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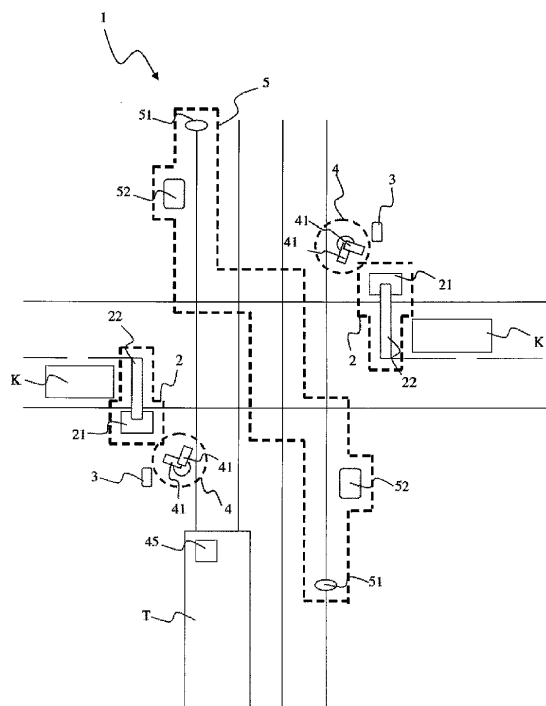
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(54) **A level crossing system**

(57) This invention pertains to a level crossing system (1) that will be used at the level crossings where the highways and railways intersect, ensuring that the traffic flow on the highway is cut off for a period that is equal to the time determined on the basis of the speed of the train (T), while at the same time the image of the level crossing is instantaneously recorded and relayed to the trains (T) within the range by means of wireless communication.

Figure 1



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Description

Technical Area

[0001] This invention is related to a level crossing system that is sensitive to speed and has image recording and transmission properties for utilization at level crossings.

Former Technique Used

[0002] Today, level crossings are used at junction points of railways and highways. These level crossings consist of elevated sections between the railways, at the same height as the surfaces of the highway and the railway, in a manner that would make the passage of the pedestrians and highway vehicles possible.

[0003] At level crossings, there are barriers that are placed in parallel to the rails preventing the entry of highway vehicles in the crossing for purposes of preventing any collision of railway and highway vehicles. At present, these barriers are of the type that can be opened and closed and to serve this purpose sensors are placed on the railway at a distance of 1000 to 1500 meters away from the crossing. When the railway vehicle (Train) passes through these sensors, a warning in the form of light and/ or sound is transmitted to the barrier and the barrier is closed upon receiving this warning. After the train leaves the level crossing, the barrier is lifted off to open the level crossing to the highway traffic again. After the train passes through the sensors and the barriers close in response, the vehicles are required to wait 2 or 3 minutes until the train clears through the crossing. The high speed trains can go the subject matter distance of 1000 to 1500 meters fast while slower ones take longer. Due to the long waiting periods some drivers attempt to cross the passage by going in between the barriers and this leads to dangerous and even fatal consequences.

[0004] At the level crossings that are used presently, the operator of the train can have the view of the crossing at a distance of a couple of hundred meters from it, however if flat surfaces do not stretch far such a distance is not sufficient for the train to stop and prevent a collision.

[0005] In US 5890682 numbered United States patent document a system that prevents collisions at railway crossings is mentioned. When the train starts approaching the crossing, a warning signal that works with the GPS system of the train, indicating the speed and position of the train is transmitted to the vehicles. By means of this signal the arrival time of the train to the crossing is derived. When the subject matter arrival time reaches a pre-determined limit, a warning is relayed to the vehicles on the highway.

[0006] In EP 0976640 numbered European patent document, a system that prevents collisions at level railway crossings is mentioned. The subject matter system includes a video camera that records and processes the images in three dimensional format from the level cross-

ing. This system at the same time identifies the type of the barrier at the crossing and contains a control system that sends, if necessary, speed control warning or brake command to the train that is approaching the crossing.

