the remainder by the smaller, M^2. These pulleys, keyed on short spindles, run in bearings supported by the ribs T T. The pulleys have considerable end play, because they are not required to guide the vehicle in a horizontal plane. Upon the locomotive the cam or incline H′ is fixed, which pushes over the lever B. A pair of bevel-wheels, R R, driven by one of the motor-shafts, give motion to a balanced centrifugal governor, W. The slider

U has a wide flange, which engages the springs 1 2 3 4. The springs 2 3 4 are insulated from the frame, and provided with binding-screws, to which wires are attached, as shown.

d is the main binding-screw. insulated from the frame, to which is led the conductor D^6 from the end of the train. The lever 5 is centered in a projection from the binding-screw, *d*, and is in metallic contact with it.

7 is an insulated spiral spring, which, under ordinary conditions, holds the lever 5 against the metal bracket 6. From a binding-screw in connection with 6 a wire is led through the motors, and thence continued to the frame; hence, under normal conditions, the current entering at *d* traverses lever 5 to bracket 6, then through the electromotors, and finally through the frame to the wire rope.

8 is a soft-iron armature, fastened to the lever 5.

9 is an electro-magnet, one end of the wire which forms its coil being in contact with the spring 3 and the other in contact with the frame at 10.

16 is a bracket similar to 6, connected with the frame at 18 through a resistance-coil, 14.

Suppose, now, that the speed of the train has exceeded the prearranged limit, then the spring V has been so adjusted that slider U will have brought the springs 2 and 3 into contact, having pressed them together by the spring 1, which is prevented from making electrical contact with the other springs by the piece of insulating material *b*. The spring 2 being electrically connected with the binding-screw *d* by the wire 12, a current will instantly traverse 12 2 3 11 9 10, exciting the core of the electro-magnet 9. The armature 8 and lever 5 are instantly pulled over, breaking the circuit through the motors and making contact at 16. A portion of the current arriving at *d* is now flowing through the electro-magnet 9 to the frame, and the other portion through the resistance-coil 14 to the frame. The resistance 14 is adjusted to admit of the current flowing through the electro-magnet 9, being sufficiently great to hold the lever 5 in contact with 16, while the speed of the train causes the springs 2 and 3 to remain in contact. So far the motive power has been cut off, but the current still flows along the train and through the locomotive to the wire rope; but the train may be going downhill and the speed continue to increase. If so, a brake is applied. The slider U will then come into contact with the spring 4, which is insulated from the frame, but connected with one terminal of the motors through the bracket 6. The slider is in contact with the frame; hence the terminals of the motors are connected together through the frame, and the motors being driven by the train will act as dynamo-electric machines, generating a current and offering resistance to the motion of the train. The momentum of the train is then expended in generating an electric current in a short circuit, which may be traced from part to part, as follows: The frame of the locomotive, the slider, the spring 4, the bracket 6, (which is connected with 4 by an insulated wire,) and the coils of the electromotors J J, which are always connected on the one side with the bracket 6 and on the other with the frame of the locomotive.

Various devices are employed to prevent excessive sparking. One is shown at the contacts 6 5 and 5 16. 17 is a double spring, which, during the operation of breaking 5 6 and making 5 16, or vice versa, makes contact with the one before the other is broken.

In Fig. 12, E is an electro-magnet used to prevent a following train from coming too near a preceding one. The core of this electro-magnet is in metallic contact with t^2, which is a metal bracket attached to the post or support G′, and supporting the wire strand or rope A^2, forming the roadway. t^2 is insulated, and so is the corresponding part, *t′*. The core of the magnet is fixed to t^2, and so there is electrical continuity between the core, the bracket t^2, and the section of the roadway which this bracket supports. The coils of the electro-magnet E are connected at one end with t^2 and at the other with an insulated wire. (Shown at F in Fig. 1.) The said insulated wire passes forward to the next support, and is attached to the piece $4^{\times}$, (see Figs. 7, 8, 9,) there situated. A part of the current is thus diverted from the roadway to pass through the magnet-coils E, when the lever B rests against the piece $4^{\times}$—that is to say, when there is a train on the section of the line immediately ahead. *n* is a soft-iron armature, centered at *o* on a metal arm, *p*, insulated from t^2, but electrically connected with *t′*, so that when the armature *n* is in contact with the core of the electro-magnet the section A′ is in electrical communication with A^2, no matter in what position the lever B of that particular insulator may be. *q* is a spiral spring which holds *n* clear of E when no current is passing in the wire of the electro-magnet.

