Aug. 28, 1923. 1,466,011

W. R. YOUMANS

ELECTRIC LOCOMOTIVE

Filed Dec. 2, 1920 2 Sheets-Sheet 1

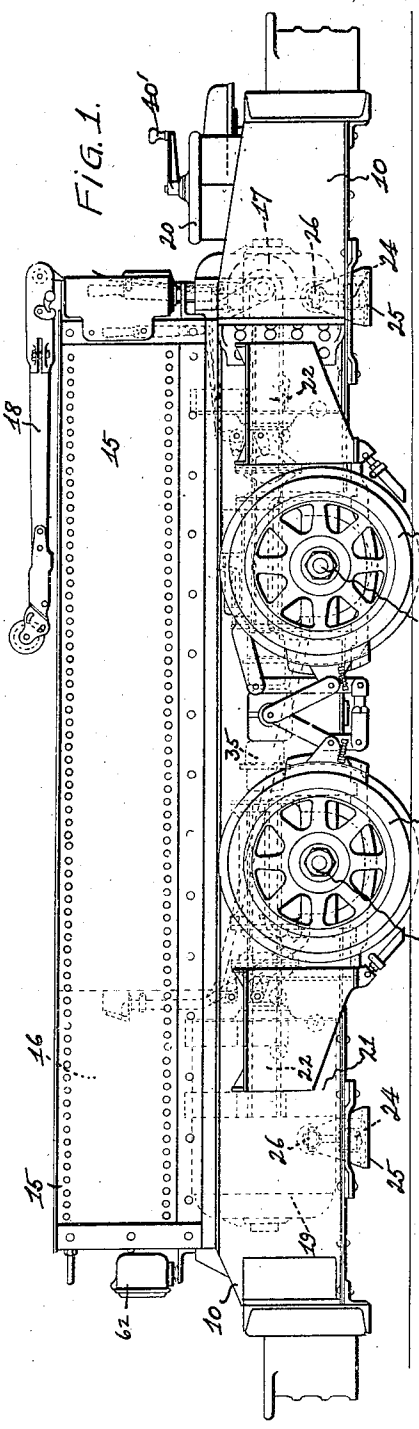

FIG. 1.

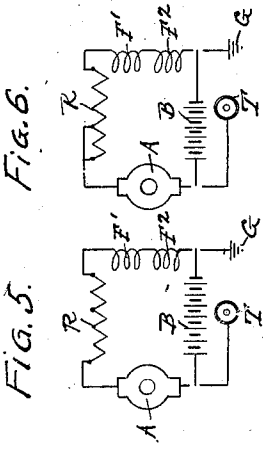

FIG. 5.

FIG. 6.

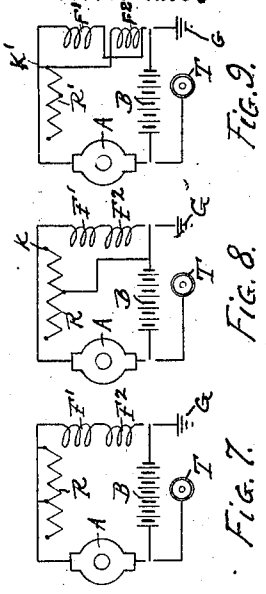

FIG. 7.

FIG. 8.

FIG. 9.

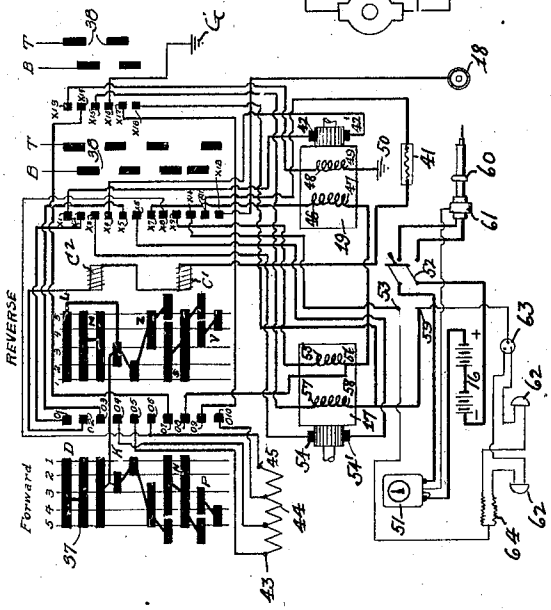

FIG. 4.

