To all whom it may concern:  

Be it known that I, RICHARD BENJAMIN PAINTON, a citizen of the United States, residing at Williamsport, in the county of Lycoming and State of Pennsylvania, have invented a new and useful System of Electrical Propulsion, of which the following is a specification.

This invention relates to an improved system of electrical propulsion especially designed for utilization in an electrical locomotive having sufficient power, speed, and tonnage, whereby the same may be operated on railroads in place of the ordinary steam-locomotives now in common use.

In carrying out the present invention it is the purpose to obviate the many objections and disadvantages to the use of the ordinary steam-locomotive, which involves an excessive coal consumption and a multiplicity of operating parts, which at times become very dangerous, while at the same time entailing a great loss of power in steam.

To this end the invention contemplates an entirely new type of electrical locomotive having novel means for its propulsion, whereby power is transmitted to the different drivers independently without the use of coupling connections between the drivers, as commonly employed in steam-locomotives, thereby insuring an exceedingly high rate of speed and a development of power that is not attainable by steam-locomotives or in the ordinary electrical systems of propulsion involving the use of a trolley-wire, third rail, or equivalent conductor for carrying the current from the power-station to the motors of the car.

The ordinary methods of steam and electrical propulsion above referred to involved a great loss of power, which is not possible in the present invention, which contemplates not only novel means for developing a high rate of speed and power in the locomotive, but also thoroughly practical and efficient means for utilizing the motion of the locomotive to generate power, which may be reserved or stored up to assist in the subsequent propulsion of the locomotive, especially when ascending grades.

With these and many other objects in view, which will readily appear as the nature of the invention is better understood, the same consists in the novel construction, combination, and arrangement of parts hereinafter more fully described, illustrated, and claimed.

While the invention is necessarily susceptible to a wide range of modification, still the preferred embodiment thereof is shown in the accompanying drawings, in which—

Figure 1 is an elevation of an electric locomotive and its battery-car equipped with the system of electrical propulsion contemplated by the present invention. Fig. 2 is a diagrammatic plan view of an electric locomotive and its battery-car, showing the arrangement of the dynamo-electric machines and the preferable way of grouping the storage batteries in the battery-car. Fig. 3 is a diagrammatic elevation showing the circuit-wire connections between the sets of batteries and the respective switches and dynamo-electric machines associated therewith. Fig. 4 is a diagrammatic view showing one set or series of the storage batteries and the switch and dynamo-electric machine in circuit therewith. Fig. 5 is an enlarged detail elevation of one of the individual switches of the switchboard. Fig. 6 is a plan view of the switchboard.

Referring to the accompanying drawings, the numeral 1 designates the main electric locomotive car supported on a plurality of driving-axles 2, each of which has mounted on the ends thereof large driving-wheels or drivers 3, which travel upon the rails of a railway in the same manner as the drivers of an ordinary steam locomotive, and in the present invention said driving-wheels or drivers 3 are preferably of a uniform size of about ten feet in diameter and are specially built to suit the dynamo-electric machines used in connection with the driving-axles, while at the same time supporting the electric locomotive sufficiently high from the track to prevent interference from obstructions, such as snow, and to insure the protection of the wire connections of the electrical propelling apparatus.

In connection with the main locomotive-car there is employed a battery car or tender 4, which is also supported upon a plurality of driving-axles 5, carrying upon their ends driving-wheels 6, similar to the driving-wheels 3 of the main or advance car 1, and in carrying out the present invention each
of the several driving-axles 2 and 5 have built thereon or fitted thereto a dynamo-electric machine 7.

The dynamo-electric machines 7 are constructed to suit the power required, both for propelling purposes and for generating electrical energy to recharge or store up the batteries; but these machines are the same type of machines as are now on the market and are known to the trade as "convertible" or "combination" generators and motors, having suitable appliances for setting the same to operate either as simple motors or as simple generators, according to the conditions of use.

