



New connection on: : 19-06-2018 : 00:56:22 - Last disconnection on: : 18-06-2018 : 16:18:38

V 4.0.0.44358(LP,U,linux) (Rev:43856 2017-04-27 09:03:29 +0200#(D201802)) (RPM D201802)

Welcome to EPOQUE Rebuild under the Production Environment

[EPODOC: SS 13] Train and rail and impedance and speed and sensor

Results in EPODOC 1

[SS 14] Train and rail and impedance

Results in EPODOC 76

[SS 15] 14 and sensor

Results in EPODOC 2

[SS 16] 14 and ohm

Results in EPODOC 0

[SS 17] 14 and speed

Results in EPODOC 11

[SS 18] ..v

[EPODOC: SS 18] ..li



1/11 © EPODOC / EPO

PN - [CN106125715](#) A 20161116

PR - CN20161454774 20160621

AP - CN20161454774 20160621

DT - I

CT - || STSE (A)

[US2006271232](#) A1 20061130 [A] (TOYAMA SOUICHI [JP], et al)

[A] 1-4

* 全文 *;

[US2010292813](#) A1 20101118 [A] (BOIKO IGOR [CA], et al)

[A] 1-4

* 全文 *;

[CN102176118](#) A 20110907 [A] (UNIV NORTHWESTERN POLYTECHNIC)

[A] 1-4

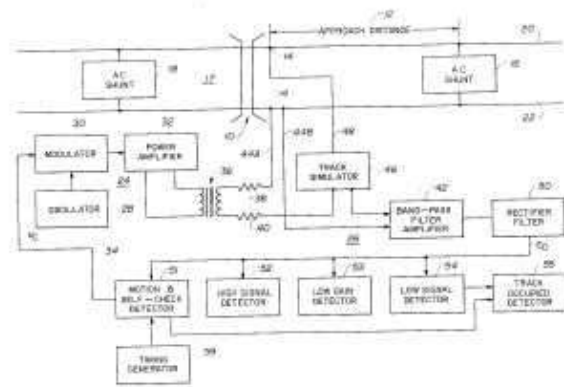
- * 全文 *;
[CN105223810](#) A 20160106 [A] (UNIV JIAOTONG SOUTHWEST)
 [A] 1-4
 * 全文 *
- CTNP - || STSE (A)
 [A] - 曹玉腾等, "再入飞行器多变量稳定裕度研究", 《航天控制》
 [A] 1-4
 * 第28-32页 *
 [A] - 孙青林等, "基于频域的多变量广义预测控制 (MIMO-GPC) 稳定性分析", 《中国工程科学》
 [A] 1-4
 * 第39-44页 *
 [A] - 顾树生等, "一种基于奇异值分析的多变量系统设计方法", 《控制与决策》
 [A] 1-4
 * 第35-39页, 第48页 *
- CNOI - [G05B23/0243](#)
- CNOA - [G05B2219/24065](#)
- PA - UNIV SOUTHWEST JIAOTONG
- TI - MIMO cascaded system stability analysis method based on **impedance** return-ratio matrix
- AB - The invention discloses an MIMO cascaded system stability analysis method based on an **impedance** return-ratio matrix. The MIMO cascaded system stability analysis method regards a high-**speed rail train** network cascaded system as an object, and comprises the steps of deducing and calculating equivalent pre-stage output **impedance** of the system, deducing equivalent post-stage input admittance of the system, calculating a system integral transfer function and acquiring a return-ratio matrix, estimating feature values of the return-ratio matrix and limiting a distribution region of the feature values, setting a forbidden region in the feature value distribution region, and acquiring MIMO system stability criterion with low conservative property. The deduction and calculation of the equivalent pre-stage output **impedance** and the equivalent post-stage input admittance of the system are the premises for acquiring the system integral transfer function, and are essential conditions for further acquiring the return-ratio matrix of the cascaded system; and the Gerschgorin circle theorem is the basis for setting the forbidden region to limit and avoid the matrix feature value range, and further reducing the conservative property of the criterion. The criterion method is suitable for stability analysis of the MIMO cascaded system, can analyze stability of the MIMO cascaded system simply and effectively, and has lower conservative property than that of the existing singular value criterion, norm criterion and the like.

