(No Model.) 3 Sheets—Sheet 1.

S. P. HOLLINGSWORTH.

ELECTRIC LOCOMOTIVE.

No. 470,627. Patented Mar. 8, 1892.

Fig. 1

Witnesses
B. W. Miller.
Baltus De Long.

Inventor
Sidney P. Hollingsworth
by Baldwin, Davidson & Wright.
his Attorneys

(No Model.)

3 Sheets—Sheet 2.

S. P. HOLLINGSWORTH.

ELECTRIC LOCOMOTIVE.

No. 470,627. Patented Mar. 8, 1892.

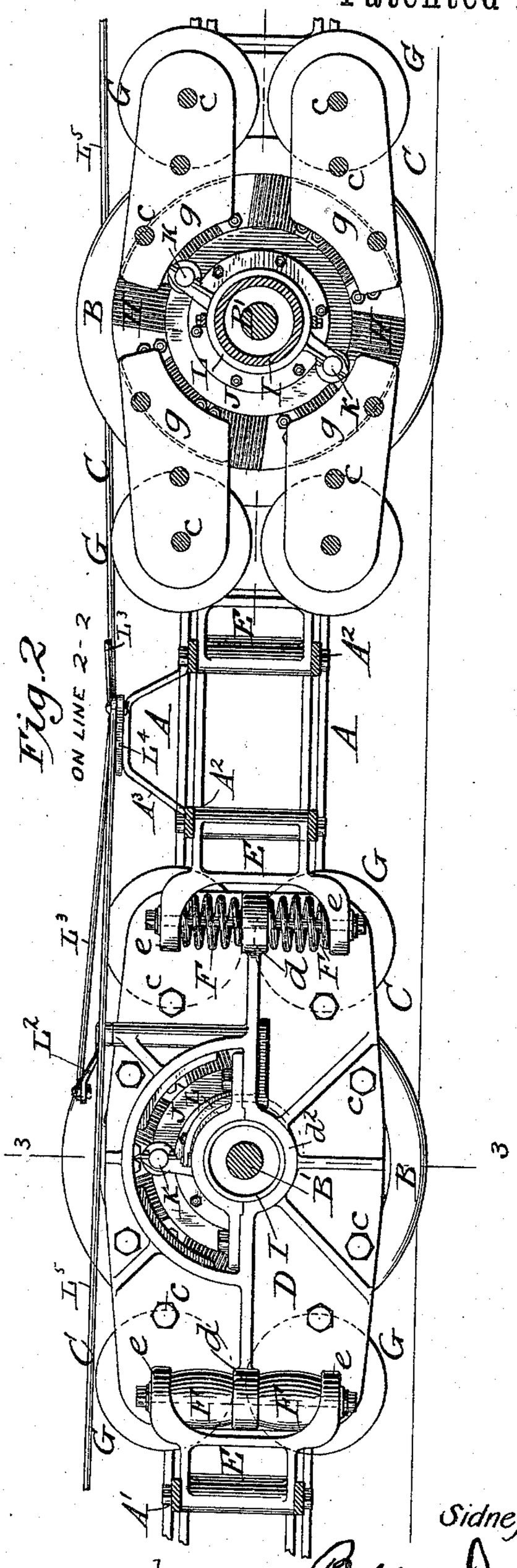


Fig. 2.

ON LINE 2-2

Witnesses
B. W. Miller.
Baltus De Long.

Inventor
Sidney P. Hollingsworth
by Baldwin Davidson & Wright
his Attorneys

(No Model.)

3 Sheets—Sheet 3.

S. P. HOLLINGSWORTH.

ELECTRIC LOCOMOTIVE.

No. 470,627. Patented Mar. 8, 1892.

