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SHUNTING AID FOR RAILWAY SIGNALLING CIRCUITS

Filed Jan. 25, 1957

FIG. 1.

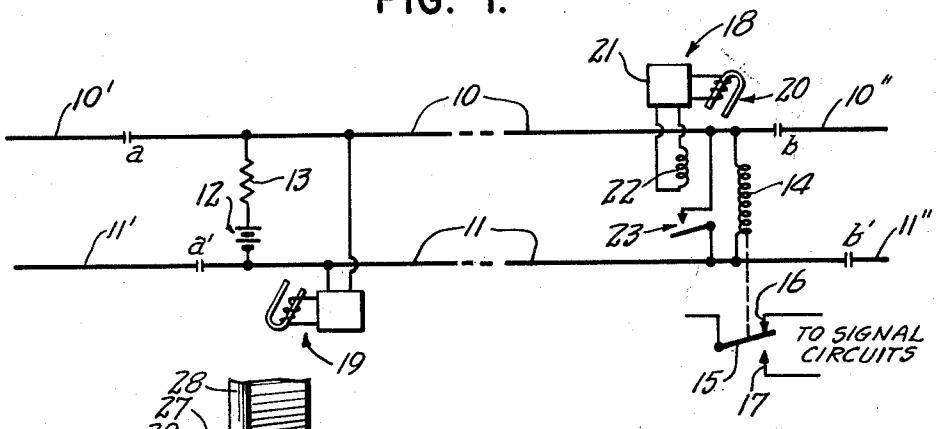


FIG. 2.

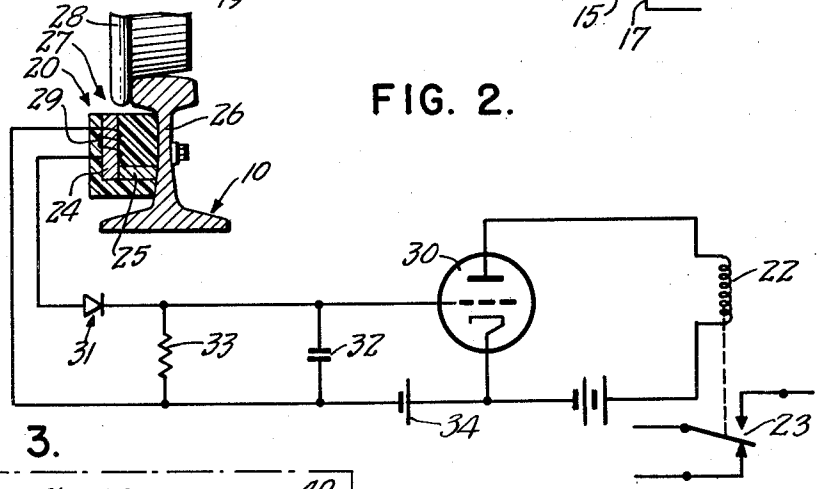


FIG. 3.

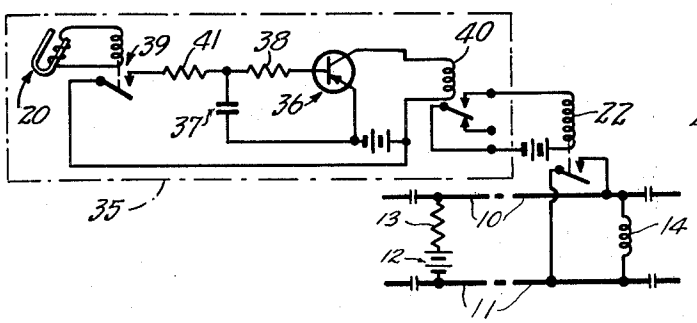
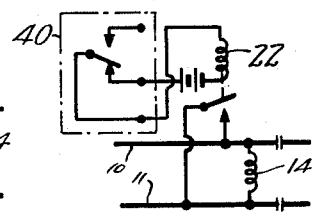


FIG. 4.



