United States Patent

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[54] **TRACTION UNIT FOR ELECTRIC MODEL RAILWAYS**

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[51] **Int. Cl.**..**B61b 11/00**

[58] **Field of Search**..............104/148; 105/130, 131; 192/55

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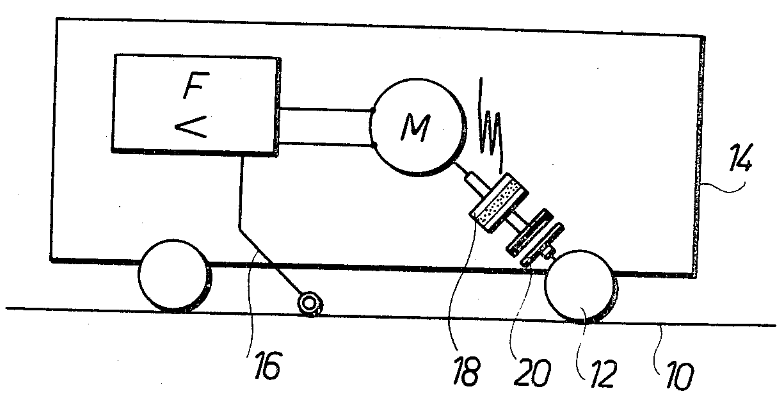
[57] **ABSTRACT**

In a traction unit for electric model railways consisting of a two-phase synchronous electric motor and an electronic unit for supplying the electric motor with two-phase pulse voltages from a feed voltage taken from the rails, an elastic clutch and, preferably, also a torque limiter is provided in the mechanical connection by means of which the electric motor drives the traction wheels, whereby the modeling range is extended to the use of quite low frequencies and, thus, to small revolution numbers of the traction wheels.