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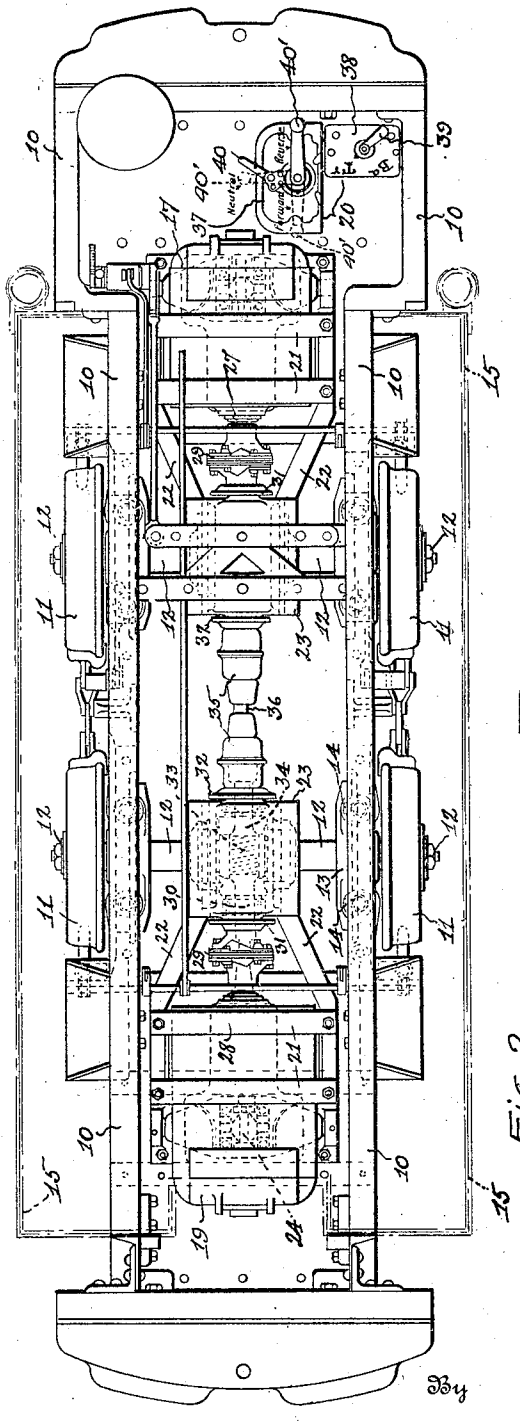

FIG. 2.

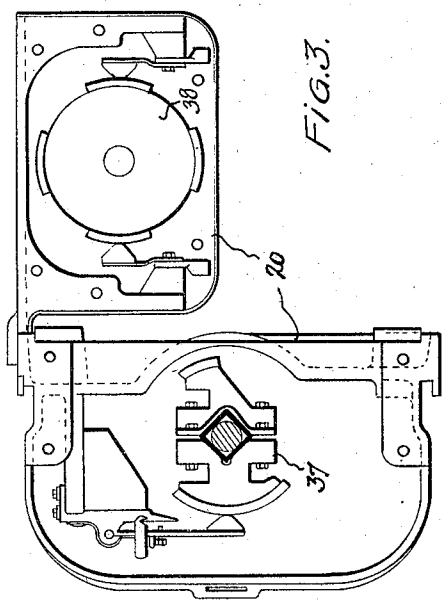

FIG. 3.

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UNITED STATES PATENT OFFICE.

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ELECTRIC LOCOMOTIVE.

Application filed December 2, 1920. Serial No. 427,789.

To all whom it may concern:

Be it known that I, WILLIAM R. YOUMANS, a citizen of the United States of America, residing at Ironton, in the county of Lawrence, in the State of Ohio, have invented certain new and useful Improvements in Electric Locomotives, of which the following is a specification.

The invention relates more particularly to locomotives adapted for use in coal and other similar mines and especially to combine in one locomotive a means for collecting cars from the working places and for hauling them singly or in train to an assembling point or to a more distant point either within or without the mine or other plant.

