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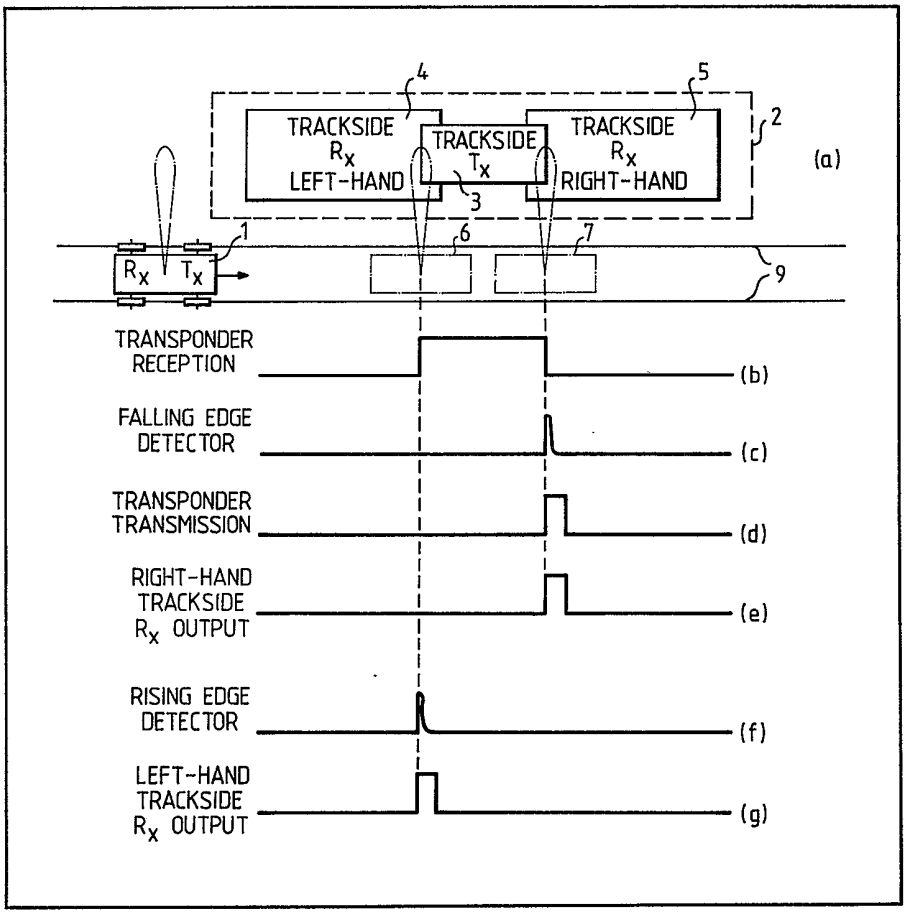
(54) **Position monitoring system**

(57) The system includes a radar system for monitoring the position of a moving body (1) carrying a transponder. The transponder receiver triggers the transponder transmitter only at the edge (and preferably the falling edge) of the reception zone. Two trackside receivers (4,5) positioned before and after the trackside transmitter (3) are therefore triggered selectively according to the direction of travel. The edge detection feature removes ambiguity arising from multiple responses and the two trackside receivers avoid ambiguity of travel direction.