[0007] In TR 2007/05031 numbered Turkish patent document, a system that provides information on the road, traffic status, position of the locomotive and train and speed suitable for the existing road and traffic conditions to the operator of the train is mentioned and the same system ensures that the train is either stopped or slowed down if the allowed speed limit is exceeded. System status and speed information is obtained from units such as GPS, etc.

A Short Explanation of the Invention

[0008] The purpose of this invention is to create a level crossing system in which the images from the crossing are recorded.

[0009] Another purpose of this invention is to create a level crossing system through which the images from the railway are transmitted to the railway vehicles through wireless transmission.

[0010] Another purpose of this invention is to create a level crossing system that would shorten the waiting period of the highway vehicles at the level crossing during the passage of the railway vehicle from the crossing.

[0011] Another purpose of this invention is to create a level crossing system that is sensitive to the speed of the vehicle on the railway.

Detailed Explanation of the Invention

[0012] A "Level Crossing System" created to achieve the purpose of this invention is shown in the drawings provided in attachment and from among these figures;

Figure 1 - Is the schematic appearance of the layout of the level crossing system that is the subject matter of this invention

Figure 2 - Is the schematic appearance of the imaging unit.

Figure 3 - The schematic appearance of the layout of the level crossing system in an application of the invention

[0013] The parts in the figures are numbered and their explanations are provided below:

1- Level Crossing System
2- Barrier

21- Body
22- Arm

3- Warning device

4- Imaging system

- 41- Camera
- 42- Recording Device
- 43- Transmitter
- 44- Receiver
- 45- Screen

5- Control System

- 51- Sensor
- 52- Control Unit

- A1, A2- First Sensor
- B1, B2- Second sensor
- C1, C2- Third sensor
- D1, D2- Fourth sensor
- T- Railway vehicle (train)
- K- Highway vehicle

[0014] The level crossing system that is the subject matter of the invention (1) contains:

- At least one opening/ closing barrier (2) to cut off the traffic flow on the highway,
- At least one warning device (3) that would ensure that the drivers of the highway vehicles are warned by sound and/ or sensory means;
- At least one imaging system (4) that records the image of the level crossing instantaneously and transmits this image to the trains (T) within the range via wireless means;
- At least one sensor (51) placed on the rail and at least one control system (5) that includes a control unit that would ensure that the barrier (2), warning device (3) and imaging system (4) are controlled on the basis of the signal received from the sensor (51).

[0015] Barrier (2); consists of a body (21) that is fixed to the ground and an arm (22) that is connected to the body on one side. The arm (22) can rotate on a plane that is at a vertical angle to the highway, on the side that it is connected to the body (21). When the arm (22) becomes horizontal it settles at a level that would not be possible for the highway vehicles (K) to pass under and as such the entry of the highway vehicles in the level crossing is prevented. After the train (T) leaves the level crossing, the arm (22) takes up a position that is vertical above the body (21) and opens up the crossing to the Highway Vehicles (K).

[0016] The warning device (3) is activated by the control system (5) with the basis of the status of the Train relative to the level crossing and ensures that the highway vehicles (K) are informed of the whereabouts of the train (T) by audio and/ or visual means.

[0017] Imaging system (4) contains at least one camera (41) that instantaneously records the image of the level crossing, and

- at least one recording device (42) that is used to record the image that is obtained from the camera (41), and
- at least one transmitter (43) that makes possible for the recorded image to be relayed to the train (T), and
- at least one receiver (44) that is placed in the train (T) and establishes communication with the transmitter (43), and
- at least one screen that is used to relay the information received at the receiver (44) to the operator of the train (Figure 2).

[0018] In the preferred application of the invention, two imaging systems (4) are used.

[0019] The cameras (41) have night vision capability and as such they ensure that the imaging system (4) is active on a 24 hour basis.

[0020] In the preferred application of the invention at least two cameras (41) are used. At least one camera (41) is placed facing the highway and at least one from the remaining is placed facing the crossing. This ensures that the image records can be accessed as needed and such records may be used as evidence in any accidents that may take place.

[0021] In the preferred application of the invention, the recording device (42) is a digital video recorder that records the images received from the cameras (41) on its hard disc (Digital Video Recorder - DVR).