3 Claims, 6 Drawing Figures



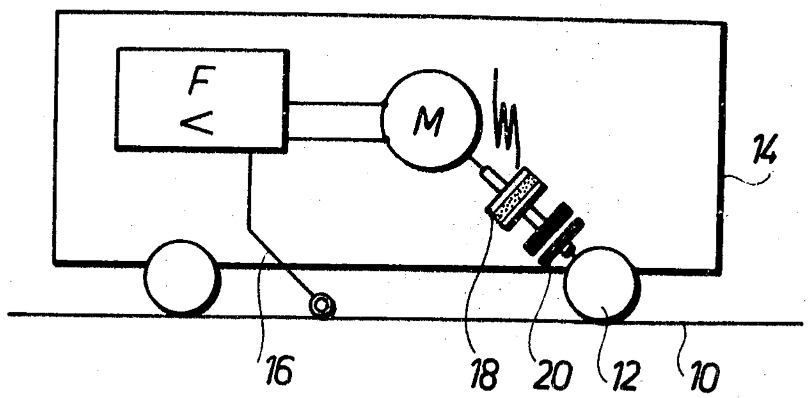


Fig. 1

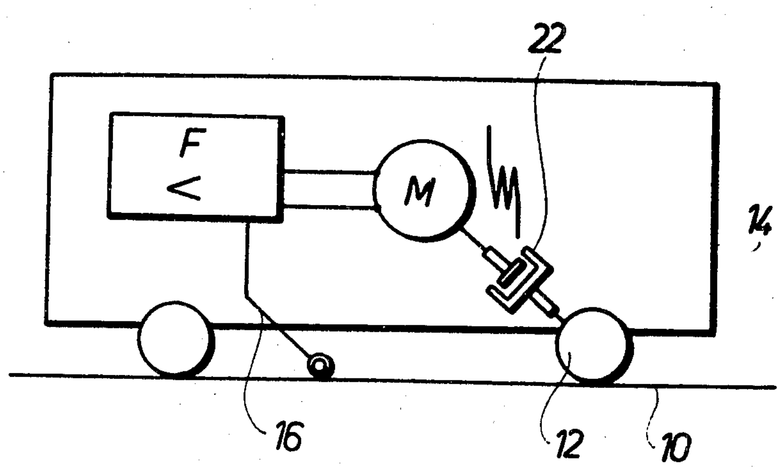


Fig. 2

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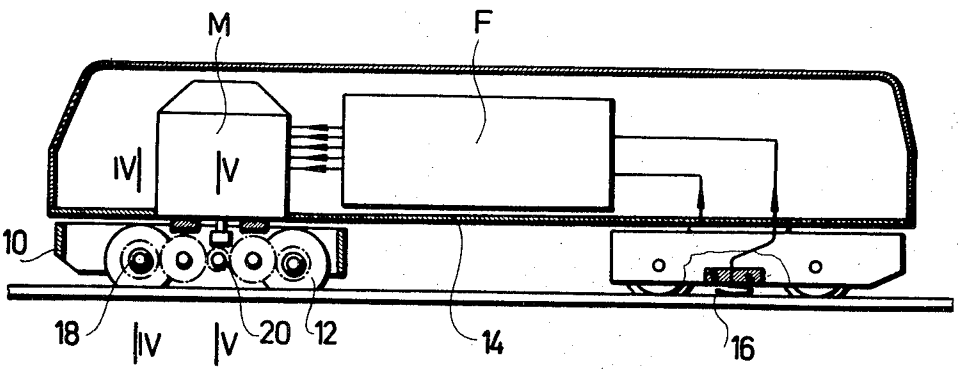

Fig.3

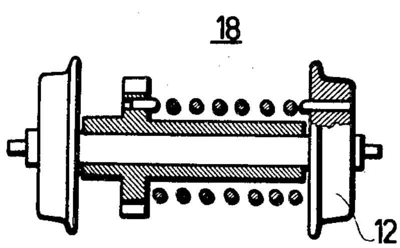

Fig.4

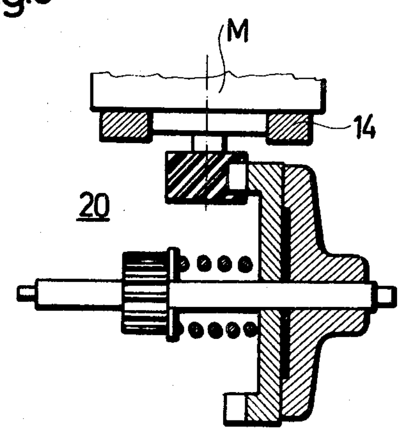

Fig.5

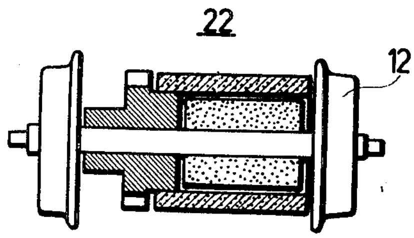

Fig.6

TRACTION UNIT FOR ELECTRIC MODEL RAILWAYS

This invention relates to traction units for electric model railways of the type having traction wheels arranged for running on a track the rails of which form electric conductors, and underframe supported by said traction wheels, an electric motor on said underframe for driving said traction wheels by means of a mechanical connection, and an electronic unit arranged for being fed by means of said rails for supplying said electric motor with a two-phase pulse voltage.

As is known, model railways are destined to simulate occurrences such as acceleration and deceleration of real railway running stock, e.g., trains or single locomotives. It has been suggested to employ two-phase synchronous motors fed with pulse voltages supplied by electronic units which operate to select a certain frequency from a series of frequencies from rails on which a traction unit is running, and to transform such frequencies into pulse voltages of prescribed frequencies suitable for operating the two-phase synchronous motors at desired speeds.

Traction units equipped with such motors are capable of simulating real acceleration and deceleration phenomena which, otherwise, would be impossible due to the basic difference between the friction to weight relations of real railway running stock and of model railways, respectively.

The only deficiency of the known system is that with very low speeds, that is with very low frequencies which are necessary to simulate the acceleration of a railway running stock at the start or its deceleration at stopping, the two-phase synchronous motor will not operate continuously but jump from one phase position to another. Apart from such jumping operation being unsuitable for simulating the operation of a running real railway stock it may also result in slipping of the traction wheels. Then, however, the running stock will not move at all.