2/11 © EPODOC / EPO

- PN - [CN102778872](#) A 20121114
- PNFP - CN102778872B B 20140723
- PR - CN20121232135 20120705
- AP - CN20121232135 20120705
- DT - I
- CT - || STSE (A)
[US7872583](#) B1 20110118 [A] (YUSHKOV ANDREY [RU], et al)
 [A] 1-4
 全文

	CN1258457C C 20060607 [A] (SINUO SCIENCE & TECHNOLOGY CO [CN]) [A] 1-4 全文 CN102004246 A 20110406 [A] (UNIV ZHEJIANG) [A] 1-4 全文 CN102267478 A 20111207 [A] [A] 1-4 全文
CTNP	- STSE (A) [A] 赵林海等, "基于AOK-TFR的轨道电路故障诊断方法", <<西南交通大学学报>>, (20110228), vol. 46, no. 01, PAGE 84 - 91 [A] 1-4 第84-91页 [A] 赵林海等, "基于HHT,DBWT的无绝缘轨道电路补偿电容故障诊断", <<铁道学报>>, (20110331), vol. 33, no. 03, PAGE 49 - 54 [A] 1-4 第49-54页 [] Zhao Lin-hai et al., "Application of Wavelets Analysis Technique in the Analyzing and Processing of Frequency Shift signal", <<Proceedings of the Seventh International Conference on Electronic Measurement & Instruments>>, (20051231)
PA	- (A B) UNIV BEIJING JIAOTONG
TI	- (A B) Real-time correction method for dynamic displacement of track circuit reader signal carrier frequency
AB	- (A) The invention relates to a real-time correction method for the dynamic displacement of the track circuit reader signal carrier frequency, which belongs to the railway field and is used for solving the problem that the track circuit reader signal carrier frequency generates dynamic displacement. The real-time correction method comprises the following steps of: obtaining a standard value f_c of the track circuit reader signal carrier frequency; calculating a compensation capacitor impedance Z_{cp} in a track circuit; obtaining a train equivalent shunt resistance R_f; calculating a carrier frequency displacement factor β; obtaining a train running speed v_s; calculating the dynamic displacement Δf_c of the track circuit reader signal carrier frequency at the running speed; calculating the frequency spectrum of the receiving signal of the track circuit reader by the track circuit reader; and according to the calculation result of the dynamic displacement Δf_c, moving the integral frequency spectrum to the zero-frequency direction for Δf_c, i.e. subtracting the dynamic displacement Δf_c from the carrier frequency f'_c in the frequency spectrum so as to realize a corresponding correction process. Information required by the correction method is directly from railway field equipment and can be directly integrated to rail circuit reader equipment, and therefore reliability and accuracy on extracting train target speed information are improved in the high- speed running process of a train.

PN - [US3777139](#) A 19731204
 PR - US19700094955 19701203
 AP - USD3777139 19701203
 DT - *
 CT - [US3246143](#) A []; [US3390256](#)
 A [];
[US3610920](#) A []
 CCI - [B61L29/286](#)
 PA - PEEL R
 TI - MOTION SENSOR SYSTEM
 AB - A system for providing grade crossing protection by sensing the presence of trains exceeding a preselected velocity in an approach track section defined by shunts across the rails. Detector circuits provide fail-safe protection from defects in the associated track section such as a broken rail or low ballast impedance between rails. A time-sharing self-test subsystem simulates an approaching high speed train by applying a fraction of a second test signal to the system every few seconds to monitor the operation of the overall system; and a low gain detector checks the gain of the system to assure that the train's speed is accurately measured.



4/11 © EPODOC / EPO

PN - [JPS60187210](#) A 19850924
 PR - JP19840041459 19840306
 AP - JP19840041459 19840306
 DT - I
 CCI - [B61L27/0038](#)
 FI - B60L15/40&C; B61L3/08&A; B61L3/16&Z
 FT - 5H115/BA02; 5H115/BB01; 5H115/FA03; 5H115/FA06; 5H115/FC07; 5H115/FC18;
 5H115/FC30; 5H115/GG07; 5H115/GG13; 5H115/HH01; 5H115/JA01; 5H115/JA10;
 5H115/JB18; 5H115/JB19; 5H115/JB20; 5H115/JC12; 5H115/JC13; 5H115/KA06;
 5H115/KC10; 5H115/KD11; 5H115/KD12; 5H115/PC02; 5H115/PG01; 5H115/QN03;
 5H115/QN06; 5H115/SF07; 5H115/SF18; 5H115/SF30; 5H115/SJ07; 5H115/SJ13;
 5H115/SL01; 5H115/TB01; 5H115/TB10; 5H115/TD18; 5H115/TD19; 5H115/TD20;
 5H115/TO12; 5H115/TO13; 5H115/TR06; 5H115/TW10; 5H115/TZ11; 5H115/TZ12;
 5H125/AA05; 5H125/BE01; 5H125/CA04; 5H125/CA14; 5H125/CB09; 5H125/CC05;