[0022] In the preferred application of the invention, at least one transmitter (43) is used in each imaging system (4). In this application, directional antennas that preferably operate at 2.4 GHz or higher frequency, with more than 18 dB of recovery are used as the transmitter. As such, it would be possible to broadcast to the necessary range even under adverse weather conditions.

[0023] The communication between the Transmitter (43) and receiver (44) is achieved via signals sent by the transmitter (43) to the receiver (44). The receiver (44) can perceive the signals at a certain distance from the transmitter (43). This distance is far enough to make possible for the train (T) to slow down sufficiently and even stop before it reaches the crossing, in case of a dangerous situation. The subject matter distance is preferably between 1500 to 5000 meters.

[0024] The screen (45) is located in the locomotive. When there is no level crossing close to the Train (T) the screen (45) reflects crossing image.

[0025] In the preferred application of the invention, more than one camera (41) is used and for this reason the image (45) on the screen is divided into the number of cameras (41) used and the images from all the cameras (41) are displayed at the same time.

[0026] The control system (5) included in the level crossing, which is the subject matter of the invention, contains at least one sensor (51) that is placed on the rail to determine whether the train (T) is approaching the level crossing, and at least one control unit (52) that ensures control of the barrier (2) and warning device (3) by

arranging the warning signals sent by the sensor (51). When the sensor (51) from its position on the rail senses the approach of the train (T), it sends a signal to the control unit (52). The control unit (52) evaluates the signal it receives and ensures that the barrier (2) is closed within a pre-determined period of time on the basis of where the sensor (51) is placed and the specifications of the train (T) arriving (load train, fast speed train, etc.), and moreover, it is ensured that the warning device warns the vehicles passing through the highway (K).

[0027] In the preferred application of the invention, the control system (5) contains four sensors for each direction (A1, B1, C1, and D1) as well as a control unit (52). In other words, on double lane railways (arrival and departure lanes) eight sensors are used (A1, B1, C1, D1, A2, B2, C2, and D2). On both lanes, three of the sensors (A1, A2, B1, B2, C1, and C2) are placed in the direction that the train (T) approaches the crossing and the fourth sensors (D1, D2) are placed on the rail facing the direction that the train leaves the crossing. The sensors (51), which are placed in the direction that the train approaches the crossing, must preferably be positioned on the rail at varying distances. The first one of the sensors that is on the same side of the railway relative to the crossing (A1, A2) at a distance that is sufficient for the train to stop, the second sensor is preferably placed 100 meters further from the first one (B1, B2) and the third sensor (C1, C2) must be placed at a distance of approximately one kilometer to the first sensor (A1, A2). The fourth sensor (D1, D2) is placed on the side of the crossing that the other sensors are not present (A1, A2, B1, B2, C1, C2). The control unit (52), on the basis of the signals received from the sensors (A1, B1, C1, D1, A2, B2, C2, D2), performs functions such as opening or closing the barrier (2), changing of the symbols on the warning device (3) and similar. When the train (T) reaches sensor one (A1, A2), the control unit (52) ensures that the warning device (3) transmits the first warning for the vehicles on the highway (K). The control unit (52) calculates the speed of the train when the train (T) reaches the second sensor (B1, B2) by dividing the distance between the first and second sensors (A1, B1, A2, B2) into the time that it takes for the train to travel from the first sensor (A1, A2) to the second sensor (B1, B2). When the train reaches the third sensor (C1, C2), the control unit (52) changes the symbol on the warning device (3). And moreover, by using the time period for the train to travel to sensor three (C1, C2), the rate of slowing down of the train is calculated and then the time required for the train to reach and leave the crossing is found. After determining the time indicated above, the arm (22) starts to turn down at approximately 45 seconds before the train (T) reaches the crossing and ensures that the barrier (2) closes the crossing to the traffic from the highway. As such, the waiting period of highway vehicles does not change on the basis of the speed at which the train (T) travels. When the train reaches the fourth sensor (D1, D2), the control unit (52) ensures that the arm (22) is lifted in line with the signal

received from the sensor (D1, D2) and as such the level crossing opens up to the highway vehicles (K).