The main object of the present invention is to eliminate such deficiencies and to extend the range of control of model railway systems of the aforesaid type to the domain of very low speeds. The basic idea of the invention consists in charging with the motive force yielded by one jump of the motor a mechanical system which is capable of yielding the stored energy continuously during the span between two subsequent jumps. Thereby, a continuous mode of operation even in the range of very low frequencies may be obtained. According to the invention, this is obtained by providing an elastic drive connection or clutch in the mechanical connection which connects the two-phase synchronous electric motor with the traction wheels of a traction unit. Obviously, when the electric motor makes a jump under the action of a very low frequency pulse voltage, the elastic clutch becomes tensioned because the traction wheels cannot follow the angular displacement of the driving shaft of the electric motor. When the tension of the elastic clutch is high enough to rotate the traction wheel, the energy stored in it becomes gradually discharged so that the traction wheels, instead of slipping, will slowly and continuously rotate.

The invention will be described in closer details by taking reference to the accompanying drawings which show, by way of example, two embodiments of the new traction unit.

FIG. 1 is a diagrammatic view of the first exemplified embodiment of the model railway traction unit of the present invention.

FIG. 2 is a diagrammatic view of the second exemplified embodiment of the model railway traction unit of the present invention.

FIG. 3 is a diagrammatic view of the model railway traction unit of the present invention.

FIG. 4 is a view in vertical section illustrating an elastic drive connection.

FIG. 5 is a view in vertical section illustrating an elastic drive connection with a torque limiter.

FIG. 6 is a view in vertical section illustrating a magnetic hysteresis coupling.

Same reference characters refer to similar details throughout the drawings.

Referring to the drawings, reference character **10** designates one rail of a model railway track with a traction unit according to the invention arranged on it. The traction unit consists of traction wheels **12** supporting an underframe **14**. The underframe **14** carries a two-phase synchronous electric motor M which is mechanically connected with the traction wheels **12**. The electric motor M is fed by an electronic feed unit F which, in turn, is fed via the rails **10** by means of a running collector **16**.

According to the invention, the mechanical connection between the electric motor M and the traction wheels **12** comprises an elastic clutch.

With the exemplified embodiment shown in FIG. 1, the elastic clutch designated by reference character **18** is of the expansion coupling type.

In addition to the elastic clutch **18**, the exemplified embodiment shown in FIG. 1 comprises also a torque limiter **20** which, however, might be substituted by the frictional contact between the traction wheels **12** and the rails **10**. Then, the torque limiter **20** may be dispensed with.

In operation, the rails **10** of the track carry various frequencies one of which is associated with the traction unit described above. This frequency is pulsed from a not represented control station and transformed by the feed unit F in e.g., square voltage pulses of a desired frequency used for feeding the two-phase synchronous electric motor M. Rotation of the motor M causes the mechanical connection between electric motor M and traction wheel **12** to rotate as well. Upon such rotation, the elastic clutch **18** becomes tensioned whereby the torque exerted by the electric motor M is first stored in the elastic clutch **18** and then released by it and damped. The torque limiter **20** ensures that the masses of the traction unit and the rolling stock coupled with it are permitted to prevail only until a torque value is obtained where the torque limiter **20** begins to slip.

FIG. 3 illustrates a toy locomotive with a pair of bogies, one of which is provided with the elastic connection between an electric motor M and traction wheels **12**. The other bogie has the running collector **16** incorporated in it. Between the electric motor M and the running collector **16** there is the electronic feed unit F which serves for converting the input DC voltage with a superposed pair of carrier frequency voltages from the track **10** into a pair of square pulse voltages of required frequencies and phase shifts. This circuit F operates in a known manner.

FIGS. 4 and 5 show details of the mechanical connection between the traction wheels **12** and the electric motor M in vertical sectional views taken along the lines IV—IV and V—V, respectively, of FIG. 3.

FIG. 4 illustrates one form of the elastic connection **18** which consists of a gear loosely supported on the axle of traction wheels **12** and connected with the latter by means of a helical spring so that torque is transmitted from the gear to the traction wheels **12** by means of the spring which permits an elastic transmission therebetween.

