

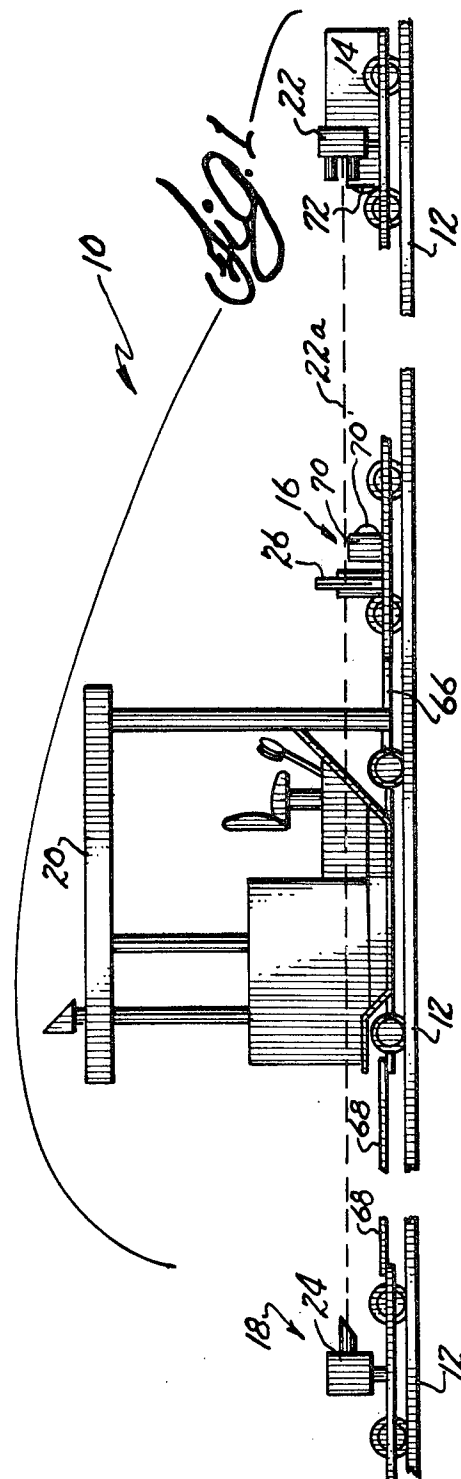
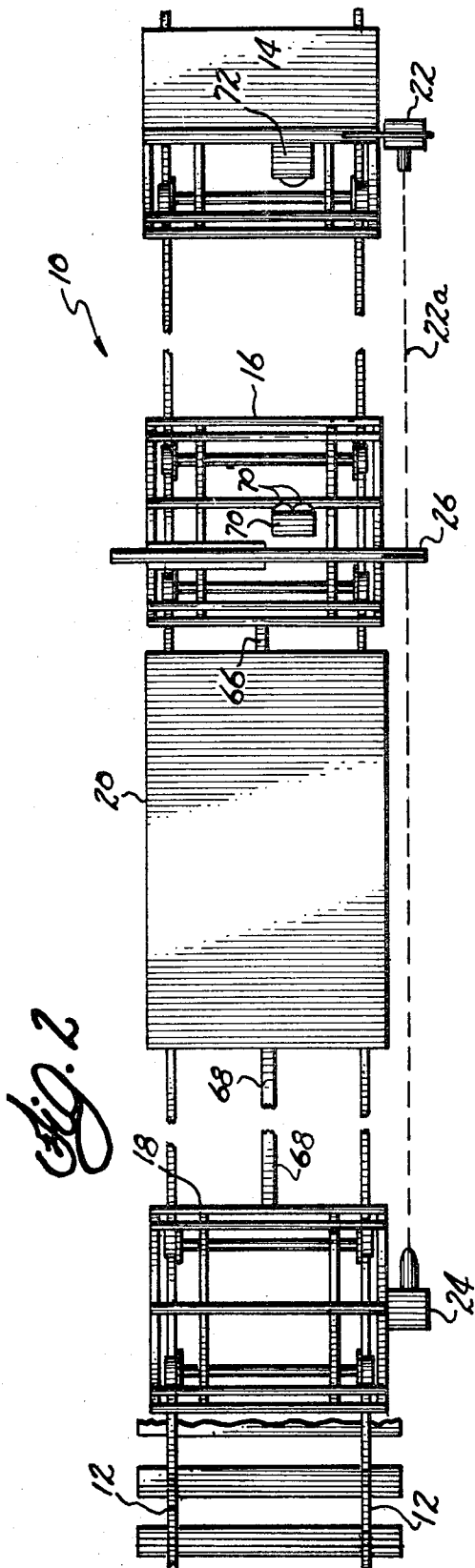
July 21, 1970