[0028] The warning device (3), in line with the directives received from the control unit (52), warns the highway vehicles (K) by visual and/ or audio means that the train is approaching. The warning device (3) is capable of sending different warnings on the basis of the number of sensors (51) used in the system. In the preferred application of the invention, the warning device is made up of numerous red colored LEDs, placed in matrix format. When there is no train approaching the level crossing, these LEDs remain off and no visual activity can be observed on the warning device (3). The warning device (3) can preferably send three different types of warning based on the distance of the train (T) to the level crossing. The first warning is given with the signal sent from the first sensor (A1, A2) to the control unit (52). This warning is preferably in the form of flashing LEDs. The second warning is given with signal sent by the second sensor (B1, B2) to the control unit (52). The second warning preferably is a "STOP" sign in the language of the country where the level crossing system (1) is located. And the third warning is given when the closing of the barrier (2) is started. Following the closing down of the barrier (2), the third warning is issued and this warning continues to be issued until the train (T) leaves the crossing. The third warning is preferably the countdown in seconds (approximately 45 seconds) of the total time that the barrier (2) will stay closed.

[0029] In one of the applications of the invention, the warning device (3) is placed on the body (21) of the barrier in a manner that would make it visible to the highway vehicles (K).

[0030] In one of the applications of the invention, the warning device (3) is placed on the arm (22) of the barrier in a manner that would make it visible to the highway vehicles (K).

[0031] In one of the applications of the invention, the warning device (3) is placed on the side of the highway in front of the barrier in a manner that would make it visible to the highway vehicles (K).

[0032] Within the framework of the foregoing fundamental concepts, it is possible to develop various applications of the level crossing that is the subject matter of the invention and as such the invention cannot be limited to the examples provided here and essentially it is as indicated in the requests.

Claims

1. A level crossing system (1) that is **characterized by:**

At least one opening/ closing barrier (2) to cut off the traffic flow on the highway, at the level crossing where the highway and railway intersect

- At least one warning device (3) that would ensure that the drivers of the highway vehicles are warned by sound and/ or sensory means including;
 - At least one imaging system (4) that records the image of the level crossing instantaneously and transmits this image to the trains (T) within the range via wireless means;
 - At least one sensor (51) placed on the rail and at least one control system (5) that includes a control unit that would ensure that the barrier (2), warning device (3) and imaging system (4) are controlled on the basis of the signal received from the sensor (51).
2. A level crossing system (1) that is as indicated in request one and **characterized by** an imaging system (4) containing:
- at least one camera (41) that instantaneously records the image of the level crossing, and
- at least one recording device (42) that is used to record the image that is obtained from the camera (41), and
 - at least one transmitter (43) that makes possible for the recorded image to be relayed to the train (T), and
 - at least one receiver (44) that is placed in the train (T) and establishes communication with the transmitter (43), and
 - at least one screen that is used to relay the information received at the receiver (44) to the operator of the train (Figure 2).
3. A level crossing system (1) that is as indicated in requests one and two and **characterized by** an imaging system (4) containing a camera (41) that has night vision capability.
4. A level crossing system (1) that is as indicated in requests one, two and three and **characterized by** an imaging system (4) containing cameras (41) that are placed in a manner which ensures that at least one of the cameras (41) faces the highway and at least one from the remaining faces the crossing.
5. A level crossing system (1) as mentioned in any one of the foregoing requests, **characterized by** a control system (5) containing four sensors in single lane railways (A1, B1, C1, D1) and eight sensors in double lane railways (A1, B1, C1, D1, A2, B2, C2, D2) as well as a control unit (52).
6. A level crossing system (1) as stated in request 5 and, **characterized by** three sensors (A1, A2, B1, B2, C1, C2) that are placed in the direction that the train (T) approaches the crossing and the fourth sensor (D1, D2) that is placed in the direction that the trains leave the crossing, for each direction.
7. A level crossing system (1) as stated in requests 5 and 6, and **characterized by** at least three sensors (A1, B1, C1, A2, B2, C2) that are placed in the direction that the train approaches the crossing, at varying distances to the crossing.
8. A level crossing system (1) as stated in requests 5 to 7, and **characterized by** a sensor (D1, D2) that is placed on the side of the crossing where the other sensors are not present (A1, A2, B1, B2, C1, C2).
9. A level crossing system (1) as stated in requests 5 to 8, and **characterized by** a control unit (52) that sends the signal for the first warning to be given to the vehicles on the highway of the approaching train, when train (T) reaches the first sensor (A1, A2).
10. A level crossing system (1) as stated in requests 5 to 9, and **characterized by** the control unit (52) that calculates the speed of the train when the train (T) reaches the second sensor (B1, B2) by dividing the distance between the first and second sensors (A1, B1, A2, B2) into the time that it takes for the train to travel from the first sensor (A1, A2) to the second sensor (B1, B2).
11. A level crossing system (1) as stated in requests 5 to 10, and **characterized by** the control unit (52) that calculates the time period for the train to travel to sensor three (C1, C2), the rate of slowing down of the train and then the time required for the train to reach and leave the crossing.
12. A level crossing system (1) as stated in requests 5 to 10, and **characterized by** the control unit (52), which ensures that the arm (22) is lifted in line with the signal received from the sensor (D1, D2) and as such the level crossing opens up to the highway vehicles (K), when the train reaches the fourth sensor (D1, D2).
13. A level crossing system (1) as stated in any one of the foregoing requests, and **characterized by** the warning device (3) that is capable of sending different warnings on the basis of the number of sensors (51) used in the system and is made up of numerous red color LEDs.
14. A level crossing system (1) as stated in any one of the foregoing requests, and **characterized by** a warning device (53) which ensures that the highway vehicles (K) are warned by lighting up the LEDs when a signal is sent from the first sensor (A1, A2) to the control unit (52).