Fig. 3

ON LINE 3-3

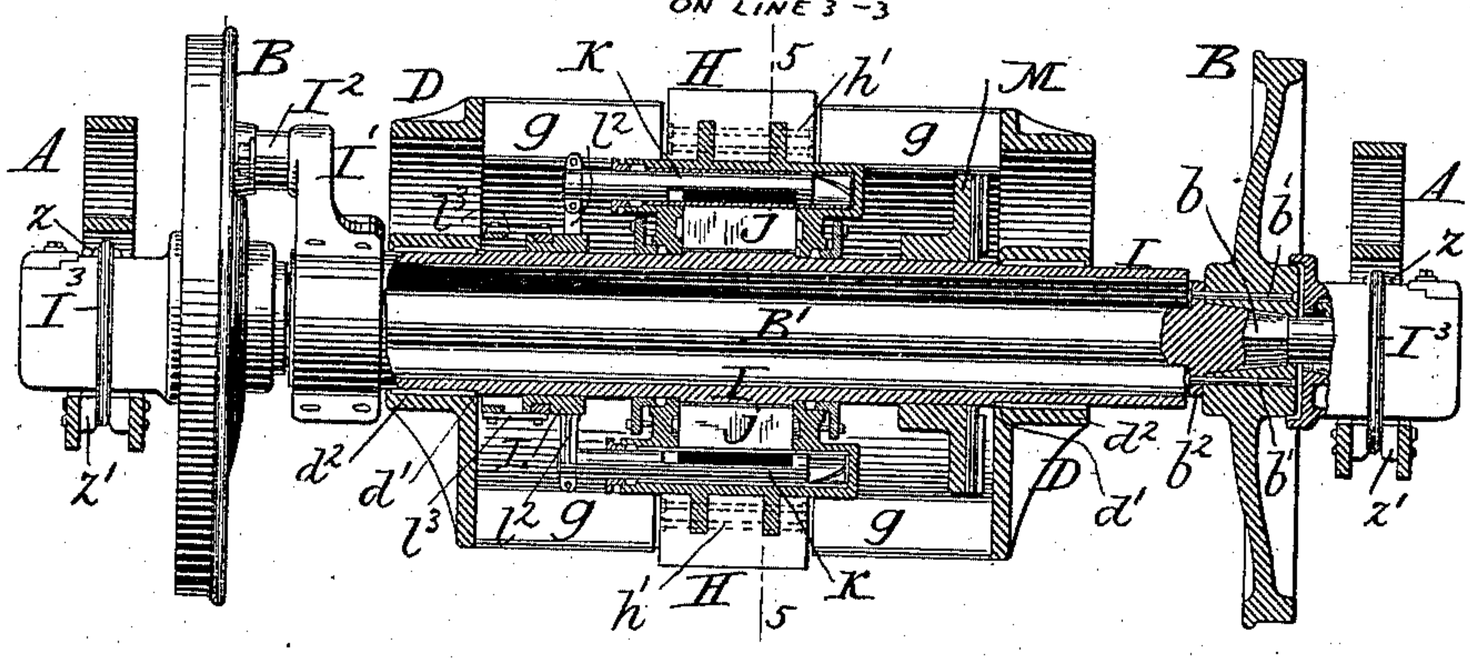


Fig. 5.