In a coal mine there are ordinarily one or more main entries from which extend side entries. From the side entries rooms are driven and in these rooms the operation of mining is carried on. Tracks are laid along the entries and into the rooms. Adjacent the tracks in the entries there are usually provided trolley wires for the transmission of power to locomotives operating on these tracks but on account of the changing conditions in the rooms it is found undesirable to extend the trolley wire into the rooms.

A number of methods have been devised and are in use for removing the cars from the rooms and later by other means hauling them to the final destination. One of the latest and most satisfactory mechanisms applied to the removal of cars from the working places is the storage battery locomotive. It is flexible, easily handled, will pass over any ordinary track and its range of travel is only limited by the capacity of the battery which it carries. It is essentially a slow speed machine and the economical removal of cars from the rooms requires a slow speed machine, so that it is particularly adapted to this work.

After the cars have been collected from the rooms to an entry, it is in most cases desirable that they be quickly transferred either to a side track on the main entry, or in some cases to their final destination. The slow speed of the storage battery propelled locomotive and the available energy which it carries would in this case limit production and in most operations it has been customary to limit the use of the storage battery locomotive to the gathering of the cars and use a trolley locomotive to haul them at a higher speed to the more distant point.

There are at present in use certain types of so-called "combination" battery and trolley locomotives where current from either the trolley or the battery may be applied to the motor or motors but in all such cases the efficient operating characteristics are sacrificed for the one condition or the other, i. e., they may be made so that they will operate well as a battery locomotive or as a trolley locomotive but not equally well under both conditions.

To provide a locomotive which will operate equally well as a trolley locomotive or as a storage battery locomotive I use two motors each coupled to a common flexible drive shaft. The drive shaft is preferably considered as made up of two worm shafts connected by means of universal joints to the propeller shaft. The worms engage two gears secured to the two axles and both axles are driven by either motor, and it will be noted that the mechanical connection of the two driving axles is one of the essential features of this design for otherwise the tractive effort which might be secured from either motor would be unsatisfactory and in this connection I prefer the use of the worm gear construction to be hereinafter more fully described.

One motor is designed for trolley voltage and it alone propels the locomotive as a trolley locomotive, while the second motor is designed for battery voltage and usually much lower than trolley voltage, and capable of propelling the locomotive alone as a storage battery locomotive. This arrangement permits the locomotive to operate at its economical speed of 3½ M. P. H. at rated draw bar pull as a storage battery locomotive and at the more desirable speed of 6 M. P. H. at rated draw bar pull as a trolley locomotive.

The two motors are operated independently through one controller which will have two drums or through two separate drums. In either case the main or operating drum will be of the reversing type with two sets of movable contacts, one set for each direction of motion. These will work in conjunction with corresponding stationary contacts or fingers for making and breaking the electrical connections to the motors. The second

or auxiliary drum will be provided with suitable movable contacts which will work in conjunction with the necessary stationary fingers to make the desired connections from either of the two sources of energy supply to its corresponding motor.

The main drum has a number of positions, in this instance five, for each direction of motion, these positions being the usual rheostatic or other speed points of a drum controller. The auxiliary drum will have two positions, one position for trolley operation and the other for battery operation and the forward motion of the locomotive is secured by moving the operating handle of the main drum in one direction and the reverse motion obtained by moving the handle in the opposite direction.

The principal object of the invention is to provide a so-called "duplex" locomotive which will answer the two above described requirements. That is, it will operate efficiently as a storage battery locomotive for gathering the cars from the rooms and it will also operate efficiently from the trolley on the entries, for quickly hauling the cars to their destination.

Other objects and advantages of the invention will readily appear from the detailed description of the construction, and arrangement of the parts and mode of operating the same.

The invention consists of structural characteristics and relative arrangements of elements which will be hereinafter more fully described and particularly pointed out in the appended claims.

In the drawings in which similar reference characters indicate the same parts in the several figures,

Figure 1 is a side elevation of the locomotive embodying the invention;

Figure 2 is a plan view of the locomotive with storage battery compartment removed for purpose of more clearly showing the arrangement and connections of the motors;

Figure 3 is a horizontal sectional view through the controller;

Figure 4 is a diagrammatic view showing the electrical connections, and

Figures 5, 6, 7, 8 and 9 are diagrams showing the main connections as the controller handle advances for the different speed combinations.