5H125/EE52; 5H161/AA01; 5H161/BB03; 5H161/BB07; 5H161/CC20; 5H161/DD04;
5H161/DD32; 5H161/EE07

PA - JAPANNATIONALRAILWAY

TI - AUTOMATIC **TRAIN** CONTROLLING METHOD

AB - PURPOSE:To perform economic and efficient **train speed** control by transmitting a shortcircuiting **impedance** of a **rail** circuit and a signal corresponding to a **train** interval obtained from the adjacent **rail** circuit signal to the **rail** circuit.
CONSTITUTION:A central transmission type **rail** transmitter 27 transmits a signal of frequency F2 to **rail** circuits 1b, 1c. An A/D converter 26 converts the transmission voltage of the transmitter 27, **rail** approaching direction transmission current and a **train** retarding direction transmission current into digital values. A calculation controller 29 transmits, when receiving a transmission signal (having a frequency F1) from a central transmission type **rail** circuit controller 21c, a signal produced by adding **train** position information of the forward **rail** circuit contained in the received signal and a distance to the trailing **train** obtained by the voltage and current, and when not receiving the signal, a signal produced by adding the distance to the preceding **train** and the distance to the trailing **train** as a **train** interval signal from the transmitter 27.

5/11 © EPODOC / EPO

PN - [JPS60187209](#) A 19850924

PR - JP19840041458 19840306

AP - JP19840041458 19840306

DT - I

CCI - [B61L27/0038](#)

FI - B60L15/40&C; B61L3/08&A; B61L3/16&Z

FT - 5H115/BA02; 5H115/BB01; 5H115/FA03; 5H115/FA06; 5H115/FC07; 5H115/FC18; 5H115/FC30; 5H115/GG07; 5H115/GG13; 5H115/HH01; 5H115/JA01; 5H115/JA10; 5H115/JB09; 5H115/JB18; 5H115/JB19; 5H115/JB20; 5H115/JC12; 5H115/JC13; 5H115/KA17; 5H115/KC10; 5H115/KD11; 5H115/KD12; 5H115/PC02; 5H115/PG01; 5H115/QN03; 5H115/QN06; 5H115/SF07; 5H115/SF18; 5H115/SF30; 5H115/SJ07; 5H115/SJ13; 5H115/SL01; 5H115/TB01; 5H115/TB10; 5H115/TD09; 5H115/TD18; 5H115/TD19; 5H115/TD20; 5H115/TO12; 5H115/TO13; 5H115/TR17; 5H115/TW10; 5H115/TZ11; 5H115/TZ12; 5H125/AA05; 5H125/BE01; 5H125/CA04; 5H125/CA14; 5H125/CB09; 5H125/CC05; 5H125/EE52; 5H161/AA01; 5H161/BB03; 5H161/BB07; 5H161/CC20; 5H161/DD02; 5H161/DD32; 5H161/EE07

PA - JAPANNATIONALRAILWAY

TI - AUTOMATIC **TRAIN** CONTROLLING METHOD

AB - PURPOSE:To perform economic and efficient **train speed** control by transmitting a shortcircuiting **impedance** of a **rail** circuit and a signal corresponding to a **train** interval obtained from the adjacent **rail** circuit signal to the **rail** circuit.
CONSTITUTION:**Rail** transmitter 21, 27 respectively transmit signals of frequencies F3, F2 to **rail** circuits 1b, 1c. An A/D converter 26 converts the transmitting voltage and currents of transmitters 21, 27 into digital values. A calculation controller 29 transmits, when receiving a transmission signal (having a frequency F1) from a **rail** circuit controller 3c, a signal produced by adding **train** position information of the forward **rail** circuit contained in the received signal and a distance to the trailing **train** obtained by the voltage and current, and when not receiving the signal, a signal produced by adding the distance to the preceding **train** and the distance to the trailing **train** as a **train** interval signal from the transmitter 21.