ON LINE 5-5

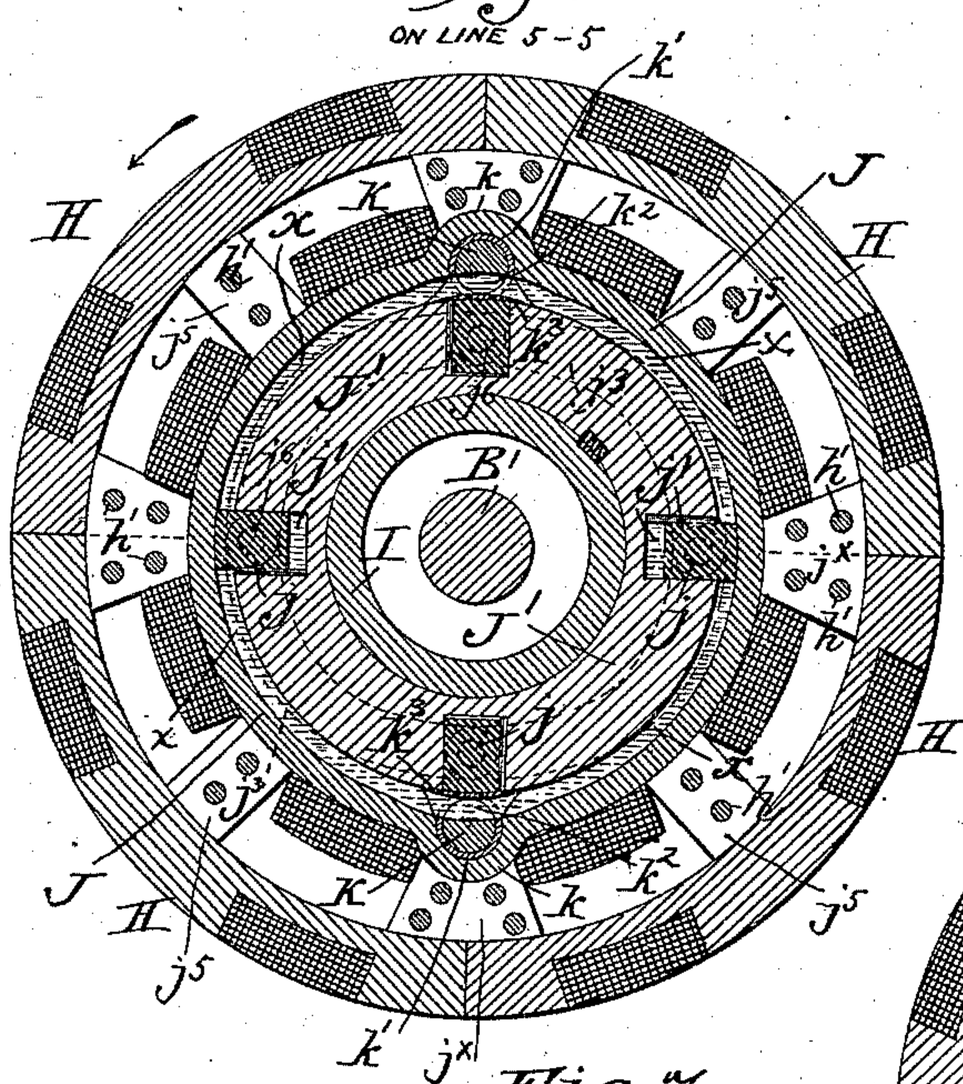


Fig. 4.

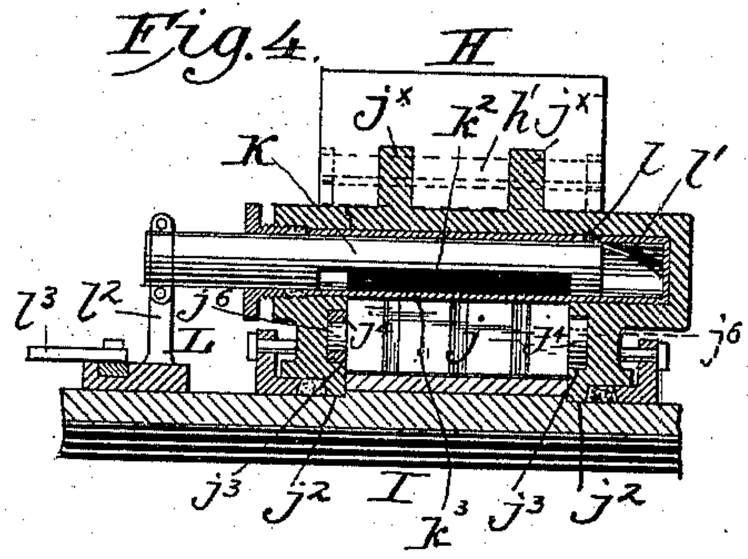


Fig. 6.