Referring to the drawings 10, designates in a general way the truck of the locomotive and consists of a rectangular frame supported on driving wheels 11, 11, which are mounted on the outer ends of the axles 12, 12, journalled in the usual bearings carried by the axle housings 13, 13, said axle housings 13, being cast with suitable recesses to receive springs 14, 14, for flexibly and yieldingly supporting said wheels 11, with respect to the truck frame 10.

15 is a rigid compartment occupying substantially the full width and length of the upper side of the truck frame 10 and securely attached thereto, and is adapted to receive a storage battery 16, for supplying the necessary electric current to properly energize the low voltage or low speed driving motor 17. 18 is the trolley pole or mechanism suitably hinged to one end of the compartment 15 and adapted to contact with the usual trolley wire and furnish current to the high voltage or speed driving motor 19, and 20 is a controller having the proper connections with the storage battery and trolley mechanism for reversing and separately regulating the two independent sources of electric current to said driving motors 17 and 19, as will be presently described.

The two separate and independent driving motors 17 and 19 are disposed at opposite ends of the truck frame 10, and are supported by cradles 21, said cradles being attached to the truss bars 22 fastened at their adjacent ends to gear housings 23, and at their opposite ends to the motor cradles 21. Cradles 21 are flexibly connected through universal joints 24 to yokes 25 which trunnion or oscillate on bearings 26 whereby the two independent driving motors 17 and 19 are free at all times to swing or adjust themselves to follow the alignment of the axles 12, 12 as will be clearly understood by the showing in Figs. 1 and 2.

27 and 28 are the motor armature shafts respectively of the low speed motor 17 and high speed motor 19 and are connected by means of flexible couplings 29, 29 to the worm shafts 30, 30, which are suitably mounted on ball bearings 31 and 32 supported in the gear housings 23, 23. Worms 33, 33 on said worm shafts 30, engage worm gears 34, 34 keyed or mounted on the axles 12, 12. The adjacent ends of the worm shafts 30, are connected by any form of suitable universal couplings 35, 35 connected together by a stub propeller shaft 36, as shown.

The controller 20 so far as its general mechanical construction and arrangement are concerned can be modified in a number of ways, but the form found best adapted for use in connection with the present invention is shown in Fig. 3, illustrating a reversing type of drum controller 37 used with the usual storage battery locomotive, with a single motor having combined and interlinked therewith an auxiliary drum 38 to provide for the operation of either of the two independent motors 17 and 19 from their respective sources of electrical energy by way of the storage battery 16 or trolley pole 18, and said auxiliary drum 38 is preferably located in proximity to the main drum 37, so that the two drums 37 and 38 may be interlocked to prevent the operation

of the drum 38 except when the drum 37 is at the neutral or "off" position. 39 is a handle for operating the auxiliary drum for driving by either the current from the trolley or the storage battery and 40 is the handle of a safety interlock, as shown for example in U. S. Patent No. 1,385,935, to A. R. Williams, dated July 26, 1921, to prevent the handle 40′ of the main drum 37 being unintentionally moved beyond the neutral and into the reverse position.

The manner of connecting up the electrical circuits in using the invention and energizing either of the two motors 17 and 19 and controlling their direction of rotation and speed will be clearly understood by reference to the diagrams shown in Figs. 4 to 9 inclusive, and is as follows:

If it is desired to run the locomotive forward while energizing the high speed motor 19 and operating from the trolley pole 18, the operator first turns the handle 39 of auxiliary drum 38 to the position marked T^r in Figure 2, which places certain fingers of series X, in contact with segments T, indicated on the right side of Figure 4, which cooperate with the trolley current. The operator then turns the interlock handle 40 into the "forward" position. The handle 40′ of the main drum 37 is then moved from the neutral position to the first of the "forward" positions or steps which brings the fingers of the series O, of said controller 37 in contact with the sections D, K, N and P, shown on left side of Figure 4.

When the sections D, K, and N, engage corresponding fingers of main controller drum 37, the circuit through the high voltage or high speed motor 19 is completed and current flows from the trolley 18 to fingers X^{12} to X^{11}, through fuse 41 to blow-out coils C^1 and C^2 to finger O^2 to section D to O^1 to X^2 to X^1, to brush 42 of motor 19, through armature to brush 42′, to X^4 to X^5 to O^3, through section K to O^5 to point 43, through resistance 44 to point 45 to X^8 to X^7 to point 46 through section of field winding to point 47 to O^8 through section N to O^7 to X^{14} to X^{13} to point 48 through section of field winding to point 49 to ground 50. Other speed connections are obtained by rotating or advancing the operating handle 40′.