6/11 © EPODOC / EPO

PN - [JPH02200566](#) A 19900808
PR - JP19890019841 19890131
AP - JP19890019841 19890131
DT - I
CT - [JPS6175054](#) A [
FI - B61L1/02
FT - 5H161/AA01; 5H161/BB20; 5H161/CC20; 5H161/DD02; 5H161/DD32; 5H161/MM15
PA - RAILWAY TECHNICAL RES INST
TI - **TRAIN STOP DETECTING DEVICE**
AB - PURPOSE: To unecessitate a warning for a level crossing and reduce the time for the route setting of a **train** by measuring continuously the distance between the fixed point and the head or tail of a **train** using a current running through a **rail** and detecting the **train** stop by the fact that the measured value remains unchanged for a fixed time. CONSTITUTION: A stop detecting current is transmitted to a certain fixed point 2 of a **rail** 1 from a transmitting part S, and the voltage V between the rails and the current I running through the rails 1 are inputted into a processing part 5. Accordingly, the distance L between the fixed point 2 and the head of a **train** 4 becomes the value proportional to the **impedance** V/I and thereby obtained by an equation, $L=K.V/I$, where K is a constant. Suppose the distance L is changed by L during the fixed time t, the **train speed** is obtained by an equation, $v= L/ t$. When this value is sufficiently small, the **train** stop is judged, and this result is outputted.

7/11 © EPODOC / EPO

PN - [GB1326986](#) A 19730815
PR - HU1970KO02372 19701114
AP - GB19710053009 19711115
DT - *; Rep
CCI - [B60L3/00](#) ; [B61L1/20](#) ; [G01N27/20](#) ; [G01B7/282](#) ; [G01B7/34](#)
CCA - [B60L2200/26](#)
PA - MAGYAR ALLAMVASUTAK
TI - METHOD AND DEVICE FOR DETECTION OF **RAIL** VEHICLE WHEELS HAVING DAMAGED CONTACT SURFACES
AB - 1326986 Electro-physical measurement MAGYAR ALLAMVASUTAK 15 Nov 1971 [14 Nov 1970] 53009/71 Heading G1N Damaged contact surfaces of railway wheels are monitored by energizing the rails from a high-frequency source, and detecting the change in **impedance** due to a damaged wheel. As described an H.F. generator is connected to an **impedance** across the rails, and the voltage pulse due to a faulty wheel is demodulated, filtered and converted to a rectangular pulse. The length of the pulse may be related to a predetermined **speed**, or a tachometer may be provided to correct the pulse length according to **speed**, and an axle counter determines the position in a **train**. A number of adjacent, short, track sections may be used to monitor multi-axled bogies.

8/11 © EPODOC / EPO

PN - [GB636882](#) A 19500510

PR - FRX636882 19450705

AP - GB19460025504 19460826

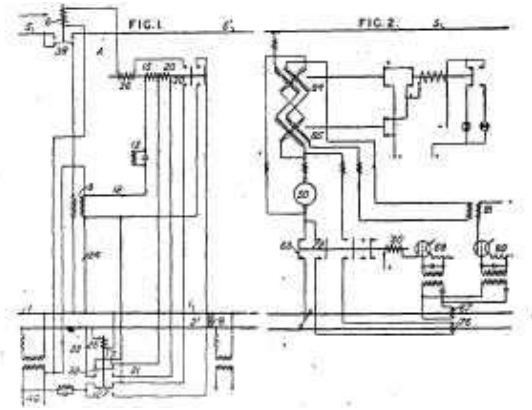
DT - *

CCI - [B61L3/185](#)

PA - AUX E D ETUDES ELECTRO TECH SO

TI - Improvements in or relating to railway signalling systems

AB - 636,882. Railway signalling systems. SOC. AUXILIARE d'ETUDES ELECTRO-TECHNIQUES. Aug. 26, 1946, No. 25504. Convention date, July 5, 1945. [Class 105] In a railway signalling system in which a generator (constant-frequency alternator) on the locomotive, giving a voltage proportional to its **speed**, feeds a line wire arranged in section lengths corresponding to the track-circuit sections but adapted to be connected up, by a relay device at the entrance to each section, to an over-all length dependent on the voltage, the system is so arranged that the track relay of an ahead occupied section causes the linewire circuit, which hitherto was earthed to the rails at the entrance end of the occupied section, to be equivalently extended by means of a transformer coupling up to the rearmost axle of the occupied section. Fig. 1 shows the arrangement at a track section and Fig. 2 the locomotive apparatus. A tachometric generator 50 on the locomotive applies a current to the line wire 5 of its section at a voltage dependant on the **speed** and this current so long as it exceeds a certain value causes at successive track sections a relay 6 to be energized to connect up the