The said convertible dynamo-electric machines 7 are technically known as "direct-current motors," built on the dynamo model and of the continuous-rotation type, whereby when a current is passed through the same from a source of electrical supply, such as from storage batteries, the same will operate as ordinary motors; but when driven by power, as by the car in the present invention, the same will operate as generators for generating the current which may be utilized for recharging the storage batteries. Inasmuch as the dynamo-electric machines 7 are of the ordinary Westinghouse type and are provided with the usual appliances to set the same for operating either as motors or as generators, it is only deemed necessary to illustrate said machines in diagram in the drawings and to show the lead-wire connections therewith. Of course when the said machines are to be used as motors they are set in the usual way to operate as motors, and vice versa.

Cooperating with the dynamo-electric machines 7 on the several axles of the electric locomotive and its battery car or tender are several sets of storage batteries 9, which are placed on suitable supports within the battery car or tender 4, which necessarily forms a part of the complete electric locomotive.

Each set of batteries 9 consists of a series of batteries arranged in a row and coupled together in a series circuit, and each of these sets or rows of batteries is designed to be associated with an individual dynamo-electric machine and switch, so that such dynamo-electric machine may be controlled entirely independently of all the others.

The dynamo-electric machines and the storage batteries all have circuit-wire connections with a controlling-switchboard 10, mounted within the main electric-locotive car 1, preferably in the position indicated in Fig. 1 of the drawings, so as to be under the complete control of the electrical engineer, and this controlling-switchboard 10 provides means whereby any dynamo-electric machine may be thrown in or out of operation independently of the others, and also enables the electrical engineer to reverse the machines when operating as motors should it be necessary to reverse the motion of the electric locomotive.

As already explained, each dynamo-electric machine 7 has associated therewith a group or set of storage-batteries and an individual controlling-switch, and the individual controlling-switches for all of the dynamo-electric machines are fitted to the switchboard 10, as plainly shown in Fig. 6 of the drawings.

Each of the controlling-switches, designated by the numeral 13, essentially consists of a circular base 13, provided upon the exposed face thereof with oppositely-arranged sets of resistance-steps 16, 12, 15, 15, 16, and 16, respectively, said resistance-steps of each set or group being connected in series in the usual manner by resistance-coils R, as plainly shown in diagrammatic Fig. 4 of the drawings. The resistance-coils R, connecting the several steps of each group, are suitably housed at the rear side of the switch-base in any approved manner and subserve the ordinary function of a resistance-box to prevent the full force of the current being switched too suddenly into the dynamo-electric machine when acting as a motor, while at the same time providing means whereby the speed of the electric locomotive is placed under the immediate control of the engineer. Each of the switchboards 9 are further provided upon the face thereof within the circle of the oppositely-arranged sets of resistance-steps with a pair of oppositely-arranged contact-segments 17 and 18, respectively, the contact-segment 17 being associated with the series of steps 15, &c., and the other contact-segment 18 being associated with the other series or group of resistance-steps 16, &c. Cooperating with the resistance-steps and contact-segments of each of the individual switches is a switch-lever 19, having a pivotal support intermediate its ends, as at 20, on the outer side of the base 13, so that the lever will have a free play over the resistance-steps as well as the contact-segments. The switch-lever 19 of each switch is provided at one end with the usual operating-handle 21 and at its other end with a contact-heel 22, adapted to be thrown into contact with either of the segments 17 or 18, while at a point contiguous to the handle 21 there of the switch-lever 19 is further provided with a contact foot or projection 23, which is adapted to travel over and only contact with the resistance-steps 15, &c., or 16, &c., according to the direction in which the lever is swung, it being noted at this point that all of the resistance-steps of both groups lie in the arc of the same circle.

In the drawings there are illustrated six driving-axles, involving the use of six dynamo-electric machines and six rows or sets of storage batteries 9, and as but two sets or rows of storage batteries 9 can appear in diagrammatic Fig. 3 of the drawings only the complete circuit-wire connections for two dynamo-electric machines and two individual switches are shown in this figure; but it will be understood that all of the dynamo-electric machines are connected up with their indi-
individual switches and batteries in the same manner. Therefore a description of the circuit-wire connections of one dynamo-electric machine and its respective switch and battery will suffice for the others.