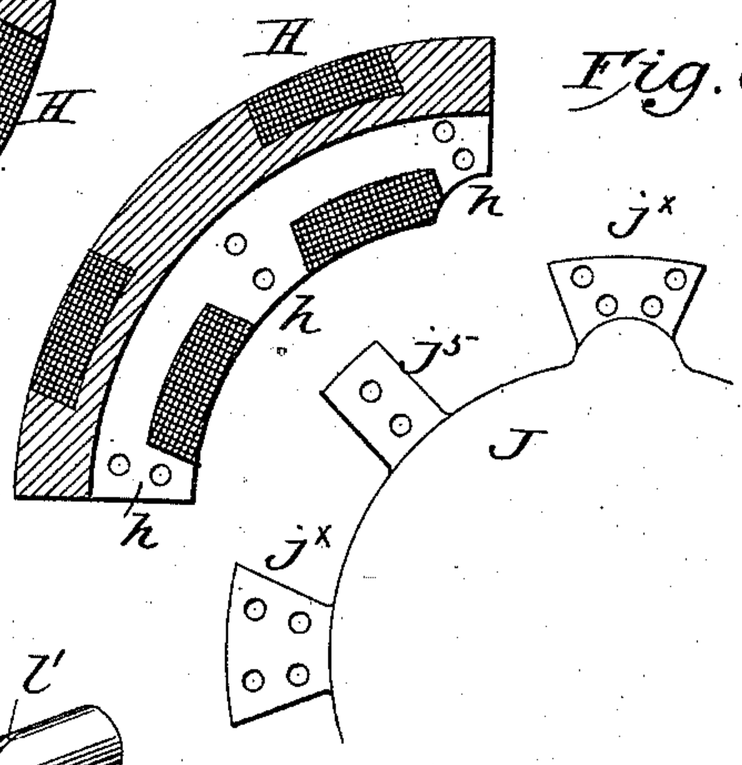
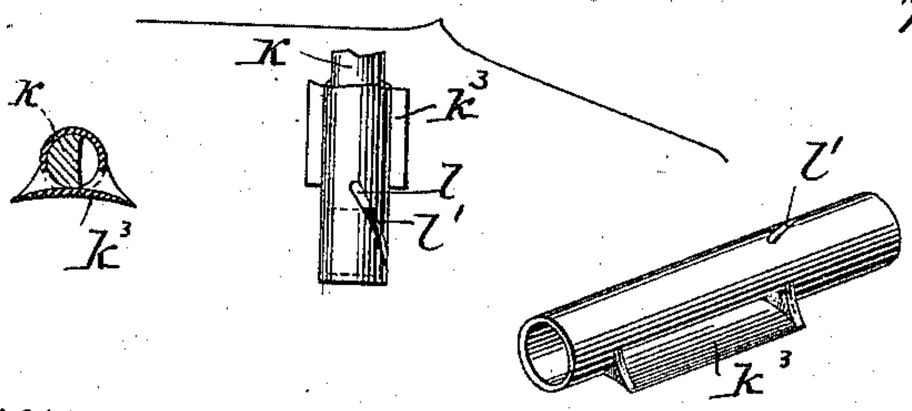


Fig. 7.



Witnesses
B. W. Miller.
Baltus DeYoung.

Inventor
Sidney P. Hollingsworth
by Baldwin Davidson & Wright
his Attorneys

UNITED STATES PATENT OFFICE.

SIDNEY P. HOLLINGSWORTH, OF WASHINGTON, DISTRICT OF COLUMBIA.

ELECTRIC LOCOMOTIVE.

SPECIFICATION forming part of Letters Patent No. 470,627, dated March 8, 1892.

Application filed December 15, 1891. Serial No. 415,158. (No model.)

To all whom it may concern:

Be it known that I, SIDNEY P. HOLLINGSWORTH, a citizen of the United States, residing in the city of Washington, in the District of Columbia, have invented certain new and useful Improvements in Electric Locomotives, of which the following is a specification.

My invention relates especially to the class of electric locomotives in which the rotary part of the electric motor is arranged concentric with the axis of the carrying-wheels. My object is to provide improved means whereby the speed of the vehicle may be regulated or varied without varying the speed of the motor, and whereby the vehicle may be started and stopped while the motor is running at full speed.

I have embodied my invention in a "gearless motor-car," because locomotives of this class possess many advantages over others. Loss of power is avoided, there is no lost motion, objectionable noise is done away with, and there is less complication of machinery; but in gearless motors some provision has to be made to relieve the motor from the jarring vibration and up-and-down motion caused by the wheels running over an irregular roadbed and by the shifting of the weight in the car-body. I so organize the apparatus embodying my improvements that the jarring vibration and up-and-down movement is not communicated to the motor mechanism to any injurious extent.