15. A level crossing system (1) as stated in any one of the foregoing requests, and **characterized by** a warning device (3) that puts up a "STOP" sign in the language of the country where the level crossing system (1) is located after second warning is given with signal sent by the second sensor (B1, B2) to the control unit (52). 5
16. A level crossing system (1) as stated in any one of the foregoing requests, and **characterized by** a warning device (3) that shows the countdown in seconds of the total time that the barrier (2) will stay closed, when the barrier commences to be lowered. 10
17. A level crossing system (1) as stated in requests 1 to 16, and **characterized by** a warning device (3) that is placed on the body (21) of the barrier in a manner that would make it visible to the highway vehicles (K). 15
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18. A level crossing system (1) as stated in requests 1 to 17, and **characterized by** a warning device (3) that is placed on the arm (22) of the barrier in a manner that would make it visible to the highway vehicles (K). 25
19. A level crossing system (1) as stated in requests 1 to 18, and **characterized by** a warning device (3) that is placed on the side of the highway in front of the barrier in a manner that would make it visible to the highway vehicles (K). 30
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Figure 1

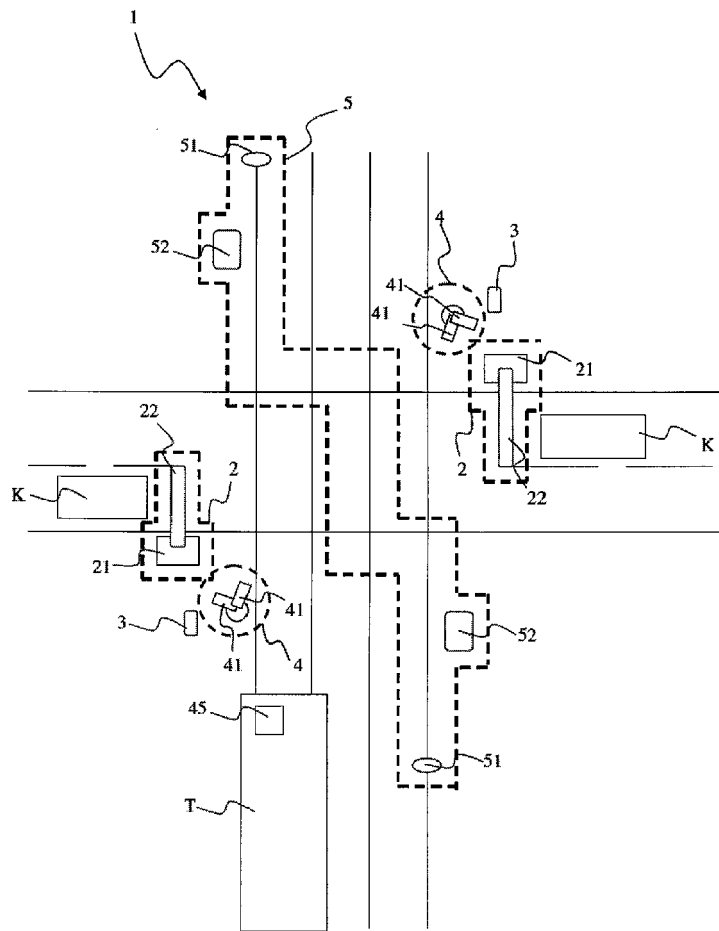


Figure 2

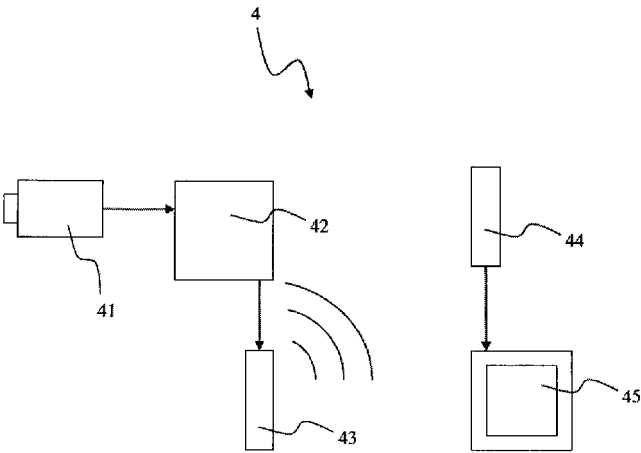
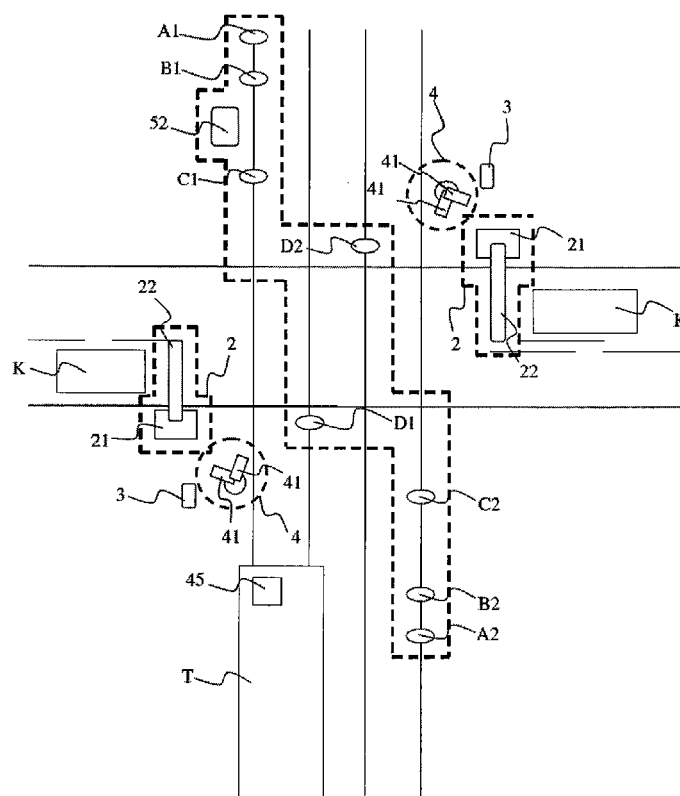


Figure 3



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 5890682 A [0005]
- EP 0976640 A [0006]
- TR 200705031 [0007]