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(54) Impedance bonds.

(57) An impedance bond unit for use in returning traction circuit current from first and second rails of a railway track, comprising a first input (1') for connection to a first rail of a railway track, a second input (2') for connection to a second rail of a railway track, a traction output (3') for returning traction current and active control means (5) coupled with the first and second inputs and the traction output for allowing flow of traction current from the first and second inputs to the traction output, and for acting to reduce the flow of signalling current between the first and second inputs.

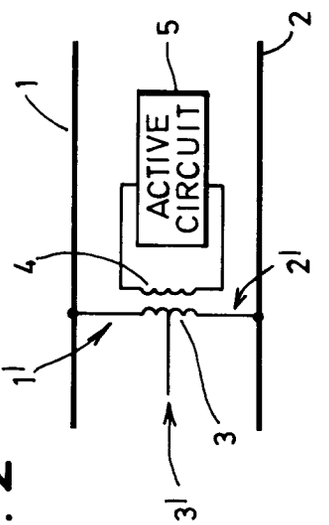

FIG. 2

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This invention relates to impedance bonds for railways.

Where railway vehicles are electrically powered, the vehicles' traction power (which may be supplied to the vehicles by, for example, a catenary wire over the railway tracks) may be returned to the substation via the rails of the track. The highest efficiency is obtained when both rails are used. In this case it is necessary to connect the rails so as to balance the return of traction current between them and to provide a return path from both rails to the substation. This may be done using a shorting bar to connect the rails directly together, but where track circuit signalling is used, shorting bars cannot be employed because they would short-circuit the track circuit system. In that case, to balance the traction current the rails are connected by impedance bond connectors which present a low impedance at the frequency of operation of the traction circuit but a high impedance at the frequency at which the track circuit signalling system operates.

Conventionally (as shown schematically in Figure 1), impedance bonds include an LC circuit connected to the rails via 1,2 via a transformer and resonated so as to have a high impedance at the frequency of the track circuit signals. The traction current is returned to the substation via a centre tap of the transformer. Where the bond acts only to balance the traction currents in the rails the centre tap is left unused. However, impedance bonds must maintain their impedance characteristics over a range of temperatures (to cope with varying weather conditions). It is difficult to design conventional impedance bonds to achieve this effect; and in overcoming the problem conventional impedance bonds are generally made to be bulky.

According to the present invention there is provided an impedance bond unit for use in returning traction circuit current from first and second rails of a railway track, comprising:

a first input for connection to a first rail of a railway track;

a second input for connection to a second rail of a railway track;

a traction output for returning traction current; and

active control means coupled with the first and second inputs and the traction output for allowing flow of traction current from the first and second inputs to the traction output, and acting to reduce the flow of signalling current between the first and second inputs.

This allows smaller and less expensive impedance bonds to be constructed.

Preferably the active control means includes sensing means for sensing the flow of signalling current between the rails, through the impedance bond unit, and for producing a control signal in dependence on the sensed flow of signalling current; and feedback means for controlling the active control means in response to the control signal to reduce the flow of signalling current between the first and second inputs. The sensing means preferably senses flow of current at the first or second input. The feedback means preferably acts in response to the current sensed at a determined (predetermined) frequency, suitably a track circuit or other signalling frequency. The active control means preferably acts to minimize or substantially prevent the flow of signalling current between the first and second inputs.

Preferably the active control means includes power supply and/or amplification means (which could be linear but most preferably includes switch mode power amplification means) controlled by the feedback means so as to apply power selectively between the rails to reduce the said flow of signalling current.

Preferably the active control means includes a transformer having a first winding coupled between the first traction input and the second traction input, with a centre tap coupled with the traction output; and a second winding coupled with the active control means.

The sensing means preferably senses flow of current between the first winding of the transformer and one rail of the track.

The present invention will now be described by way of example with reference to Figures 2 and 3 of the accompanying drawings, in which:

Figure 2 is a schematic diagram of an impedance bond unit; and

Figure 3 is a schematic diagram in greater detail of an impedance bond unit.

Figure 2 shows two side-by-side rails 1,2 between which one winding 3 of a transformer is connected via inputs 1' and 2'. The other winding 4 of the transformer is connected across an active power supply/amplification circuit 5. This replaces the capacitor of the conventional impedance bond circuit. The active power supply/amplifier supplies power selectively across the winding 4 so as to give the effect of reducing the flow of signalling current between the rails whilst allowing flow of traction current from the rails to a traction return output 3' connected to a centre tap of the winding 3.