If it is desired to operate the locomotive in the reverse direction while energizing the high speed motor 19 and taking current from the trolley pole 18, the operator first turns the handle 39 of auxiliary drum 38 to the position marked T^r in Figure 2, which places certain fingers of series X in contact with segments T indicated on the right side of Figure 4 which cooperates with the trolley current. The interlock handle 40 is then adjusted to the "reverse" position. The handle 40′ of the main controller drum 37 is then moved from the neutral, central, position to the first of the "reverse" positions which brings certain fingers of the series O, of said controller 37 in contact with sections L, M, S, V shown at the right side of Figure 4.

When the sections L, M, S engage corresponding fingers of main controller drum 37 the circuit through the high voltage or trolley motor is completed and current flows from the trolley 18 to finger X^{12} to finger X^{11} through fuse 41 to blow-out coils C^1 and C^2 to finger O^2 to section M to O^3 to X^5 to X^4 to brush 42′ of motor 19, through armature to brush 42 to X^1 to X^2 to O^1, through section L to O^5 to point 43 of resistance, through resistance to X^8 to X^7 to point 46 through field section to point 47 to O^8 through sections S to O^7 to X^{14} to X^{13} to point 48, through field section to point 49 to ground 50. Other speed connections are obtained by advancing handle 40′.

If it is desired to operate the locomotive in the forward direction while taking the current from the battery 16 and energizing the low voltage or low speed motor 17, the operator first turns the handle 39 of auxiliary drum controller 38 to the position marked in Figure 2, B^a, which adjustment places certain fingers of series X in contact with segments B on the right side of Figure 4, and adapted to be connected with the storage battery 16. The interlock handle 40 is then adjusted to the "forward" position. The handle 40′ of the main controller drum 37 is then moved from the neutral position to the first of the "forward" positions which brings certain fingers of the series O in contact with the sections D, K, N and P, and when sections D, K and N engage corresponding fingers, the circuit through the low voltage or low speed motor 17 is completed and current from the battery 16 flows through the ampere hour meter 51 to switch 52 to point 53 to X^{10} to X^{11} to fuse 41, through blow-out coils C^1 and C^2 to O^2 through section D to O^1 to X^2 to X^3 to brush 54 of motor 17 through armature to brush 54^1 to X^6 to X^5 to O^3 through section K to O^5 to point 43, through resistance 44 to point 45 to X^8 to X^9 to point 55 through the field section to point 56 to O^8 through section N to O^7 to X^{14} to X^{15} to point 57 through field section to point 58 to point 59 through switch 52 to battery 16. Other speed connections are obtained by advancing the handle 40′.

If it is desired to operate the locomotive in the "reverse" direction while taking the current from the battery 16 and energizing the low voltage or low speed motor 17, the operator first turns the handle 39 of auxiliary drum 38 to the position marked B^a in

Figure 2, which places certain fingers of series X in contact with segments B indicated on the right side of Figure 4 and adapted to be connected with the storage battery 16. The interlock handle 40 is then adjusted to the "reverse" position. The handle 40′ of the main controller drum 37 is then moved from the neutral position to the first "reverse" position which brings certain fingers of the series O of the controller 37 in contact with sections L, M, S, V shown at the right in Figure 4.

When the sections L, M, S engage corresponding fingers of main controller drum 37 the circuit through the low voltage motor is completed and current flows from the battery 16 through the ampere hour meter 51 to switch 52 to point 53, switch being thrown to the left or running position, to X^{10} to X^{11} to fuse 41 through blow-out coils C^1 and C^2 to O^2 through section M to O^3 to X^5 to X^6 to brush 54′ of motor 17 through armature to brush 54 to X^3 to X^2 to O^1 to section L to O^5 to point 43, through resistance to point 45 to X^8 to X^9 to point 55, through field section to point 56 to O^3 through section S to O^7 to X^{14} to X^{15} to point 57, through field section to point 58 to point 59 through switch 52 to battery 16. Other speed connections are obtained by advancing handle 40′.