I. L. JOY ET AL
RAILROAD TRACK ALIGNMENT INDICATING SYSTEM
EMPLOYING MODULATED INFRARED TECHNIQUES

3,521,066

Original Filed March 16, 1966

4 Sheets-Sheet 1



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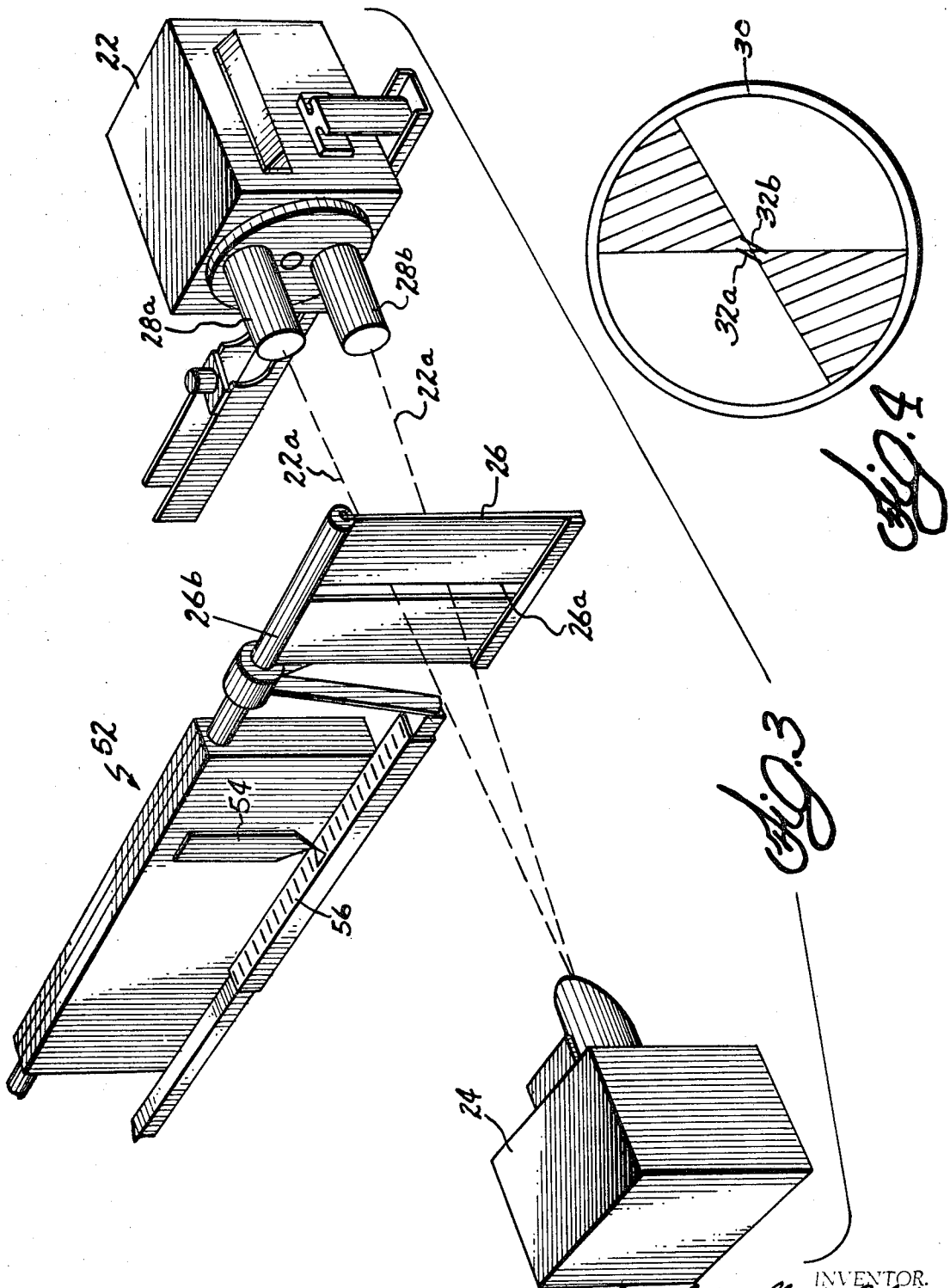
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4 Sheets-Sheet 3