Figure 3 shows the impedance bond unit in greater detail. The rails 1,2 are coupled together via inputs 1' and 2' across one winding 3 of a transformer, a centre tap 6 of which receives traction current to be returned via output 3' from vehicles on the track, for example to a substation. The other winding 4 of the transformer is connected across the active power supply circuit 5. This comprises a power supply unit 7 and a switch mode amplifier 8.

The power supply unit comprises a standard rectifying power supply circuit connected between the

rails via inputs 1" and 2", and a switch mode power supply unit 9, and uses the signalling current in the rails for its power. Alternatively the unit could use a separate source if available.

The switch mode amplifier 8 comprises a current sensor 10, a control feedback unit 11 and a control circuit 12. The current sensor 10 detects the flow of current between the impedance bond unit and the rail 2. A representation of the detected current is transmitted to the control feedback unit 11 which, using negative feedback, produces a feedback signal in dependence on the detected flow of current at (or in the region of) a determined frequency (the frequency of the track circuit signals in the railway system). The feedback signal is received by control circuit 12 which selectively controls the supply of power from the power supply unit 7 to the winding 4 of the transformer, in response to the feedback signal, so as to ensure that the flow of current through the impedance bond unit at (or in the region of) the determined frequency of the track circuit signals is minimized. This involves current flow to and from the power supply unit. Thus the power supply unit only needs to supply power to cover any power losses.

To reduce the load on the switch mode amplifier 8, the circuit may include resonant capacitor 13 connected across winding 4.

The impedance bond unit may be used to assist in the management of the railway system by measuring and recording (or transmitting to a control station) data on the flow of current in the system. For example, such data could include details of the level of the traction return current, the difference in current between the rails and the harmonic content of the return current could be measured. To allow this to be done, current sensor 10 has an output 14 for transmitting to a recordal/transmission unit data concerning the detected flow of current.

Claims

1. An impedance bond unit for use in returning traction circuit current from first and second rails of a railway track, comprising:

   a first input for connection to a first rail of a railway track;

   a second input for connection to a second rail of a railway track;

   a traction output for returning traction current; and

   active control means coupled with the first and second inputs and the traction output for allowing flow of traction current from the first and second inputs to the traction output, and for acting to reduce the flow of signalling current between the first and second inputs.

2. An impedance bond unit as claimed in claim 1, wherein the active control means includes:

   sensing means for sensing the flow of signalling current between the rails, through the impedance bond unit, and for producing a control signal in dependence on the sensed flow of signalling current; and

   feedback means for controlling the action of the active control means in response to the control signal to reduce the flow of signalling current between the first and second inputs.

3. An impedance bond unit as claimed in claim 2, wherein the sensing means senses flow of current at one of the traction inputs.

4. An impedance bond unit as claimed in claim 3, wherein the sensing means includes an output for transmitting data concerning the sensed flow of current to a recordal or transmission means.

5. An impedance bond unit as claimed in any of claims 2 to 4, wherein the control signal is produced in dependence on the sensed flow of current in the region of a determined frequency.

6. An impedance bond unit as claimed in claim 5, wherein the determined frequency is a track circuit frequency.

7. An impedance bond unit as claimed in any preceding claim, wherein the active control means includes power amplification means.

8. An impedance bond unit as claimed in claim 7, wherein the power amplification means is a switch mode amplification means.

9. An impedance bond unit as claimed in claim 7 or 8 as dependent directly or indirectly on claim 2, wherein the power amplification means is controlled by the feedback means so as to cause power to be applied selectively between the rails to reduce the said flow of signalling current.

10. An impedance bond unit as claimed in any preceding claim, wherein the active control means includes power supply means.

11. An impedance bond unit as claimed in claim 10, wherein the power supply means comprises a switch mode power supply means.

12. An impedance bond unit as claimed in claim 10 or 11, wherein the power supply means includes third and fourth inputs for connection to the first and second rails respectively, to allow the power supply means to draw power from track circuit

signals in the rails.

13. An impedance bond unit as claimed in any of claims 10 to 12, wherein the active control means includes a transformer having a first winding coupled between the first input and the second input, with a centre tap coupled with the traction output; and a second winding coupled so as to receive power from the power supply means.