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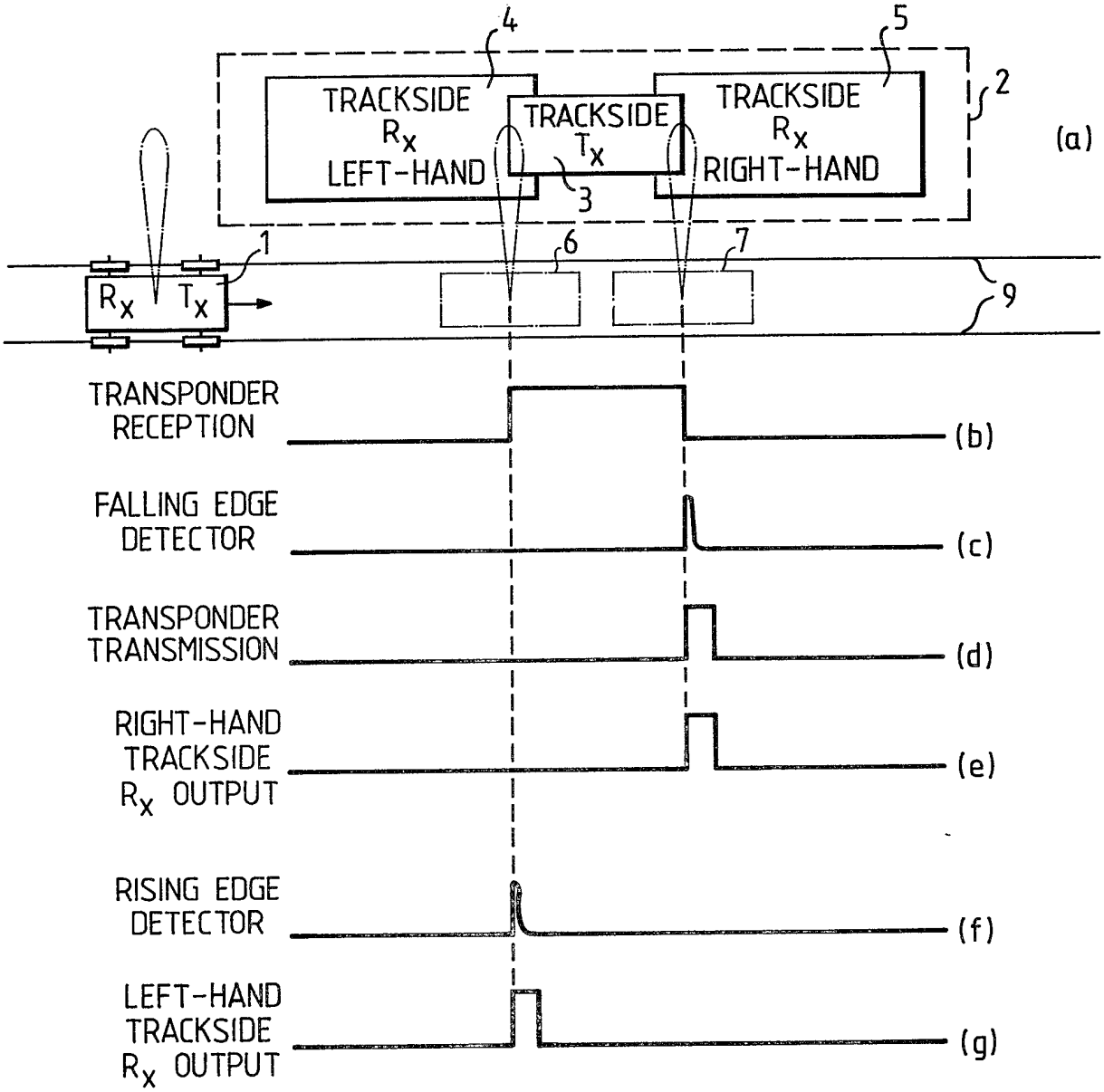
The drawing(s) originally filed was/were informal and the print here reproduced is taken from a later filed formal copy.


4
5
TRACKSIDE
R_X
LEFT-HAND
TRACKSIDE
T_X
TRACKSIDE
R_X
RIGHT-HAND
2
(a)
3
1
6
7
9
R_X
T_X
TRANSPONDER
RECEPTION
(b)
FALLING EDGE
DETECTOR
(c)
TRANSPONDER
TRANSMISSION
(d)
RIGHT-HAND
TRACKSIDE
R_X OUTPUT
(e)
RISING EDGE
DETECTOR
(f)
LEFT-HAND
TRACKSIDE
R_X OUTPUT
(g)

SPECIFICATION

Position monitoring system

This invention relates to a system for monitoring the position of vehicles and other mobile items including things such as warehouse goods, retail shop products etc.