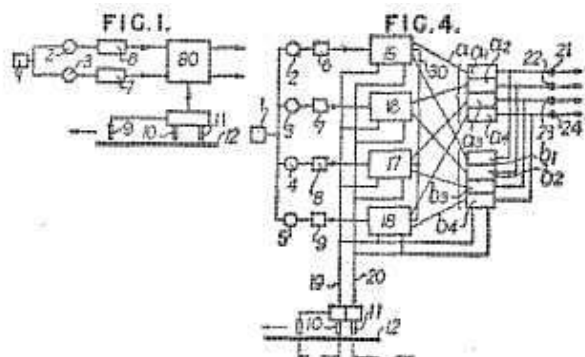
line wires 5 of successive sections until such an overall length is reached that the line **impedance** reduces the current below the value necessary to cause operation of the next relay 6. The relay 6 is picked up by the line wire current passing over a back contact 38 of this relay 6 to the primary winding of a transformer 9 the secondary of which energizes over front contacts 17 of the track relay 25 a winding 15 of a device A which thereupon closes its front contact 30 whereby the track-circuit source 46 energizes over a front contact 27 of the track relay a holding winding 36 for the device A, and also energizes the winding of the relay 6 which thereupon moves its contact 38 to its front points thereby linking up the section line wire 5 to the line wire 51 of the next section. Similar actions occur at successive track sections until such an overall length is reached that the line-wire current is below the value necessary to cause operation of the winding 15 of the next device A. At an occupied section however the track relay 25 is de-energized and its open front contact 27 prevents the holding winding 36 of the device A and the relay 6 being energized ; thus the line-wire 5 is connected by back contact 38 of relay 6 and primary of transformer 9 to the track **rail** 1 of the occupied section. The secondary of the transformer feeds a circuit comprising wire 12, rejector 13 (for track-circuit frequency), windings 15, 20 of device A, wire 21, back contact 22 of track relay 25, wire 23, **rail** 21, axle B, **rail**

1 and wire 24 ; thus the line-wire circuit is extended (through the transformer coupling) by an amount equivalent to the length of **rail** in the occupied section up to the rear axle of the ahead vehicle. The locomotive apparatus comprises a wattmeter type relay in the circuit to the line-wire, and inductor coils 67, 76 arranged over the rails one of which coils 67 normally is energized by the track-circuit current in the rails to energize a relay 70 through an amplifier 69 tuned to the frequency of the track-circuit current. The other coil 76 is normally inactive but receives current from the locomotive generator on entry into an occupied section thereby setting up current of line-wire-current frequency in the rails to actuate the first coil 67 which through an amplifier 80 tuned to the frequency of the line-wire current energizes a transformer 81 feeding a second set of current coils 84, 85 in the wattmeter relay. On entry into an occupied section the coil 67 no longer receives energy from track-circuit current in the rails since this is absent so that the relay 70 becomes deenergized so removing generator current from the circuit comprising the line-wire and return **rail** by reason of its open front contact 63 while at its back contact 72 the locomotive generator is applied to the coil 76 to induce current in the **rail** circuit provided by the rails, the rear axle of the ahead **train** already in the section, and the front axle of

the entering **train**. The wattmeter relay controls circuits to cab signals showing " clear " and " danger " (" proceed at sight "). The generator circuit and the circuits of the coils above the rails include relays front contacts of which are included in the circuits to the cab signals thereby to give warning of any failure by the disappearance of all signals (" clear or " danger ").

9/11 © EPODOC / EPO

- PN - [GB882383](#) A 19611115
- PR - FRX882383 19580724
- AP - GB19590025138 19590722
- DT - *; Rep
- CCI - [B60L3/10](#) ; [B60T8/1705](#) ;
[B60T8/3245](#)
- CCA - [B60L2200/26](#)
- PA - FORGES ATELIERS CONST
ELECTR
- TI - Systems for detecting the
skidding of wheels of railway
vehicles
- AB - 882,383. Electric selective
signalling systems. FORGES ET
ATELIERS DE CONSTRUCTIONS
ELECTRIQUES DE JEUMONT.
July 22, 1959 [July 24, 1958],
No. 25138/59. Class 40 (1). In
a system for detecting
skidding in railway vehicle
wheels, the frequencies of
pulse trains, each
proportional to the individual
speeds of the wheels, are
compared with each other
and also with the frequency
of a further pulse **train**
representing the
absolute **speed** of the vehicle
and produced by a magnetic
recording and receiving
device co-operating with the
track. In a first embodiment,
Fig. 1, an oscillator 1 feeds A.
C. through modulators 2, 3