60 represents the usual charging plug, and 61 the charging socket which cooperate with the switch 52 for connecting the battery 16 with a suitable source of electrical energy whenever said battery is to be recharged, and 62, 63 and 64, indicated in Figure 4, are respectively, the headlight lamps, switch, and resistance which are common expedients in mine locomotives and need no further disclosure.

The diagrams shown in Figures 5 to 9 inclusive, illustrate the main connections as the controller handle 40′ advances from point 1 to point 5 to effect the different speed combinations, and the arrangement of control shown is what is known as the "split field" type, that is, the field windings are divided into two parts which are first connected in series to give high starting torque and later connected in parallel for normal operation at the higher speed and represents the type of control, essential to the most economical operation of this type of locomotive.

The five speed combinations illustrated in Figures 5 to 9 inclusive, correspond with the five positions of the controller handle 40′ and the reference characters applied to the different devices or elements indicated in these figures are as follows: A, the armature; R, the resistance; F′ and F^2 the field windings or sections; B, the battery; T, the trolley; and G the ground, and it will be seen and readily understood therefrom that the operation as will be explained is the same whether the motor energized is the low voltage or battery motor 17 taking its current from the battery 16, or the higher voltage or trolley motor 19 taking its current from the trolley with the return side grounded, and with this understanding and particular explanation with the use of the battery current and motor, Fig. 5 shows all resistance R, in field windings or sections which are in series, and the current passing from battery B, to armature A, through resistance R, to field section F′, to field section F^2 to battery B. Figure 6, shows part of resistance R, in field windings in series, and the current passes from battery B, to armature A, through part of resistance R, to field section F′, to field section F^2, to battery B. Figure 7 indicates all of the resistance R, out of field windings in series and the current passes from battery B, to armature A, to field section F′, to field section F^2, to battery B. Figure 8 shows part of resistance R, in parallel with field sections in series and the current passes from battery B, to armature A and divides at K, part of current goes to field section F′, to field section F^2 to battery B, and the other part of the current is shunted around the field sections F′ and F^2 and passes through part of resistance R, to battery B, and Figure 9 shows all the resistance R, out of the field sections or windings in parallel and the current passes from the battery B to armature A and divides at K′ and part of the current going through field section F′ to battery B and the other part going through field section F^2 to battery B.

From the foregoing disclosure of construction and arrangement of the different elements comprising the locomotive and manner of distributing and applying the electric current to the motors thereof, it will be seen that all the objects, functions and advantages of the electric locomotive set forth in the statement of invention have been fully and efficiently carried out at a minimum of cost of manufacture, installation and operation.

It will also be understood and is obvious that various other forms and modifications of the locomotive may be made without departing from the essential features and underlying principles of my invention and I do not wish to be understood as limiting myself to the specific and preferred construction herein shown and described.

What I claim is:—

1. An electric locomotive comprising a main frame, driving wheels, axles for said driving wheels, a trolley mechanism, a storage battery, a driving mechanism flexibly connecting said axles and constructed and arranged so that all said wheels are drivers, an electric motor on said frame and provided with sectional field windings to per-

mit "split field" control and connected to the driving mechanism and adapted to utilize high voltage current from the trolley mechanism, a second electric motor on said frame and also provided with sectional field windings to permit "split field" control and connected to the driving mechanism and adapted to utilize low voltage current from said storage battery, a controller comprising two sets of resistance contacts adapted to introduce starting resistance and secure the desired speed combination, and two sets of auxiliary contacts constructed, arranged and movable independently of the resistance contacts and adapted respectively to connect the trolley mechanism and resistance contacts in circuit with the high voltage motor or to connect the battery and the resistance contacts in circuit with the low voltage motor.

2. In an electric locomotive the combination with the main frame and two sets of driving wheels, an axle for each set of driving wheels, a trolley mechanism, a storage battery, a driving mechanism flexibly connecting both sets of axles so that all wheels are drivers, an electric motor near one end of the frame and provided with sectional field windings to permit "split field" control and connected to the driving mechanism and adapted to utilize high voltage current from the trolley mechanism, a second electric motor near the other end of the frame and also provided with sectional field windings to permit "split field" control and connected to the driving mechanism and adapted to utilize low voltage current from said storage battery, a controller comprising two sets of resistance contacts constructed, arranged and adapted to introduce starting resistance and secure the desired speed combination, and two sets of auxiliary contacts, constructed, arranged and movable independently of the resistance contacts and adapted respectively to connect the trolley mechanism and resistance contacts in circuit with the high voltage motor or to connect the battery and the resistance contacts in circuit with the low voltage motor.