In monitoring the position of track vehicles it is known to employ a radio transponder, i.e. a transmitter which responds to the actuation of an associated receiver, and which can in effect be 'interrogated', the transponder being fitted to the vehicle. A transmitting and receiving station at a trackside location is then used to interrogate the adjacent track location and if a vehicle is present a response is obtained. A single such presence will give a presence indication for the whole time the vehicle transponder is within a zone of interaction, i.e. a zone in which the vehicle receiver can detect the transmission from the trackside and in which also, the trackside receiver can detect the vehicle transmission. If there is interference, or intermittent or unstable reception, it may appear that there have been several responses, apparently indicating the passage of several vehicles. Such confusion can in some cases be dangerous and the prime object of this invention is to prevent such false multiple indications.

A single presence detector as indicated above gives no indication of the direction of travel of the vehicle. Two trackside receivers at the trackside station can be used to give successive signals, the order of the signals indicating the direction of travel. However, if the vehicle should happen to stop and reverse in the middle of the first detector zone, it would not be clear whether the vehicle had in fact reversed or had stopped after the first zone.

According to the present invention, a system for monitoring the position of a movable body, comprises receiving and transmitting means adapted for mounting on the body, the receiving means being responsive to a predetermined signal to initiate a predetermined operation of the transmitting means following acquisition or cessating of a predetermined signal, the system further comprising stationary receiving and transmitting means adapted for location adjacent a possible path of a movable body, the stationary transmitting means being adapted to transmit the predetermined signal and the stationary receiving means and the movable transmitting means having a zone of interaction such that the predetermined operation of the movable transmitting means occurs within the zone of interaction and can be detected by the stationary receiving means to indicate presence of a movable body.

There are preferably two stationary receiving means at a monitoring station having separate zones of interaction with the movable transmitting means such that the above operation of the movable transmitting means cannot be detected by both stationary receiving means, the direction of travel of the body being indicated by which of the two stationary receiving means detects the operation of the movable transmitting means.

In this preferred form of the present invention, both objects, avoidance of false multiple indications and indication of departure direction are achieved.

A vehicle position-monitoring system in accordance with the invention will now be described, by way of example, with reference to the accompanying drawing showing a vehicle transponder passing a trackside receiver/transmitter station and also some signals that arise at various positions of the vehicle.

Referring to the drawing, the vehicle 1 runs on a track 9, past a trackside station 2. The vehicle carries a radio transponder the transmitter of which is switched on in response to reception of a predetermined frequency signal by the receiver.

The trackside equipment comprises a transmitter 3, a left-hand receiver 4 and a right-hand receiver 5. Each of the rectangles 3, 4 and 5, is intended to represent the left and right hand limits of the field of influence of the component in question. Thus, for example, when the vehicle transmitter 1 passes underneath (in the drawing) any part of the rectangle 4 of the left-hand trackside receiver, the signal levels are such that communication takes place between them.

As so far described, the arrangement would appear to be a version of the double presence detector referred to above. However, the vehicle transponder differs in the following respect. While its receiver is continuously responsive to transmission from the trackside (within a 'zone of interaction'), the vehicle transmitter is not triggered into operation until the received signal falls away as the vehicle passes out of the field of the trackside transmitter 3. To achieve this the transponder incorporates a circuit which detects the falling edge of the received signal and triggers the vehicle transmitter accordingly. The duration of this vehicle transmission is then predetermined, to give an unmistakable received signal at the trackside while not being so long that multiple indications can occur.