controlled by the respective driving wheels, and two-state devices 6, 7 to a frequency comparator 80 which also receives a further signal, at a frequency proportional to the absolute **speed** of the vehicle, from a magnetic recording and pick-up device 9 ... 11 co-operating with the track 12. This device may be of the type described in Specification 818,782. A head 9 records a magnetic signal on the **rail** which is subsequently picked up by a head 10; when a further head 11 picks up the signal it causes the head 9 to record a new signal, and so on. The device is not effective when the vehicle is travelling slowly. The modulators 2, 3 may each comprise a stationary cored inductor the **impedance** of which is varied by teeth or like projections moving with each driving wheel (Figs. 2 and 3, not shown). In another embodiment counters are used instead of a frequency comparator. Four wheelcontrolled modulators 2 ... 5, Fig. 4, supply, via two-state devices 6 ... 9, counters 15 ... 18, each of which can count to 31 before returning to zero; they are also zeroized by signals appearing on line 19 or line 20. If any counter reaches 29, say, before a zeroizing pulse arrives, and the other counters have not reached this state, a signal is sent to the appropriate one of four alarm relays a1 ... a4 to indicate by means 21 ... 24 that a wheel is skidding and initiate corrective action. If all the counters reach 29 together an interconnecting arrangement 30 blocks operation of all the alarm

relays al ... a4. A further four alarm relays bl . . . b4 are made receptive when the device 10 picks up a signal laid down by head 9 (only operative above a certain **speed**) and are subsequently blocked when the device 11 picks up the signal. During this interval if any of the counters reaches a count of 27, say, the corresponding alarm is operated.

10/11 © EPODOC / EPO

PN - [GB498034](#) A 19390102

PR - GB19370015219 19370601

AP - GB19370015219 19370601

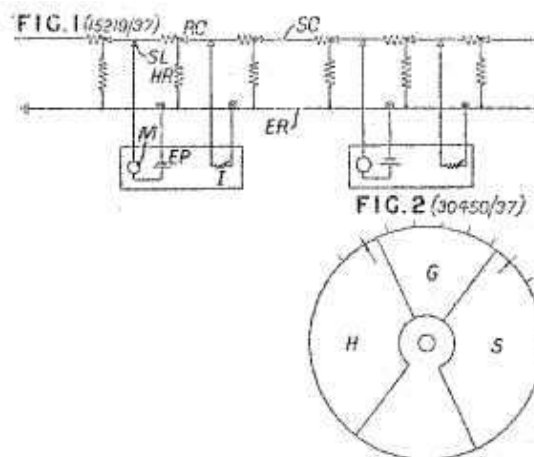
DT - *

CCI - [B61L3/185](#)

PA - STANDARD TELEPHONES
CABLES LTD; JOHN BALMAIN
GRIFFITHS; ANDREW BROWN

TI - Improvements in or relating
to railway signalling systems

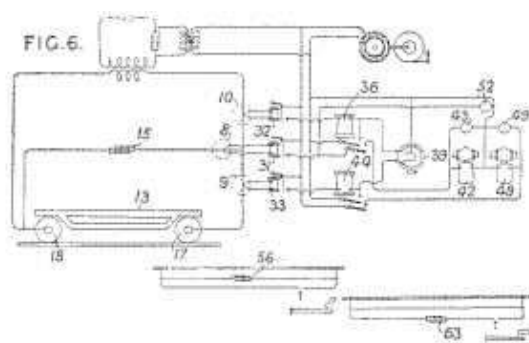
AB - 498,034. Railway signalling systems. STANDARD TELEPHONES & CABLES, Ltd., GRIFFITHS, J. B., and BROWN, A. June 1, 1937, Nos. 15219 and 30450. [Class 105] A continuous line circuit extends along the track and the trains are provided with a front signalling equipment comprising a measuring device M and means EP for applying electric power to the continuous circuit and with a rear equipment, which may be a speedometer-controlled low-**impedance** shunt I across the continuous circuit, varying the characteristic of the circuit fed by the front equipment of a following **train** so that the measuring device of this following **train** gives an indication of the safe