In carrying out my invention I preferably arrange the armature of the motor concentric with the car-axle and support the field-magnets in a frame flexibly or yieldingly supported in the truck-frame. I connect the armature with the wheels and axle by flexible couplings through a clutch of peculiar construction, which, briefly stated, consists of two members, one of which is connected to the armature and the other to the wheels and axles. A liquid—such as oil—is interposed between the two members of the clutch and the flow of the liquid is controlled by suitable valve mechanism. When the regulating-valves are fully closed, the two clutch members are connected to move together at the same speed. When the regulating-valves are fully open, one clutch member may rotate without moving the other. By suitably adjusting the regulating-valves to vary the flow of the liquid between the clutch members the speed of the driven member of the clutch, and consequently the speed of the vehicle, may be varied at will.

In the accompanying drawings I have shown my invention embodied in an electric locomotive or electric motor-car constructed in accordance with what I deem the most practical and efficient way. I wish it understood, however, that I do not limit myself to this one form of apparatus, as I have devised many others and consider them as within the scope of my present invention.

Figure 1 is a top view of so much of a car-truck embodying my improvements as is necessary to illustrate the novel subject-matter. The left side of the figure is in plan, the right side partly in section. Fig. 2 is a longitudinal section on the line 2 2 of Fig. 1. Fig. 3 is a transverse section on the line 3 3 of Figs. 1 and 2. Fig. 4 is a detail view in section, showing more particularly the clutch mechanism. Fig. 5 is a central transverse section on the line 5 5 of Fig. 3, but on a larger scale. Fig. 6 is a detail diagram view showing a section of the armature and a section of the clutch member to which it is secured. Fig. 7 is a detail view of the casing of one of the regulating-valves.

The truck-frame may be constructed in any suitable way. I have shown in the drawings so much of the side bars A and cross-bars A′ A^2 as is necessary to show how my improvements are applied. The frame may be either rigidly secured to the axle-boxes, in which case springs should be interposed between the truck-frame and the car-body, or springs may be interposed between the boxes and the frame. Both methods of construction are well known.

The car-wheels B may be secured to the axles B′ in the usual way, or in some cases I prefer to removably secure one of a pair of wheels to the axle, as shown in Fig. 3, my object being to readily withdraw the wheels and axles from the truck without disturbing the motor mechanism. As shown in Fig. 3, one end

of the axle B′ is formed with a polygonal tapered portion *b*, which fits a corresponding socket in the wheel. Rivets *b′* extend through the wheel and through an annular flange or collar b^2, formed on the axle. I deem it important in this connection to use rivets instead of bolts, as bolts are apt to work loose, while rivets will remain firm until cut by a cold-chisel or other such tool. I have shown in the drawings a four-wheel truck, each set of wheels being provided with motor mechanism. As this mechanism is practically the same at both ends of the truck, I will describe that at one end only.

The field-magnets C are secured by bolts *c* to a frame D of suitable shape and construction. The frame is formed with lugs *d*, which extend between the arms *e* of brackets E, secured to the cross-pieces A^2 of the truck-frame. Springs F are interposed between the lugs *d* and the arms *e* and afford a yielding or elastic support for the motor-frame and the mechanism connected therewith. I desire to use a motor having an armature of large diameter, and so I locate the pole-pieces of the field-magnets at the sides of the armature, and in order that the coils and pole-pieces of the field-magnets may not be in the way of the clutch-operating mechanism which I employ I arrange the axes of the coils G parallel with the axis of the armature H and locate the pole-pieces *g* close to the sides of the armature. By this arrangement I may employ a field having eight pole-pieces, as shown, with the requisite amount of metal and coils of sufficient size.

The frame D, which is yieldingly supported by the truck-frame, as above set forth, is formed with openings *d′* and bearings d^2, Fig. 3, for a sleeve I, which extends through the openings and is free to turn in the bearings d^2. The sleeve surrounds the axle B′ without touching it, its interior diameter being considerably greater than the diameter of the axle, so that the axle may have a free up-and-down movement therein.