In explaining the circuit-wire connections for each dynamo-electric machine and its respective switch and batteries reference is made particularly to diagrammatic Fig. 4 of the drawings, which figure of the drawings illustrates the complete wire connections, which are duplicated for each of the dynamo-electric machines. As explained, the storage batteries of each group are coupled together in series, and one terminal of each group has connected thereto a battery-wire, leading to one of a pair of binding-posts 24, 25, fitted to the switch-lever 19 and thoroughly insulated from each other in any approved manner, such as indicated in Fig. 4 of the drawings. The other battery-wire connects with the other of said binding-posts—namely, the binding-post 25—and also with the other terminal of the same group or set of storage batteries 9. The dynamo-electric machine 7, associated with the group or set of batteries and the individual switch referred to, has connected therewith in the usual manner the two lead-wires c and d, respectively. The lead-wire c of the dynamo-electric machine has branch-wire connections e and f, respectively, with the binding-posts 26, 27, the binding-post 20 being connected with the last resistance-step 13° of one group and the binding-post 27 being fitted to the contact-segment 17. The other lead-wire d of the dynamo-electric machine has branch-wire connections g and h, respectively, with the binding-posts 28, 29, the binding-post 28 being fitted to the last resistance-step 15° of the other group of such steps and the binding-post 29 being fitted to the other contact-segment 18, thus completing the circuit-wire connections with the controlling-switch. Assuming the switch-lever to be in the position shown in full lines in Fig. 4 of the drawings, the same will contact with the resistance-step 15° and also with the contact-segment 18, but spans and has no contact with the segment 17. The circuit for the machine, set to act as a motor, will then be completed through the wire a, binding-post 24, switch-lever 19, resistance-steps 15°, 15°, 15°, binding-post 26, branch wire e, lead-wire c, dynamo-electric machine 7, lead-wire d, branch wire h, binding-post 29, switch-lever, binding-post 25, and other battery-wire b. By advancing the switch-lever over the resistance-steps 15°, 15°, &c., the speed of the electric locomotive may be increased at the will of the engineer, and by swinging the switch-lever around to the other group of resistance-steps 16°, &c., the current will be reversed through the dynamo-electric machine 7 acting as a motor, and consequently provide for reversing the rotation of its armature. The position of the switch-lever in reversing the dynamo-electric machine as a motor is shown in dotted lines in Fig. 4 of the drawings, and when the lever is in this position the current passes from the battery-wire a through the resistances 16°, &c., and the lead-wire d, which is in the reverse direction from that just described.

In addition to the resistance-steps and contact-segments each individual switch is further provided with a pair of diametrically opposite insulator rest-steps 30, upon which the switch-lever is swung to throw the machine entirely out of action, either as motors or generators, if being noted that the rest-steps are made of suitable insulating material and have no wire connections therewith.

In the practical operation of the electric locomotive it will be understood that the entire set of storage batteries 9 are fully charged at the station or stopping-point before starting the electric locomotive, so that when it is ready to make a start it is simply necessary to manipulate one or more of the individual switches to throw the current into one or more dynamo-electric machines after setting the latter to operate as motors. By this operation the electric locomotive is caused to be propelled solely by battery power, and in carrying out the invention it is proposed to use batteries of sufficient size and capacity to furnish sufficient power for running the electric locomotive for a hundred miles or more between stations without depending upon the energy developed from the dynamo-electric machines when set to operate as generators. Of course at times it may not require all of the dynamo-electric machines acting as motors to propel the electric locomotive, thereby enabling the electrical engineer to hold the inactive dynamo-electric machines in reserve to assist in propelling upgrade or drawing heavy loads; but when the electric locomotive is traveling on downgrades the dynamo-electric machines may be set to operate as generators, so that in being driven by the car the same will generate a current, which is utilized to recharge the storage batteries. It will thus be seen that the electric locomotive provides means for storing up a portion of its own energy, which may be utilized when the machines are again converted into motors.