distance ahead ; the measuring device is segregated from the low-**impedance** shunt of its own **train**, for example by rectifiers RC inserted in the continuous circuit at intervals less than the distance between the front and rear equipments of a **train**. The integrity of the continuous circuit is verified by providing high-**impedance** shunts HR across the circuit at intervals and the **train** is not allowed to proceed unless the measuring device shows more than a predetermined minimum current. The continuous circuit may be provided by a line SC and an earthed running **rail** ER; the front and rear equipments of a **train** have brush contacts SL engaging the circuit and the rectifiers are tested by two spaced brushes with a voltmeter therebetween. If the voltage is abnormal a warning is given and a marking on the track may be effected. To guard against failure the rear equipment is provided with a plurality of low-**impedance** shunts. The measuring device may be operated by the phase condition of the current. Fig. 2 shows an indicator with a red sector H controlled by the receiving equipment and with a red sector S controlled by a speedometer. As the actual **speed** approaches the permitted **speed** a green background G is progressively covered by the red sectors and finally contacts are closed for automatic braking. If the continuous circuit is out of order or broken the sector H moves reversely and uncovers

a red background. At track points the signalling circuit is connected to the particular route set up; when the points are open a track shunt is placed on the signalling circuit. Cabin indications may be given by equipment, similar to the front equipment, connected to the circuit; for example to indicate a **train** in the approach to points the equipment would be connected some distance before the points. At curves or gradients the characteristic of the circuit may be modified to impose appropriate **speed** limits. A set of relays may be used instead of a current indicator to respond selectively to the magnitude of the current. The receiving equipment may control the propulsion motor. The connection between the **train** and the line circuit may be inductive.

- 11/11** © EPODOC / EPO
- PN - [GB112005](#) A 19180509
- PR - USX112005 19161214
- AP - GB19170001900 19170207
- DT - *
- CCI - [B61L3/221](#)
- PA - STARIE BERNARD [US]
- TI - Improvements in **Train** Stop and **Speed** Control Systems for Railways.
- AB - 112,005. Starie, B. Dec. 14, 1916, [Convention date].
Track apparatus actuating signals on trains for stopping trains.- Signalling and **train**-stopping apparatus on a **train** is controlled by the changes in magnitude of alternating current in a main circuit and two branch circuits on the **train**, one of which



includes the frame of the vehicle, owing to the action of other branch circuits on the track which include insulated joints, inductances or condensers inserted or cut out by the movements of the visual signals on the track.

Fig. 6 shows

diagrammatically three signals or relays 8, 9, 10 supplied from an alternating-current generator. The relay 10 is in the main circuit; the relay 8 in a branch circuit including a condenser 15; the relay 9 in a branch circuit including the axles 17, 18 and the vehicle frame 13 which has a

considerable **impedance**. The rails between the axles 17, 18 also have a considerable importance. The apparatus is adjusted. so that normally, the relay 8 receives a large leading current, the relays 9 and 10 a smaller lagging current. At signalling points, the **impedance** of the track rails is increased either by a **rail** of greater cross-section or by a heavy copper conductor bonded to the **rail** and condensers are arranged in branch circuits closed by switches on the signals. At a danger signal, the additional **impedance** in the branch circuit due to the rails causes the lagging current in the relay 9 to equal the leading current in the relay 8, and the relay 10 receives practically no current. At a caution signal, a capacity 56 is included in parallel to the track **rail** and causes the current in the relay 9 to become zero, and the relay 10 receives full current. At a clear signal, the additional **impedance** of the

track rails is balanced by a capacity 63 in parallel with the **rail** circuits. Fig. 6 shows a high-frequency generator and thermo-junction relays 8, 9, 10, controlling relays 31, 32, 33, which are normally energized but are momentarily deenergized by reduction of current through the relays 8, 9, 10. Relays 32, 33 control self-holding relays 36, 44 which in turn and in conjunction with the **speed** indicator 39 control the signals 43, 49 and brake valves 42, 48, in such a way that the brake valves can only be re-set after reduction of **speed**. Relay 31 controls the brake magnet 42 and a signal 52 which indicates that the apparatus is in working order. Since any defective circuit de-energizes the relay 8, this trouble is indicated by the signal 52 and stoppage of the **train**.