I claim as my invention—

1. In the herein-described system of telpherage, the combination of a conductor divided into sections, switches which normally bridge from one section to the other, traveling trains or vehicles, electric motors on the trains or vehicles, by which they are driven, and devices operated by the trains or vehicles to move said switches successively and divert the current through the motors on said trains or vehicles, so that the motors are connected in series through the divided conductor.

2. The combination, substantially as set forth, of a conductor divided into sections, switches which normally bridge from one section to the other, trains or vehicles which run upon said divided conductor as a support or roadway, electric motors on the trains or vehicles, and means for actuating said switches to move them successively and divert the current from the divided conductor through the

motors on the trains or vehicles, whereby such motors are connected in series through the divided conductor.

3. In a system of telpherage, the combination of an insulated suspended conductor, a source of electric energy connected therewith, a traversing train or vehicle sustained thereby and traveling thereon, and an electric motor upon said vehicle, supplied with electricity from said sustaining-conductor.

4. In a system of telpherage, the combination of a suspended wire, cable, or support, a vehicle traveling thereon, and hanging below or in part below said wire, cable, or support, an electric motor on the vehicle, and an electric circuit connected with a source of electric energy from which said motor is supplied with electricity.

5. The combination of a traveling vehicle, an electric motor thereon for actuating it, an electric supply-circuit, a governor carried by the vehicle, which governor automatically cuts out the electric motor when a given speed is reached, and a brake which is applied by short-circuiting the motor when a higher speed has been reached.

6. The combination of a traveling vehicle, an electric motor thereon for actuating it, an electric supply-circuit, a branch or shunt circuit around the motor, a governor carried by the vehicle, and mechanism whereby the governor automatically shunts the current from the electric motor when a given speed is reached.

7. The combination of a support or roadway, electrically-actuated trains or vehicles traveling along said support or roadway, an electric circuit, a source of electric energy, and motors on the trains or vehicles for driving them connected in series in said circuit.

8. The combination, substantially as set forth, of a divided insulated conductor, traveling trains or vehicles, electric motors carried by said vehicles for driving them connected in series with the sections of said conductor, and mechanism by which said motors are connected in series with the sections of the divided conductor.

9. The herein-described organization for automatically blocking electrically-propelled trains or vehicles which are connected in series with a divided electric conductor, which consists in the combination of a divided conductor, traveling trains or vehicles, motors carried thereby for driving them connected in series with the sections of said divided conductor, circuit-connections, and mechanism for maintaining the continuity between the sections of the divided conductor, whereby the motor on a train or vehicle connected between the sections of said conductor is cut out of the circuit.

10. The combination of a divided conductor, traveling trains or vehicles, electric motors carried thereby, means by which said electric motors are connected in series with the sections of the divided conductor, and mechanism for blocking or stopping the trains or vehicles by electrically connecting the end of one section of the conductor with the end of the adjoining section, whereby the electric motor between the two said sections of the conductor will be cut out of the circuit.

11. The organization of apparatus for propelling trains or vehicles in series by electricity, consisting in the combination of apparatus at a station for maintaining a uniform electric current, a conducting system by which said current passes to and through the trains or vehicles upon the line in series, and a speed-governing apparatus on each train or vehicle, which regulates the reception of current from the conductor.

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