The sleeve I is provided with an arm I′, to which is pivotally connected a link I^2, in turn connected by means of a vertical pivot i^4 to a link I^4, which is connected by a vertical pivot i^5 with a link I^5, pivotally connected with a pin *i* on the car-wheel B. It is obvious that if the sleeve I is rotated the vehicle will be propelled and that the car-wheels and axle may vibrate up and down without imparting a corresponding vibration to the sleeve. On the right side of Fig. 1 I have shown a substitute for the links shown at the left side. In this instance the car-wheel is provided with a lug *i′* and two arms are formed on the sleeve I. A bolt i^2 extends loosely through the arms and through a hole *y* in the lug and through the springs i^3. A yielding connection is thus formed between the sleeve and the wheel. The hole *y* is sufficiently wide to allow the bolt i^2 to have a slight transverse movement.

By the construction above described provision is made for allowing the wheels and axles to have a slight transverse movement relatively to the truck-frame or car-body, and in like manner the truck or car-body may have a transverse movement relatively to the wheels and axle. As shown in Fig. 3, the truck-frame is suspended from the axle-boxes by means of links I^3. The upper portions of the links rest in seats *z* on the top of the boxes, and the lower portions of the links are arranged in grooved blocks *z′*, which are secured to the truck-frame. It is sometimes desirable that the wheels and axles should move relatively to the truck-frame or the car-body—as, for instance, when the car is running at high speed and comes to a curve. Should there be a rigid connection the car will tend to "jump the track;" but this tendency is somewhat reduced by means of the construction above set forth. The construction allows the wheels to follow the track at all times, while the body may for an instant retain its forward motion.

When the truck-frame in the construction shown moves laterally or transversely relatively to the wheels and axle, the links will swing in their seat *z* as centers. When the wheels and axles move transversely relatively to the truck, the links swing from their seats *z′* as centers.

As above described, the connections between the arms I′ and the wheels are sufficiently flexible to permit of this transverse movement.

The armature or rotary part H of the motor is arranged centrally about the sleeve I, and between the armature and the sleeve is arranged the clutch mechanism for connecting it with the sleeve.

The clutch has two principal members—a driving member J and a driven member J′. The member J′ is securely fastened to the sleeve I and it is provided with a series of radially-moving valves or abutments *j*, seated in corresponding recesses *j′*. The driving member J is arranged to incase the member J′ and it bears at j^2 on the sleeve I, being free to turn thereon. The inner walls of the member J are formed with cam-grooves j^3, in which work rolls j^4, mounted on studs j^6, projecting laterally from the abutments *j*. By this means the abutments are moved radially at the proper times. There is an annular space *x* left between the two clutch members, and this space is filled with liquid, such as oil. Valve-casings *k* are formed in the member J, and these are provided with seats or linings *k′* for the valves K, which are cylindrical, fitting closely to the seats, but are cut away at k^2, so that when turned to the proper position a free passage is left for the flow of the liquid in the space *x* between the two clutch members. All joints are suitably packed to prevent leakage.

I have shown two valves K. A greater or less number may be employed. The casing

of each valve is provided with a closed portion k^3, closely adjacent to the inner member of the clutch and against which the valve K works when closed. The outer end of each valve K is connected by means of an arm l^2 with a sliding sleeve L, which is connected by links l^3 with an arm L′, in turn connected to a lever-arm L^2, pivoted to the frame at l^4. The lever-arm L^2 is connected at its inner end to a rod L^3, connected to a centrally-pivoted cross-bar or lever L^4, pivoted on a bracket A^3 on the truck-frame. Each end of the lever L^4 is connected to a rod L^5, which leads to a crank or other operating device. As the valves are moved laterally by the sleeve L, pins l on the valves engage with inclined grooves l' in the valve-casings and cause the valves to turn to open or close the passages which they control. The armature H is secured to the outer member J of the clutch. I preferably form the armature in sections, so that it may be removed laterally from the clutch member.