INVENTORS
WILLIAM M. PELINO
CORNELIUS A. GALLAGHER
BY
Mitchell & Beckert
ATTORNEYS

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SHUNTING AID FOR RAILWAY SIGNALLING CIRCUITS

William M. Pelino, Garden City, and Cornelius A. Gallagher, Hicksville, N.Y., assignors to Servo Corporation of America, New Hyde Park, N.Y., a corporation of New York

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6 Claims. (Cl. 246—28)

Our invention relates to an aid to railway-signalling devices and is particularly applicable to block-signalling systems.

In block-signalling systems, the presence of rolling stock on a particular section of track is relied upon to shunt a signalling relay, whereby automatic visual signals may be developed to reflect the presence of a train (or the lack of presence of a train) in a particular signalling block. With modern railroad rolling stock, such as lightweight cars, the development of adequate low-resistance shunt paths through the wheels and axles of the rolling stock has become a problem, particularly in the presence of snow or ice on the track or in regions in which sand used for braking or starting has developed a vitreous film on the track.

It is, accordingly, an object of the invention to provide an improved railway-signalling device, and at the same time an improved means for boosting the effectiveness of existing block-signalling systems.

It is another object of the invention to provide an improved track-shunting aid for block-signalling circuits.

It is a further object to provide a device of the character indicated which will not only improve the effectiveness but will also entail no modification of existing block-signalling installations, so that even if the device of the invention should for some unaccountable reason fail to function, it will nevertheless not in any way impair the functioning of the existing block-signalling system.

It is a general object to meet the above objects with extremely reliable equipment requiring a minimum of power supply and maintenance, yet materially improving the reliability of existing systems, and which will function regardless of weather extremes, and regardless of vitrified conditions of the rails.

Other objects and various further features of novelty and invention will be pointed out or will occur to those skilled in the art from a reading of the following specification in conjunction with the accompanying drawings. In said drawings, which show, for illustrative purposes only, preferred forms of the invention:

FIG. 1 is a simplified diagram illustrating the spaced rails of a block-signalling system to which shunting aids of our invention have been applied;

FIG. 2 is an electrical diagram schematically illustrating one application of a shunting aid of our invention; and

FIGS. 3 and 4 are diagrams similar to FIG. 2, but illustrating modifications.

Briefly stated, our invention contemplates a device for application to existing block-signalling systems in order to improve the reliability thereof. The device comprises essentially a magnetic wheel trip mounted on a rail and developing a voltage pulse for each passing railroad wheel flange. Storage circuits respond to the voltage pulses to maintain an adequate control level, for wheel-trip pulses of sufficiently rapid recurrence, reflecting a minimum train-speed response for the system. For train speeds above this minimum, a shunting relay is actuated to short-circuit the block-signalling winding.

Referring to FIG. 1 of the drawings, our invention is shown in application to a section of track comprising two

spaced elongated rails **10—11** of length corresponding to a conventional block-signalling section on a railroad. Insulation of rails **10—11** from each other and from the adjacent rails **10'—10''** and **11'—11''** is suggested by discontinuities, indicated at *a—b* and at *a'—b'* in the drawing. Considering only the section covered by the rails **10—11**, the conventional block-signalling circuitry is illustrated by a low-voltage source **12** and current-limiting resistor **13** exciting the rails **10—11** at one end. At the other end of the block section is the winding **14** of the conventional block-signalling circuit relay, which also includes an armature **15** and signalling contacts **16—17**.

Normally, that is, in the absence of a train on the section **10—11**, sufficient control voltage is developed from source **12** to actuate and hold the relay armature **15** in the position shown, thus determining completion of the "clear" circuit condition through the signalling contact **16**. Theoretically, when a train enters the section, and regardless of the section end from which entry is made, the low-resistance shunting path (from one wheel, through its axle to the other wheel, and across both tracks **10—11**) is relied upon to short out or shunt the voltage across the relay winding **14**, thus causing the winding **14** to drop out; the circuit through armature **15** is then completed to the contact **17**, which determines the "stop" or "caution" condition of the signalling circuit.

In accordance with our invention, we apply to the existing system (represented by source **12**, relay **14** and rails **10—11**) auxiliary means in the form of an all-weather shunting aid whereby the presence of a train in the section may more reliably cause the relay **14** to function in the above-described manner. Occasionally, the shunting path, including the wheels and axles of passing rolling stock, is insufficient to enable relay **14** to drop out. As indicated generally above, this may be due to a vitrified surface condition on the rails, or to ice or snow, or merely to the fact that the rolling stock itself is too light in weight.