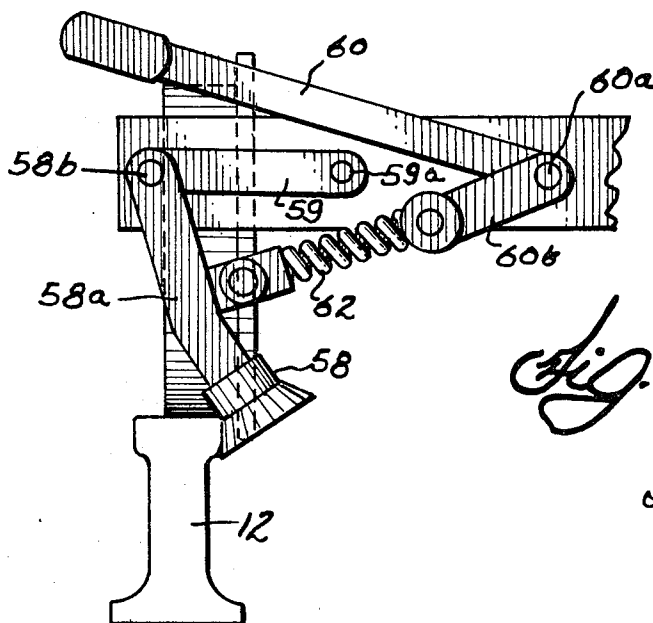
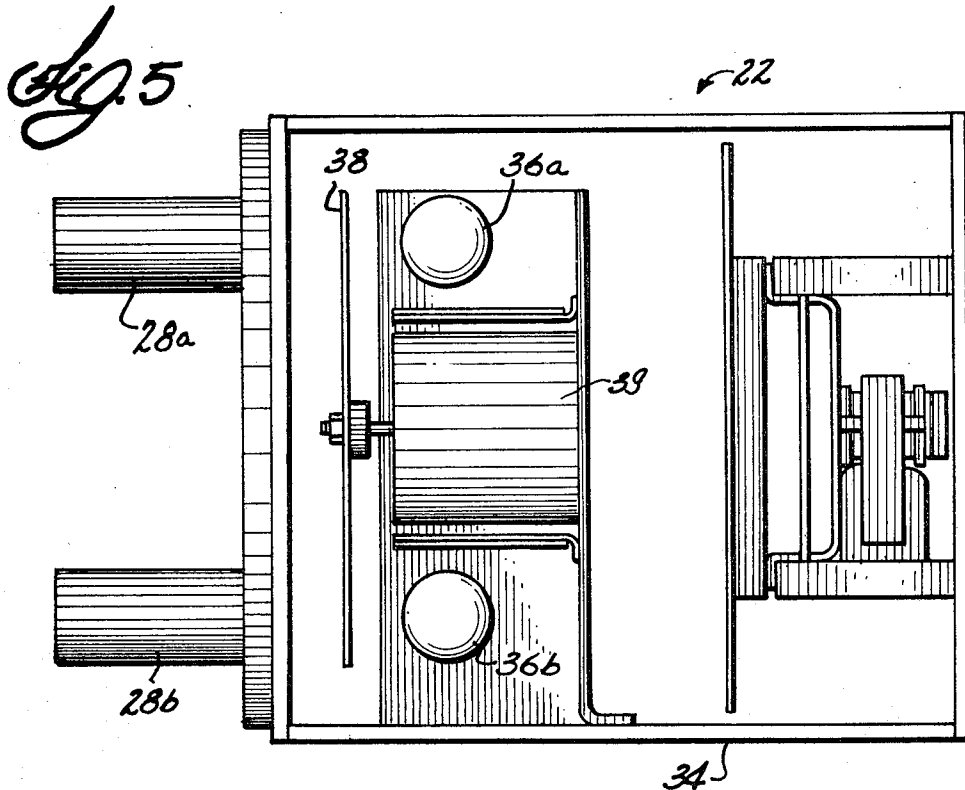


Fig. 6

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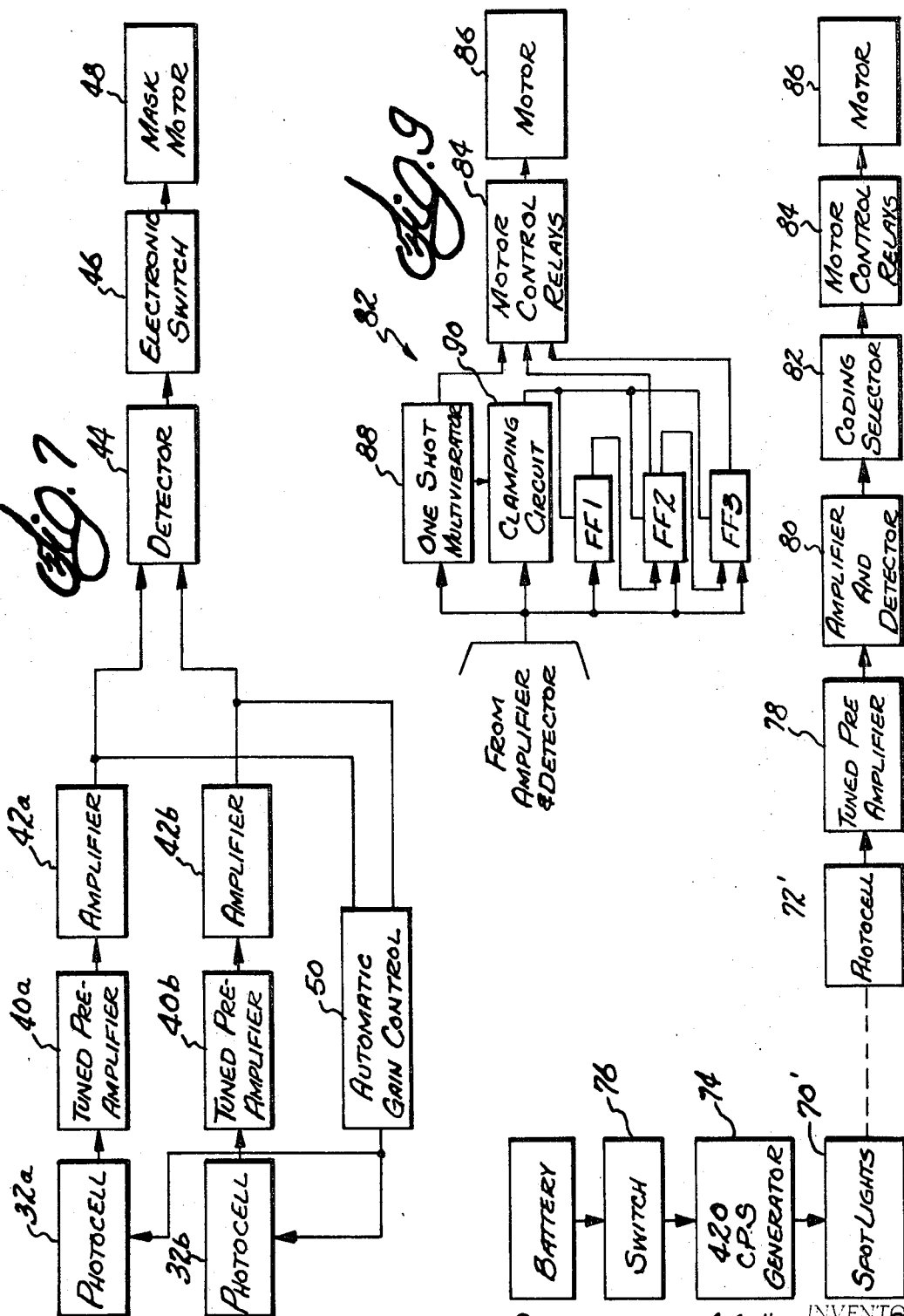