As shown, the clutch member J is provided with lugs j^5 $j^\times$, and the armature is formed in four sections, the ends of which fit closely together when in place. Each section of the armature-core is provided with seats or recesses h, into which the lugs j^5 $j^\times$ project. Bolts h', extending through the cores of the armature-sections and through the lugs, firmly secure the parts together. The lugs $j^\times$ are formed with inclined sides, thus making a more secure connection, but one which permits of the ready removal of the armature-sections.

As shown, the commutator M is secured to the sleeve I, and the commutator-brushes N are adjustably secured to the frame D.

I deem the organizations shown and described most practical and efficient. The field-magnets and the armature always maintain the same relative position, and the two clutch members also always maintain the same relative position. There is no danger of the armature striking against the field-magnets, even when a drum-armature is used, and an armature of large size may be employed approximating in diameter that of the wheels. The armature may rotate continuously and be readily applied to effect the rotation of the wheels, either suddenly or gradually, by the use of the clutch mechanism employed. The armature may rotate at a constant speed, and the speed of the vehicle may be varied by suitably adjusting the regulating-valves.

When the valves K are fully open, the clutch member J′ and the sleeve I remain stationary; but if the valves K are turned to completely close the openings in the valve-seats, the liquid, which is practically non-compressible, will form a secure connection between the two clutch members, the valves K pressing against the liquid, and the liquid in turn pressing against the valves or abutments j and against the inner and outer members of the clutch. There being no escape for the liquid and it being practically non-compressible, the two members of the clutch must revolve together. In like manner the speed of the driving part may be regulated by partially closing the regulating-valves, so as to provide an opening greater or less in extent in the valve-seats for the flow of the liquid.

I claim as my invention—

1. In an electric locomotive, the combination of a continuously-running motor, the vehicle wheels and axle, a clutch member connected to the wheels by flexible couplings, a clutch member connected to the motor, a liquid for connecting the two clutch members, and mechanism for controlling the flow of the liquid.

2. In an electric locomotive, the combination of a yieldingly-supported electric motor, a car axle and wheels adapted to move vertically relatively to the motor, a clutch member connected to the motor, a clutch member connected to the wheels and axle, a liquid for connecting the clutch members, and valve mechanism for controlling the liquid.

3. In an electric locomotive, the combination of a truck-frame, wheels and axle on which the truck-frame is supported, a sleeve encircling the axle and in which the axle is free to move vertically, an electric motor, a clutch member connected to the rotary part of the motor, a clutch member connected to the sleeve and flexibly connected to the wheels and axle, a liquid for connecting the clutch members, and mechanism for controlling the liquid.

4. The combination of a car axle and wheels, a clutch the two members of which are connected by a liquid controlled by valve mechanism, an electric motor the armature of which is formed in sections separately removable from the clutch, and connections between the motor, the clutch members, and the wheels and axle.

5. In an electric locomotive, the combination of the wheels and axle and an electric motor through which the axle passes axially, a clutch member connected to the armature, a clutch member connected to the wheels and axle, a liquid for connecting the clutch members, means for controlling the liquid, and flexible connections between the clutch and the wheels and axle.

6. The combination of a truck-frame, a field-magnet, a frame to which it is secured, yielding connections between the truck-frame and the field-magnet frame, a sleeve mounted in the field-magnet frame, connections between this sleeve and the car-wheels, an armature encircling the sleeve, a clutch member secured to the armature, a clutch member secured to the sleeve, a liquid for connecting the two members of the clutch, and mechanism for controlling the liquid.

7. In an electric locomotive, the combination of a truck-frame, a field-magnet frame, yielding connections between the truck-frame and the field-magnet frame, field-mag-

nets secured to the field-magnet frame, an armature secured to a sleeve surrounding the car-axle and having its axis parallel with the axes of the coils of the field-magnets and having the pole-pieces of the field-magnets on its opposite sides, flexible or yielding connections between the sleeve and the car-wheels, and clutch mechanism the two members of which are connected and disconnected by a liquid controlled by a valve mechanism.

In testimony whereof I have hereunto subscribed my name.

SIDNEY P. HOLLINGSWORTH.

Witnesses:

LLOYD B. WIGHT,

B. W. MILLER.