Preferably, we apply one of our shunting aids at each end of the block-signalling section **10—11**, and we show in FIG. 1 the employment of two such aids **18—19**. As indicated generally above, and as described in more detail in connection with FIG. 2, each of our shunting aids comprises a magnetic wheel trip **20** and associated integrating and amplifying means **21** for governing a relay **22** having contacts **23** connected either directly across the winding **14** or (as shown) to the rails **10—11**, in close adjacency to the point of connection of the winding **14** thereto.

In FIG. 2, our shunting aid is shown to employ a magnetic wheel trip **20** of the variety discussed in greater detail in copending Gallagher-McDonald application Serial No. 627,330, filed December 10, 1956. Such wheel trip is characterized by magnetic-core means including a permanently magnetized core element **24**, and an element **25** of flux-conducting material which, in conjunction with the web **26** of the rail section **10** to which it is applied, may establish at **27** a permanently polarized magnetic flux gap through which the flanges **28** of passing railroad wheels may pass; passage of a wheel flange through gap **27** modulates or varies the reluctance in the described magnetic circuit, thus causing winding means **29** (coupled to the magnetic flux path) to develop a voltage pulse for each passing wheel flange. As a practical matter, adequately strong voltage pulses may be developed for wheel flanges on trains passing at speeds as slow as 5 miles an hour and ranging up to the top speeds of express trains.

The integrating circuit which functions from the wheel trip **20** is shown to utilize a vacuum-tube amplifier **30**,

the output circuit of which includes the winding **22** of the relay utilized to shunt the signal-relay winding **14**. In the form shown, voltage pulses developed by trip **20** are rectified at **31** before application to a storage circuit comprising a capacitance **32**, shunted by a leakage resistance **33**, whereby positive voltage, adequate to overcome the effect of bias at **34**, will be stored at **32** (and thus at the control grid of amplifier **30**) as long as voltage pulses of adequate repetition rate, reflecting at least minimum train speed, are developed at trip **30**. Once the stored voltage at **32** drops below the threshold of operation of amplifier **30** (meaning that the train has stopped, or that it is located between trips **19—20**, or that it has left the block section), the charge on capacitor **32** will leak off to the extent that amplifier **30** will cease to conduct, thereby dropping out the relay **22**.

In FIG. 3, we show application of our invention to an integrating circuit **35** based essentially on a transistor amplifier, employing the transistor **36**. In order that the storage circuit **37—38** shall not be overloaded but, on the other hand, shall be loaded always with incoming voltage pulses of substantially the same level, we employ clipping means **39** interposed between the wheel pick-up device **20** and the amplifier **36**. The clipping means is shown to be an extremely sensitive relay **39** which will pick up for wheel pulses of all the various magnitudes that may be developed by trip **20**, regardless of the speed of passing trains within the design range of the equipment. The collector circuit of the transistor **36** is shown to include a relay **40** constituting the first stage of a two-stage relay, in which the relay **22** may be considered the second stage. The arrangement in FIG. 3 happens to be one in which excitation of relay winding **40** determines the closing of relay **22** and thus the shunted condition of the track circuit; in the slight modification illustrated in FIG. 4, the excitation of relay **40** drops out the relay **22**, but nevertheless also achieves the desired shunting.

In operation, the wheel pick-up **20** develops a pulse output which will vary (in timing and in magnitude) with the speed and position of each wheel flange **28** cutting the field of the flux gap **27**. For each pulse of at least threshold level, the relay **39** functions to clip or to equalize the energy supplied to the capacitor **37**; whenever relay **39** closes, charging current is applied through resistor **41** to capacitor **37**, said resistor **41** serving to limit the charging current to protect the contacts of the sensitive relay **39**. With a sufficiently low resistance value at **41**, the capacitor **37** is usually charged in about 0.2 millisecond. Each sufficiently frequent impulse to the relay **39** keeps the charge on the capacitor to a peak, or at least above the threshold level determining conduction in the transistor amplifier **36**, meaning that the relay **40** is continuously actuated; this condition continues until the train has passed the wheel trip **20**. Capacitor **37** discharges only slightly between pulses, allowing enough base current to flow through the transistor to the emitter to keep the collector current at least at a level which will assure against drop out of relay **40**. After all wheels of the train have passed, the storage circuit **37—38** will discharge slowly through the base-emitter circuit of the transistor, thus allowing the collector current to fall off, and eventually to allow the output relay **40** to drop out.