Fig. 8
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3,521,066

RAILROAD TRACK ALIGNMENT INDICATING SYSTEM EMPLOYING MODULATED INFRARED TECHNIQUES

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Continuation of application Ser. No. 534,835, Mar. 16, 1966. This application Feb. 13, 1969, Ser. No. 802,726

Int. Cl. G01j 1/16; G01p 3/36

U.S. Cl. 250—83.3

9 Claims

ABSTRACT OF THE DISCLOSURE

This three-station system for quantitatively indicating the lateral alignment of railroad track comprises a modulated infrared transmitter, a tuned infrared receiver spaced from the transmitter and a shadow mask device positioned therebetween, all being movable along the track. The infrared receiver produces an output signal dependent upon any imbalance in the modulated infrared energy impinging on adjacent selected portions of the receiver, and the resultant output signal, if any, is used to adjust the position of the shadow mask so as to remove the imbalance. The movement of the infrared transmitter along the track is controlled by an independent coded and modulated infrared transmitter-receiver combination.

This application is a continuation of our application Ser. No. 534,835, filed Mar. 16, 1966 and now abandoned.

The present invention relates generally to a railroad track alignment indicating system and, more specifically, relates to such a system employing infrared control signals.

A primary object of the present invention is to provide a new and improved railroad track alignment indicating system. More specifically, it is an object to provide such a system which utilizes infrared control signals.

A further object of the present invention is to provide such a system which is immune to extraneous infrared signals. In this connection, it is an object to provide such a system which responds only to infrared energy having prescribed frequencies.

Another object of the present invention is to provide a new and improved system for indicating the amount of horizontal misalignment of railroad track using a reference established by infrared techniques.

Another object of the present invention is to provide a new and improved remote control system for controlling the movement of a first vehicle relative to a second vehicle. More specifically, it is an object to provide such a system for controlling the movement of a first railroad car relative to a second railroad car. In this connection, it is an object to provide a railroad track alignment indicating device employing such a system which utilizes a prescribed frequency infrared control signal. Still another object is to provide such a system which is immune to extraneous infrared signals and only responds to an infrared signal of the prescribed frequency.

An additional object of the present invention is to provide a new and improved system for indicating the amount of misalignment of railroad track which system employs a prescribed frequency infrared beam reference signal and which also includes a remote control system for controlling the position of a first railroad vehicle rela-

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tive to a second railroad vehicle by means of a prescribed frequency infrared beam control signal.

A general object of the present invention is to provide a new and improved railroad track alignment indicator characterized by simplicity, efficiency, economy and ease of operation. Another general object is to provide such a device employing a new and improved remote control system for controlling the movement of a first railroad car relative to a second railroad car, also characterized by its simplicity, economy, efficiency and ease of operation. Still another general object is to provide a new and improved remote control system for controlling the movement of a first vehicle relative to a second vehicle.

Other objects and advantages of the present invention will become apparent upon reading the attached, detailed description taken in conjunction with the drawings.

In one form of the present invention, a railroad track alignment indicating system is provided which includes an infrared beam transmitter mounted for movement along the track for directing a prescribed frequency infrared beam control signal along the track. Additionally, the system includes a tuned infrared receiver mounted for movement along the track which is positioned to receive the infrared beam from the transmitter and to produce an output control signal dependent upon the lateral position of the infrared beam projected thereon. Further, a shadow mask device is provided which is mounted for movement along the track and which is positioned between the transmitter and the receiver, usually at a prescribed distance from the receiver, for controlling the lateral position of the infrared beam projected onto the receiver in response to the output control signal therefrom. In a preferred embodiment the shadow mask device is positioned so that the beam is centered on the receiver by means of null point servo circuitry. The movement or position of the shadow mask device to achieve centering of the beam on the receiver, i.e., the null point, is used as the indication of the rail portion supporting the shadow mask device relative to the infrared reference line established between the transmitter and receiver.

This embodiment of the alignment indicating system also includes means for controlling the position of the transmitter mounting means relative to the receiver and shadow mask device mounting means. For such purposes a coded prescribed frequency infrared beam control signal is employed. The result is an all-infrared alignment system which is free from many of the vexing shortcomings of prior-art devices.

For the purpose of providing a detailed description of a railroad track alignment indicating system constructed in accordance with the teachings of the present invention, reference will now be made to the drawings wherein:

FIG. 1 is a side elevational view of a railroad track alignment indicating system constructed in accordance with the teachings of the present invention;

FIG. 2 is a top elevational view of the system shown in FIG. 1;

FIG. 3 is a partial perspective view of a control portion of the system shown in FIGS. 1 and 2;

FIG. 4 illustrates an infrared photocell receiver utilized in the system shown in FIG. 3;

FIG. 5 is a sectional side view of a transmitter device utilized in the system shown in FIG. 3;

FIG. 6 illustrates means utilized in the system of FIGS. 1 and 2 for positioning the railroad cars utilized therein relative to the track;

FIG. 7 is a block diagram of misalignment indicating system utilized in the system of FIG. 1;

FIG. 8 is a block diagram of a control system utilized

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in the system of FIG. 1 for controlling the relative positions of a pair of railroad cars utilized therein; and

FIG. 9 is a more detailed block diagram of a portion of the control system shown in FIG. 8.