The main electric-locomotive car 1 is preferably provided in its front end with a pilot or tender 31, extending well up on the front end of the car-body and of an approximately triangular shape. The said pilot or tender 31 has the opposite converging sides thereof curved to afford a minimum resistance to the air, while at the same time providing for casting off any obstacles that may be on the track.

To insure the thorough illumination of the track far in advance of the electric locomotive, there is employed an electric searchlight or lamp 32, having a suitable knuckle connection 33 with the front end of the car.
body 1 for the purpose of adjustment, whereby the same may be adjusted to and fastened in any suitable position for properly directing the light upon the track. This adjustable search-light is included in a series circuit with the individual storage battery 34 in the battery-car and with an individual cut-off switch 35, fitted to the switchboard 11 below the plane of the switches 12, so as to be under the immediate control of the electrical engineer within the main electric locomotive car.

It may be further explained at this point that the dynamo-electric machines 7 are not only combination-machines capable of being converted into generators or motors at the will of the engineer, but are also of the reversible type, so as to not only permit of reversing the direction of travel of the train, but also through the medium of the switches 12 to provide for properly taking the current from the machines when acting as generators and operating in either direction. Ordinarily when the electric locomotive is traveling on downgrades all of the dynamo-electric machines are converted into generators; but should a slower rate of speed be required the engineer may utilize only a few of the machines as motors while the remaining machines are converted into generators for recharging the batteries. In this connection it may also be observed that when the locomotive is going at a high rate of speed the conversion of certain of the machines into generators will cause the same to act in the capacity of brakes to check the speed.

Various changes in the form, proportion, and the minor details of construction may be resorted to without departing from the principle or sacrificing any of the advantages of this invention.

Having thus described the invention, what is claimed as new, and desired to be secured by Letters Patent, is—

1. In a system of electrical railway propulsion, the combination of a plurality of driving-axles, each having a convertible dynamo-electric machine thereon, a set of storage batteries for each dynamo-electric machine, and a switchboard having independent wire connections with the dynamo-electric machines and the storage batteries associated therewith, substantially as set forth.

2. In a system of electrical railway propulsion, the combination of a plurality of driving-axles, each having a convertible dynamo-electric machine thereon, a set of storage batteries for each dynamo-electric machine, and a switchboard having a plurality of individual switches, each switch having independent wire connections with the dynamo-electric machine and the set of batteries associated therewith, substantially as set forth.

3. In a system of electrical propulsion, the combination of a plurality of driving-axles, dynamo-electric machines fitted to each axle and convertible into either motors or generators, storage batteries, and switches common to the dynamo-electric machines either as motors or generators.

4. In an electrical locomotive, the combination of a main car and tender, each having a plurality of driving-axles, a convertible dynamo-electric machine fitted to each driving-axle, a plurality of storage batteries grouped within the tender, and a controlling switchboard having a plurality of individual switches, each switch having independent wire connections with a dynamo-electric machine and the group of batteries associated therewith, substantially as set forth.

5. In a system of electrical railway propulsion, the combination of the driving-axle, a convertible dynamo-electric machine for turning the axle, a group of storage batteries, a switch essentially consisting of a base having oppositely-arranged sets of resistance steps, a pair of oppositely-located segments, and a swinging switch-lever having at one end a contact-heel working over the segments and, contiguous to the other end, a contact foot or projection working over the resistance steps, a pair of binding-posts fitted to the switch-lever and insulated from each other, the battery-wires connected respectively with the separate binding-posts of the switch-lever, and the lead-wires of the dynamo-electric machine, each having branch-wire connections respectively with the last resistance step of one of the sets thereof, and the contact-segment contiguous thereto, substantially as set forth.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

RICHARD BENJAMIN PAINTON.

Witnesses:

T. F. GAHAN,
GILMAN FORD.