While the train is still in the block section, and after it has passed, say, the trip **20**, the multiple shunting paths developed by all wheels and axles of the train will be sufficient to hold the shunted condition of the signalling relay, so that the existing block-signalling system will continue to indicate the occupied condition of the block section. When the train passes out of the block-signalling section **10—11**, there will be no more excitation of either of the pick-ups **19—20**, and neither will there be any multiple shunt paths across the rails **10—11**. This condition will permit restoration of potential from source **12** to the relay winding **14**, thus enabling the circuit to recondition itself to reflect the unoccupied condition of the block section **10—11**.

It will be seen that we have described a relatively simple and fool-proof device which, in practice, has been found to be extremely reliable as an aid to existing block-signalling systems; its installation in no way impairs the efficiency of any pre-existing block-signalling system. The device is unaffected by weather conditions, and particularly for the transistorized version of FIGS. 3 and 4, virtually no maintenance checking is necessary.

While we have described the invention in detail for the preferred forms illustrated, it will be understood that modifications may be made within the scope of the invention as defined in the claims which follow.

We claim:

1. In combination, a railway block-signalling circuit comprising two electrically insulated spaced rails of section length, a voltage source continuously connected to said rails at one end of said length, a signal relay having a winding energized from and continuously connected across said rails at the other end of said length, a magnetic wheel trip responsive to the passage of a wheel flange near one of said ends and developing a voltage pulse at the time of each such passage, and shunting means including storage means responsive to a predetermined minimum rate of wheel-trip pulses and directly electrically shunting said winding upon detection of said minimum rate.

2. In combination, a railway block-signalling circuit comprising two electrically insulated spaced rails of section length, a voltage source continuously connected to said rails at one end of said length, a signal relay having a winding energized from and continuously connected across said rails at the other end of said length, a first magnetic wheel trip responsive to the passage of a wheel flange near one of said ends and developing a voltage pulse at the time of such passage, a second magnetic wheel trip responsive to the passage of a wheel flange near the other of said ends and developing a voltage pulse at the time of such passage, and shunting means including separate storage devices respectively connected to said trips and responsive at each of said ends to a predetermined minimum rate of wheel-trip pulses, said shunting means directly shunting said winding upon detection of said minimum rate by one of said storage devices.

3. In combination, a railway block-signalling circuit comprising two electrically insulated spaced rails of section length, a voltage source continuously connected to said rails at one end of said length, a signal relay having a winding energized from and continuously connected across said rails at the other end of said length, a magnetic wheel trip responsive to the passage of a wheel flange near one of said ends and developing a voltage pulse at the time of each such passage, integrating means responsive to the output of said wheel trip to develop a steady voltage for recurring wheel-trip pulses of at least a minimum periodicity reflecting a minimum speed to which said combination will respond, and means shunting said winding in response to a voltage of predetermined level developed by said integrating means.

4. In combination, a railway block-signalling circuit comprising two electrically insulated spaced rails of section length, a voltage source continuously connected to said rails at one end of said length, a signal relay having a winding energized from and continuously connected across said rails at the other end of said length, a magnetic wheel trip responsive to the passage of a wheel flange near one of said ends and developing a voltage pulse at the time of each such passage, and shunting means including a storage device connected to the output of said wheel trip and responsive to a predetermined minimum rate of wheel-trip pulses to develop a control voltage, said shunting means further including a relay connected to said storage device and having contacts connected in shunting

relation with said signal-relay winding and effective to shunt said winding in response to detection of said minimum rate.

5. The combination of claim 4, in which said shunting means includes a clipping device serving effectively to develop from voltage pulses at the output of said wheel trip storage-input voltage pulses of a given level, so that regardless of the speed of passing wheel flanges, all voltage pulses to said shunting means will be of the same or substantially the same level.

6. The combination of claim 4, in which said shunting means includes a rectifier connected to polarize input pulses to said storage device.

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