While the invention has been shown and will be described in some detail with reference to particular exemplary embodiments thereof, there is no intention that it be limited to such detail. Quite to the contrary, it is intended here to embrace all modifications, alternatives and equivalents falling within the spirit and scope of the invention as defined by the appended claims.

Referring now to the drawings, and more specifically to FIGS. 1 and 2, a railroad track aligning system 10 is shown which is constructed in accordance with the teachings of the present invention. The system 10 is provided to indicate the amount of misalignment, if any, of the track supporting the shadow mask device. In the exemplary arrangement, the track alignment indicating system includes three basic sections; namely, a transmitter car 14, an indicator car 16, and a receiver car 18 all mounted for movement along the track. Additionally, a propelling car 20 is provided which may be equipped with facilities for laterally shifting the track adjacent the indicator car 16 to bring it into desired alignment, such a car being described, for example, in U.S. Pat. 3,240,161. It should be understood, of course, that a separate propulsion car can be eliminated and integral propulsion means applied to indicator car 16 and/or receiver car 18.

In the exemplary arrangement, the indicator car 16 is secured to the forward or right hand end of the propelling car 20, as viewed in FIGS. 1 and 2, whereas the receiver car 18 is attached to the rear or left hand end of the propelling car 20. Consequently, the indicator car and the receiver car are moved concurrently with the propelling car, all as a unit. Additionally, the transmitter car 14 is separately positioned on the track forward or to the right of the indicator car 16, as viewed in FIGS. 1 and 2.

In accordance with one aspect of the present invention, an infrared transmitter 22 is mounted on the transmitter car 14 for directing an infrared control beam 22a, which is modulated at a prescribed frequency, along the track. For the purpose of receiving the prescribed frequency infrared beam control signal, a tuned infrared beam receiver 24 is mounted on the receiver car 18. Additionally, a shadow mask device 26, which projects into the path of the infrared beam 22a, is mounted on the indicator car 16. This controls the position of the infrared beam 22a projected onto the receiver 24 in accordance with the relative position of the track portion adjacent indicator car 16 with respect to the line of reference established by the infrared beam transmitted by transmitter 22 and received by receiver 24. Finally, means (not shown in FIGS. 1 and 2) are provided for moving the shadow mask device responsive to the receiver output signal.

The infrared transmitter 22, the infrared receiver 24 and the shadow mask device 26 are shown in greater detail in FIG. 3. As may be seen, the exemplary infrared transmitter 22 includes a pair of infrared beam outputs 28a and 28b which are directed toward the receiver 24. The shadow mask device 26 is supported by a movable shaft 26b and has a vertically disposed slot 26a provided therein which allows for the passage of a defined portion of the infrared beam 22a therethrough to the receiver 24. During an aligning operation, the shadow mask device 26 is moved laterally until substantially equal amounts of the infrared beam 22a are received by the two photocells. The lateral movement of shadow mask device 26 is controlled by a servo motor responsive to signals from receiver 24 until the desired balance of signals received by the two photocells is achieved.

In practice, the transmitter 22 and the receiver 24 are mounted so as to be equally spaced from the reference rail and the infrared beam therebetween establishes a line of reference for checking the alignment of inter-

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mediate track where the mask device 26 is located. As already indicated, the mask device 26 is servo controlled so that the vertical slice of infrared energy striking the receiver 24 is equally divided between cells 32a and 32b. If the reference rail at the location of mask device 26 is spaced the same distance from the mask device as it is from transmitter 22 and receiver 24, it is properly aligned (assuming tangent track). If the spacing is different, it is not properly aligned. Any difference in spacing is used as the indication of misalignment.

Referring to FIG. 4, the infrared beam receiving portion of the receiver 24 is shown. The beam receiving portion includes an input lens 30 and a pair of infrared photocells 32a, 32b associated therewith, the outputs from which are balanced to achieve the desired null. The photocells 32a, 32b are offset from vertical positions to increase the sensitivity of the receiver 24. The operation of the system in response to the outputs of the photocells 32a, 32b will be described hereinafter.

Referring now to FIG. 5, the details of the transmitter 22 are shown. The transmitter 22 has a main outer housing 34 within which the infrared producing means are disposed and to which the infrared outlets 28a, 28b are secured. The infrared producing means include a pair of light bulbs 36a, 36b which may, for example, be 115 volt, 500 watt projector bulbs and which are positioned in alignment with the infrared outlets 28a, 28b. The bulbs 36a, 36b may be connected in series across a 110-120 volt source whereby they are operated at half voltage. At such voltage a substantial amount of infrared is produced and bulb life is greatly extended.

For the purpose of modulating the infrared energy projected out of the outputs 28a, 28b from the bulbs 36a, 36b at a prescribed frequency, a rotatable disc 38 is interposed between the infrared outlets and the bulbs which has a selected number of apertures (not shown) provided therein that pass between the outlets and the bulbs as the disc is rotated, and a motor 39 is provided for rotating the disc 38 at a prescribed speed. The disc 38 may, for example, have 12 holes or apertures formed therein and the motor 39 may, for example, operate at a speed of 3600 r.p.m. so that the infrared energy produced by the transmitter 22 is modulated at a frequency of 720 cycles per second. Thus, it will be seen that the transmitter 22 functions to modulate the infrared output produced by the bulbs 36a and 36b at a prescribed frequency to produce frequency modulated infrared control signals. The vertical "slice" of this modulated infrared energy which is transmitted through the vertical aperture in mask device 26 impinges on the photocells of receiver 24.