3. An electric locomotive, comprising a main frame, a plurality of sets of driving wheels, axles for said driving wheels, a trolley mechanism, a storage battery, separate and independent high and low voltage current driving motors, each of said motors provided with sectional field windings to permit "split field" control, a driving mechanism connecting axles to said driving motors so that all wheels are drivers, said high voltage motor being adapted to utilize current from the trolley mechanism, and the low voltage motor being adapted to utilize current from said storage battery, a controller comprising two sets of resistance contacts constructed, arranged and adapted to introduce starting resistance and to secure the proper electrical connections for the desired speed combinations, and a switch with two sets of auxiliary contacts constructed, arranged and movable independently of the resistance contacts and adapted respectively to connect the trolley mechanism and the resistance contacts in circuit with the high voltage motor or to connect the battery and the resistance contacts in circuit with the low voltage motor.

4. In an electric locomotive, the combination with the main frame, and two sets of driving wheels, an axle for each set of driving wheels, a storage battery, two electric driving motors, each of said motors provided with sectional field windings to permit "split field" control, a driving mechanism flexibly connecting both sets of axles to said driving motors so that all wheels are drivers, one electric driving motor being adapted to utilize current from the trolley mechanism, the other electric motor being adapted to utilize current from said storage battery, a controller comprising two sets of resistance contacts constructed, arranged and adapted to introduce starting resistance and secure the proper electrical connections for the desired speed combinations, and a switch with two sets of auxiliary contacts constructed, arranged and movable independently of the resistance contacts and adapted respectively to connect the trolley mechanism and the resistance contacts in circuit with one of said motors or to connects the battery and the resistance contacts in circuit with the other motor.

5. In an electric locomotive the combination with the main frame, driving wheels supporting said frame, axles for said driving wheels, suitable gearing mounted on each axle, a driving shaft for each axle having a gear thereon adapted to drive the corresponding gear on the axle, a flexible connection between the driving shafts, an electric motor connected to each of the two drive shafts, and each motor provided with sectional field windings to permit "split field" control, one of said motors being adapted to utilize current from the trolley mechanism and the other motor being adapted to utilize current from a storage battery, means for supporting and holding the motors in proper relation with said gears and shafts, means for flexibly connecting the motors with the frame, a controller comprising one drum with two sets of resistance contacts constructed, arranged and adapted to introduce starting resistance and secure proper electrical connections for the desired speed combinations for the forward and reverse movement of the locomotive, and a second drum or switch with two sets of auxiliary contacts constructed, arranged and

movable independently of the resistance contacts and adapted respectively to connect the trolley mechanism and resistance contacts in proper electrical circuit with one of said motors or to connect the battery and the resistance contacts in circuit with the other motor.

6. In an electric locomotive, the combination with the main frame, driving wheels supporting said frame, axles for said driving wheels, worm gears mounted on said axles, a driving shaft for each axle having a worm thereon and adapted to drive the corresponding worm gear on the axle, a flexible connection between the driving shafts, an electric motor connected to each of the driving shafts, one of said motors being adapted to utilize current from the trolley mechanism, the other being adapted to utilize current from the storage battery, both being equipped with sectional field windings to permit "split field" control, means for supporting and holding said motors in proper relation with said gearing, means for flexibly connecting the motors with the frame, a controller comprising one drum with two sets of contacts arranged and adapted to introduce starting resistance and to secure proper electrical connections for the desired speed combination for the forward and reverse movement of the locomotive, an interlock for said drum to prevent the same being unintentionally moved beyond the neutral and into reverse position, a second drum or switch, with two sets of contacts constructed, arranged and movable, independently of the resistance contacts and adapted respectively to connect the trolley mechanism and resistance contacts in proper electrical circuit with one of said motors or to connect the battery and the resistance contacts in circuit with the other motor.

In testimony whereof, I affix my signature.

WILLIAM R. YOUMANS.