The operation is illustrated in the drawing. As the vehicle 1 passes the station 2, nothing happens until it crosses the left hand limit (as indicated in broken lines at 6) of the trackside transmitter 3. The transmitter 3 is continuously operated so that the vehicle receiver is activated as shown at (b). Reception continues as in (b) until the vehicle receiver (indicated at 7) passes beyond the right hand limit of the transmitter 3. At this point the vehicle receiver output collapses and the falling edge in (b) is detected to produce a trigger output as in (c). The vehicle transmitter is initiated by this trigger output to produce the signal (d) which, overlapping the right-hand trackside receiver 5, is detected for the predetermined duration of transmission. A single short output is thus produced by the receiver 5 as shown in (e).

No output, it will be noted, was produced by the receiver 4, since the vehicle transmitter had passed out of their common interaction zone when the vehicle receiver output collapsed to produce the trigger pulse (c).

If the vehicle travels from right to left the diagrams (b) (c) (d) and (e) will be reproduced, but as a mirror image about a vertical line through the centre of the

trackside transmitter. In this case only the left-hand receiver 4 will produce an output. Thus an output is produced by receiver 4 or 5 according to the direction of travel, right-to-left, or vice-versa.

If a vehicle should pass into the field of influence of the trackside transmitter then stop and reverse, it is only the trackside receiver on the leaving side that will be activated.

For both continuous travel and reversal therefore, it is the trackside receiver on the departure side which will produce an output.

Instead of using the falling edge of the vehicle receiver signal the rising edge may be detected, as shown in diagram (f) and (g). This again will achieve the object of a 'spot' response from continuous signal reception, but will indicate only the approach direction, which may be inadequate in some situations.

In the above system, precautions may be taken to avoid response to false transients. For example the falling edge in diagram (b) may be discounted unless the following 'zero' signal persists for some predetermined time.

In an alternative arrangement, a single trackside receiver may be used but having a field of influence extending beyond the trackside transmitter zone in both directions. Falling or rising edge detection is again used to avoid false indications, but no indication of travel direction would be given.

It may be seen that the present invention provides a very simple system which resists confusion and which, in a preferred embodiment, provides directional information with a minimum of logic circuitry.

While the most obvious application of the invention is to the monitoring of vehicles, it will be clear that it can also be applied to the monitoring of goods or articles of any kind if the transponder is suitably sized and adapted for carriage by the article. Thus the movement of goods within warehouses, in and out of buildings, through restricted enclosures, etc, can all be accommodated.

CLAIMS

1. A system for monitoring the position of a movable body, comprising receiving and transmitting means adapted for mounting on the body, said receiving means being responsive to a predetermined signal to initiate a predetermined operation of said transmitting means following acquisition or cessation of said predetermined signal, the system further comprising stationary receiving and transmitting means following acquisition or cessation of said predetermined signal, the system further comprising stationary receiving and transmitting means adapted for loctation adjacent a possible path of a said movable body, the stationary transmitting means being adapted to transmit said predetermined signal and the stationary receiving means and the movable transmitting means having a zone of interaction such that said predetermined operation of the movable transmitting means occurs within said zone of interaction and can be detected by the stationary receiving means to indicate presence of a said movable body.

2. A position monitoring system according to Claim 1, including two stationary receiving means at a monitoring station having separate zones of interaction with the movable transmitting means such that said operation of the movable transmitting means cannot be detected by both stationary receiving means, the direction of travel of the body being indicated by which of the two stationary receiving means detects said operation of the movable transmitting means.

3. A position monitoring system according to Claim 1 or Claim 2, wherein said body is a vehicle having predetermined path of travel.

4. A position monitoring system according to Claim 2, wherein the movable receiving means is adapted to detect the cessation of said predetermined signal and thus provide an indication of the direction in which the movable body departs from the monitoring station.

5. A position monitoring system according to Claim 1 and comprising one stationary receiving means having a zone of interaction with the movable transmitting means which zone extends beyond the zone of interaction of the stationary transmitting means and the movable receiving means in the direction of the path of the movable body, said predetermined operation of the movable transmitting means being detectable by the stationary receiving means to indicate the presence of the movable body.

6. A position monitoring system substantially as hereinbefore described with reference to the accompanying drawing.

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