A block diagram of a control system, associated with the photocells 32a, 32b of the receiver 24, for responding to the outputs produced by the photocells is shown in FIG. 7. As may be seen by reference thereto, the outputs produced by the photocells 32a, 32b are transmitted to tuned preamplifiers 40a, 40b which are tuned to the prescribed modulation frequency of the infrared energy produced by the transmitter 22. Accordingly, the control system responds only to infrared signals which are modulated at the prescribed frequency or frequency band.

The outputs of the tuned preamplifiers 40a, 40b are amplified in amplifiers 42a, 42b and are transmitted to a differential detector 44 which produces an output having a polarity and magnitude dependent upon the relative amplitudes of the signals applied thereto. The detector 44 controls the operation of an electronic switching network 46 which, in turn, controls the operation of a motor 48. The motor 48 functions to drive supporting shaft 26b of the shadow mask device 26 to the right or left (FIG. 3) in a horizontal direction substantially perpendicular to a line between transmitter 22 and receiver 24. This incipiently repositions the shadow mask device 26 so that the infrared energy impinging on cells 32a and 32b is balanced. The outputs of the amplifiers 42a, 42b are also transmitted to an automatic gain control network 50

which controls the gain of the photocells 32a, 32b and prevents overloading, particularly when transmitter 22 is close to receiver 24.

A brief description of the overall operation of the system 10, as thus far described, may now be helpful in understanding the present invention. As previously mentioned, when the track adjacent the indicator car 16 is in alignment, equal amounts of the infrared beams 22a and projected onto the photocells 32a, 32b through the slot 26a in the shadow mask device 26. Under these conditions, the photocells 32a, 32b produce equal outputs. Assuming infrared signal 22a is modulated at the tuned frequency of the preamplifiers, the photocell outputs are amplified and are transmitted to the differential detector 44. Since the signals applied to the detector 44 are equal in amplitude, a zero or null resultant output is produced by the differential detector 44 and the electronic switching network 46 is not rendered operative. Under these conditions, the motor 48 is not rendered operative and, thus, no movement is imparted to the shadow mask device 26, indicating that the track is in alignment.

On the other hand, if the track portion adjacent the indicator car 16 is misaligned (or curved), different amounts of the infrared beams 22a are incipiently projected onto the photocells 32a, 32b through the slot 26a in the shadow mask device 26. Different outputs are incipiently produced by the photocells 32a, 32b by the different amounts of infrared energy received thereby. Accordingly, the signals applied through the differential detector 44 will have different amplitudes so that a resultant output is produced thereby which renders the electronic switching network 46 operative. Under these conditions, the motor 48 is rendered operative to drive the shadow mask device 26 to the right or left in a direction transverse to the track depending upon the polarity of the resultant output. The shadow mask device 26 is driven to the right or left until equal amounts of infrared energy are projected onto the two photocells 32a, 32b and a null detector output is again produced. When the null detector output is again produced, the electronic switching network 46 is rendered inoperative causing the motor 48 to be rendered inoperative.

Means are provided for providing an indication of the amount of track misalignment responsive to movement of the shadow mask device 26 in a direction transverse to the track. For this purpose, an indicator device 52 (FIG. 3) is mounted on the indicator car 16 which is associated with the supporting shaft 26b of the shadow mask device 26. As may be seen, the exemplary indicator device 52 includes a stationary pointer 54 and a movable scale 56, which moves in conjunction with shadow mask device 26. The amount of misalignment or curvature, if any, is indicated by the position of the pointer 54 relative to the scale, which is marked with suitable indicia on each side of a zero point, e.g., inches. The scale 56 is secured to the supporting shaft 26b of the shadow mask device 26 for concurrent movement therewith to the right or left in a transverse direction with respect to the track in response to operation of the motor 48.

When the track portion adjacent the indicator car 16 is in alignment so that no movement is imparted to the supporting shaft 26b, the pointer 54 is positioned at a zero point along the scale 56 to indicate no misalignment. On the other hand, when misalignment or curvature exists, supporting shaft 26b is driven to the right or left in a direction transverse to the track and the scale 56 is driven concurrently therewith. When a null output is thereafter produced by the detector 44 so that the motor 48 ceases to operate and movement of the supporting shaft 26b is stopped, the amount of misalignment or curvature is indicated by the position of the pointer 54 relative to the scale 56. During a typical track aligning operation, the position of the track adjacent the indicator car 26 is adjusted by the amount indicated by the indicator device 52. When the track is properly aligned, a null out-

put is produced by the detector 44 and the pointer 54 is positioned at the zero or null position on the scale 56 to indicate no misalignment or curvature. As aforementioned, track shifting equipment may comprise a part of the propelling car 20. Since the details of the track shifting equipment do not constitute a portion of the present invention, the details thereof are not set forth herein.