FIG. 1

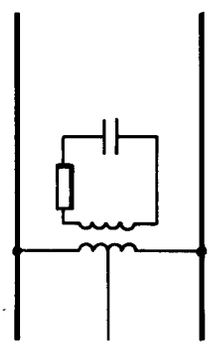


FIG. 2

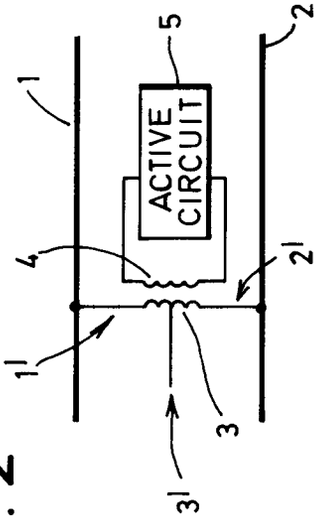
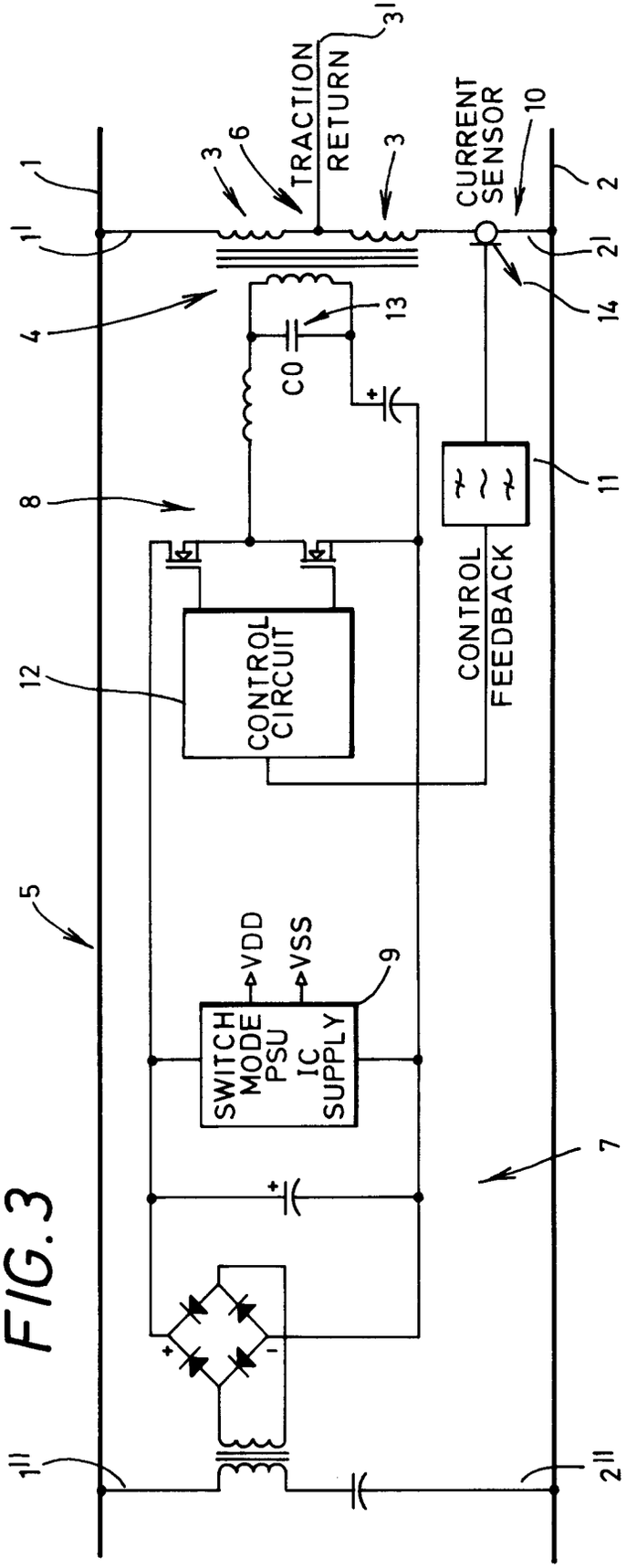


FIG. 3



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EUROPEAN SEARCH REPORT

Application Number
EP 94 30 1669

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
A	FR-A-2 240 673 (JEUMONT-SCHNEIDER) * the whole document *	1-6	B61L1/18
A	EP-A-0 038 639 (ANSALDO SOCIETA PER AZIONI) * the whole document *	1-6	
A	EP-A-0 110 261 (SASIB S.P.A.) * the whole document *	1-6	

TECHNICAL FIELDS SEARCHED (Int.Cl.5)

B61L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	26 August 1994	Reekmans, M

CATEGORY OF CITED DOCUMENTS

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