FIG. 5 shows the torque limiter **20** with a horizontal axle on which a pinion is mounted for meshing with the aforesaid gear of the elastic connection **18**. The axle of the pinion supports a friction disc, the inside surface of which engages with the outside surface of a circular-arc tooth gear. This, in turn, meshes with a pinion on the vertically arranged shaft of the electric motor M. The frictional connection between the circular-arc tooth gear and the friction disk is ensured by a helical spring disposed between the pinion and the former.

In operation of the elastic connection shown in FIGS. 4 and 5, the shaft of the electric motor M rotates the pinion at its lower end which, in turn, rotates the circular-arc tooth gear. This is pressed by its spiral spring against the inside surface of the friction disk so that the latter is rotated together with the former. Thus, the pinion on the shaft of the friction disk is set into rotation as well as rotates, in turn, the gear of the elastic connection **18**. The spiral spring of the latter is tensioned until the static resistance of the traction wheels **12** is overwhelmed and the latter begin to rotate. Then, the toy locomotive is propelled on the track **10**. Should the resistance of the traction wheels **12** be greater than the frictional force between the disk of the torque limiter **20** and its circular-arc tooth gear determined by the strength of its helical spring, the circular-arc tooth gear will slip on the friction disk as described in connection with the embodiment of FIG. **1**.

The exemplified embodiment shown in FIG. **2** differs from the previous one in that the elastic clutch **18** and the torque limiter **20** are replaced by a single magnetic hysteresis coupling **22** which is actually a combination of both the elastic clutch **18** and the torque limiter **20**.

The operation of the exemplified embodiment according to FIG. **2** is essentially the same as that of the previous exemplified embodiment. The only difference is due to the elastic clutch **18** and the torque limiter **20** of the first embodiment being replaced by the magnetic hysteresis clutch **22** which means that the function of energy storing and releasing as well as torque limiting is performed by one and the same unit.

FIG. **6** shows with greater specificity the embodiment of the invention of FIG. **2** where the functions of the elastic connection **18** shown in FIGS. **1** and **4** and the torque limiter **20** shown in FIGS. **1** and **5** are performed by a single unit formed by a magnetic hysteresis coupling **22**. Here, the gear of the elastic coupling **18** of the previous embodiment carries a sleeve made of hysteresis material whereas the shaft of the traction wheels **12** carries a cylindrical body of magnetic material.

In operation, the coupling between the gear and the traction wheels shaft is obtained by the magnetic field which is generated by the mutual rotation of the sleeve and the cylindrical body. Obviously, the generation of such magnetic field requires a mutual displacement of both component parts which corresponds to the function of the elastic connection **18**. On the other hand, if the resistance against motion of the toy locomotive exceeds a certain value, the field between the sleeve and the cylindrical body will not be strong enough to rotate the traction wheels in which case the sleeve will rotate around the stationary cylindrical body which corresponds to the function of the torque limiter shown in FIG. **5**.

What we claim is:

1. In combination with a miniature electric model railway including a model electric locomotive having a two phase synchronous motor for driving locomotive traction wheels supplied with pulse voltages of prescribed frequencies by an electronic feed unit operative to select a frequency from frequencies provided thereto by model railway rails, an improved traction unit mounted on said model locomotive and adapted to provide a continuous drive torque to said traction wheels when low frequency pulse voltages from said electronic feed unit cause said two phase synchronous motor to cease continuing operation and to jump between phase positions, comprising an input drive unit mechanically connected to said two phase motor to be driven thereby, and an output drive unit connected to drive said traction wheels and mechanical energy storage means operating to couple said input drive unit to said output drive unit, said mechanical energy storage means operating to store mechanical energy yielded by each jump of the synchronous motor and to gradually discharge the stored energy continuously to said output drive unit during the span between successive jumps of said synchronous motor.

2. The combination of claim **1** wherein said mechanical energy storage means includes a mechanical expansion coupling connected between said input and output drive units, said output drive unit including a torque limiter to limit the torque applied to said traction wheels by said traction unit.

3. The combination of claim **1** wherein said mechanical energy storage means constitutes a magnetic field coupling said input drive unit to said output drive unit, said input and output drive units being formed of material to create said magnetic field and provide a magnetic hysteresis coupling.

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