Gauge means are provided for positioning the transmitter car 14, the indicator car 16 and the receiver car 18 relative to a selected rail of the track. This may be accomplished in a variety of ways. For example, special gauge wheels may be lowered against the gauge side of the line rail and locked. Similar gauge wheels may then be resiliently loaded against the gauge side of the opposite rail, thereby keeping the first-mentioned gauge wheels tight to the line rail. The keyed infrared source 22 and tuned infrared receiver 24 are then adjusted by conventional mechanical adjusting devices to be spaced exactly the same horizontal distance from the gauge side of line rail. Similarly, the slot 26a of shadow mask device 26 has exactly the same spacing from the gauge side of line rail when the pointer 54 is positioned at the zero point along the scale 56.

An example of gauge means which might be employed is illustrated in FIG. 6. Gauge wheel 58 is rotatably mounted on arm 58a, which in turn is pivotally mounted at 58b on the frame of the particular wheeled car under consideration. Gauge wheel 58 may be spring loaded against the gauge side of rail 12 by means of hand lever 60 which pivots at 60a. When lowered as shown in FIG. 6, lever 60 forces lever arm 60b past the center position whereby spring 62, which is under compression, bears against arm 58a. The next effect is to force the gauge wheel or wheels (or flanges of the support wheels) on the opposite side of the car against the gauge side of the corresponding rail.

The gauge wheels may be locked into a fixed position by means of arm 59, which also pivots at 58b and moves with 58a. Locking is accomplished by passing a pin (not shown) through hole 59a when it registers with a corresponding hole or series of corresponding holes in the frame of the car.

When the railroad track aligning system 10 is utilized for aligning straight or tangent track, the indicator car 16 is suitably secured to the forward or right hand end of the propelling car 20, as viewed in FIGS. 1 and 2, by a connecting bar 66, whereas the receiver car 18 is suitably attached to the rearward or left hand end of the propelling car 20 by a draw bar 68 or the like. Consequently, the indicator car 16 and the receiver car 18 are moved as a unit with the propelling car 20. The transmitter car 14 is positioned forward or to the right of the indicator car 16, as viewed in FIGS. 1 and 2, and is independently movable along the track. In a typical setup for the aligning of straight track, the indicator car and the receiver car are so associated with the driving car that the center of the receiver 24 is positioned 31 feet from the shadow mask device 26. The transmitter car 14 may be positioned a substantial distance from the forward end of the indicator car 16 such as, for example, a maximum distance of 700 feet, depending upon the power of the infrared beam transmitter 22.

During operation, the position of each section of track adjacent the indicator car 16 is checked for alignment. If misaligned, it is repositioned to bring it into alignment. Subsequent to a track alignment checking and shifting operation, the propelling car 20 is driven toward the transmitter car 14 a distance no greater than about 31 feet so that receiver 18 always is positioned on aligned track. The track alignment checking and shifting operation is then repeated. This operation is continued until transmitter car 14 is closely approached. The transmitter car 14 is then driven forward a suitable distance and a corresponding series of operations are again repeated. In each

case cars 16 and 18 are worked up to car 14 in a series of steps.

The exemplary railroad track aligning system 10 may also be utilized for checking the alignment of curved track.

For this purpose, the transmitter car 14 is attached to the front end of the indicator car 16 by a draw bar (not shown) so that the centers of the transmitter 22 and the receiver 24 are positioned equal distances, e.g., 31 feet, from the shadow mask device 26. Under these conditions, the center of the transmitter 22 is positioned 62 feet from the center of the receiver 24 and thus a 62 foot cord is formed therebetween for a curved portion of the track. The aligning system 10 functions the same with curved track as it does with straight track except for the fact that the indicator mechanism 52 always indicates curvature as well as misalignment. With such spacing of the cars the inches of curvature indicated by the indicator mechanism 52 are directly convertible into degrees of curvature for the curved track. Specifically, with a cord of 62 feet being formed between the transmitter 22 and the receiver 24, a one inch reading on the scale 56 of the indicator indicates one degree of curvature and each additional inch indicates an additional degree of curvature. The technique of aligning curved track with the readings obtained is well known in the art and need not be specifically described herein.

In accordance with another aspect of the present invention, infrared control means are provided for remotely controlling the movement of the transmitter car 14 relative to the front end of the indicator car 16. For this purpose, an infrared beam transmitter 70 is positioned on the indicator car 16 for directing a prescribed frequency infrared beam control signal along the track. Means are associated with the transmitter 70 for coding the infrared beam control signal produced thereby. Additionally, a tuned infrared receiver 72 is mounted on the transmitter car 14 for receiving the coded infrared beam control signal from the transmitter 70 and for controlling the movement of the transmitter car 14 in accordance therewith. The infrared transmitter 70 may, for example, be in the form of a pair of 4.7 volt sealed beam headlights 70' (FIGS. 2 and 8) having a small mass in the filament thereof which are electronically modulated to provide the desired frequency output. The receiver 72 may include a photocell pickup device 72' (FIG. 8).

Referring to FIG. 8, a block diagram of a control system for remotely controlling the movement of the transmitter car 14 is shown. For the purpose of modulating the infrared beam produced by the transmitter 70, a generator 74, e.g., a 420 cycles per second generator, is provided which is rendered operative by a manual control switch 76 to modulate the operation of the transmitting headlights 70. Accordingly, the infrared beam control signal produced by the transmitter 70 is modulated at 420 cycles per second and the modulated signal is directed toward the receiver 72. The switch 76 may, for example, be a manually operable push-button type switch situated in the propelling car 20.

The exemplary receiver 72 includes a photocell 72' for producing an output signal responsive to the receipt of the infrared beam control signal produced by the transmitter 70. The output signal produced by the photocell 72' is transmitted to a tuned preamplifier 78 which is tuned to the frequency at which the infrared beam control signal produced by the transmitter 70 is modulated (420 cycles per second in the exemplary arrangement). The output of the tuned preamplifier 78 is amplified and detected by an amplifier-detector 80 and the resultant output is transmitted to a coding selector 82. The coding selector 82 responds to a prescribed coding of the infrared beam control signal to control the operation of motor control relays 84 which, in turn, control the operation of a motor 86. When rendered operative, the motor 86 functions to drive the transmitter car 14 away from or toward the

indicator car 16 depending upon the coding of the infrared beam control signal.

In order to code the infrared beam control signal transmitted from transmitter 70, the operator of the system operates the push-button switch 76 in accordance with a prescribed code. In order to control forward movement of the transmitter car 14 away from the indicator car 16 with the exemplary coding selector 82, described herein-after, the operator depresses the push-button switch 76, releases the push-button switch and then, again, depresses the push-button switch and holds it in the depressed condition. As will become apparent, this causes the motor 86 to operate to drive the transmitter car away from the indicator car until the push-button switch is thereafter released or the signal from transmitter 70 is otherwise interrupted (a "fail-safe" system). On the other hand, for reverse movement of the transmitter car 14 toward the indicator car 16, the push-button switch 76 is depressed, released, depressed, released and then depressed and held in the depressed condition. This causes the motor 86 to operate to drive the transmitter car toward the indicator car until the push-button switch is thereafter released or the signal is otherwise interrupted.

Referring to FIG. 9, a block diagram of an exemplary coding selector 82 is shown. The exemplary coding selector 82 includes a one shot or monostable multivibrator 88 which is provided to produce an output pulse having a prescribed time period, for example, a five second time period, responsive to the application thereto of an input pulse. The multivibrator 88 functions to control the time period during which the coded infrared beam control signal must be received to control movement of the transmitter car. Additionally, the coding selector includes three flip-flops FF1-FF3 for cooperating with the multivibrator 88 to control the operation of the motor control relays 84.

It will be apparent that the input signal applied to the coding selector 82 from the amplifier-detector 80 are coded or pulsed in accordance with the coding applied to the infrared beam control signal by manual operation of the switch 76. The pulses or coded portions produced during a coding operation are applied to the multivibrator 88 and to the flip-flops FF1-FF3. The first pulse or coded portion produced responsive to the first depression of the switch 76 causes the multivibrator 88 to be rendered operative to produce the prescribed period output signal or pulse and also causes the flip-flop FF1 to be rendered operative to produce an output pulse which is transmitted to the flip-flop FF2 to condition the flip-flop FF2 for operation. The second pulse produced responsive to the next depression of the switch 76, after it has been released, causes the flip-flop FF2 to be rendered operative to produce an output pulse which is transmitted to the flip-flop FF3 to condition the flip-flop FF3 for operation. Additionally, the output pulse of the flip-flop FF2 is transmitted to the motor control relays 84.

The period of the output pulse produced by the flip-flop FF2 corresponds in time to the time period the push-button switch 76 is depressed to produce the triggering pulse for the flip-flop FF2. If the pulse is produced by the flip-flop FF2 during the time period of the output pulse produced by the multivibrator 88 and the time period of the flip-flop pulse extends beyond the end of the multivibrator pulse, the motor control relays 84 are rendered operative to initiate operation of the motor 86 in a direction to drive the transmitter car 14 away from the indicator car 16. As long as the switch 76 is continuously maintained in the depressed condition, the motor 86 will continue to drive the transmitter car away from the indicator car, provided the signal received by photocell 72' is not otherwise interrupted. When the push-button switch is thereafter released, the motor 86 will stop operating and the transmitter car will stop.

If during the time period of the output pulse from multivibrator 88 the switch 76 is released a second time and depressed again, the resulting third pulse applied causes

the flip-flop FF3 to be rendered operative to produce an output pulse which is transmitted to the motor control relays 84. The output pulse produced by the flip-flop FF3 likewise has a time period determined by the period of depression of the pushbutton switch 76. If this pulse is produced by the flip-flop FF3 during the time period of the output pulse produced by the multivibrator 88 and the time period of the flip-flop pulse extends beyond the end of the multivibrator pulse, the motor control relays 84 are rendered operative to cause the motor 86 to operate to drive the transmitter car 14 toward the indicator car 16. The transmitter car 14 will continue to be driven in this direction as long as the switch 76 is maintained in the depressed condition, provided the signal received by photocell 72' is not otherwise interrupted. When the push-button switch 76 is thereafter released, the motor 86 stops operating and the transmitter car stops.

When the push-button switch 76 is released subsequent to the end of the time period of the pulse produced by the multivibrator 88, a pulse is transmitted to a clamping circuit 90 which responds thereto to reset the flip-flops FF1-FF2 to their initial conditions to condition the coding selector for a subsequent operation. During the time period of the output pulse produced by the multivibrator 88, a signal is transmitted from the multivibrator to the clamping circuit 90 to render the clamping circuit inoperative in response to pulses transmitted thereto during releasing operations of the switch 76.

It is thus apparent that the transmitter car 14 is readily controlled by coded infrared signals from indicator car 16, the code being applied by manually keying push-button switch 76 which is conveniently located in car 20. Assuming multivibrator 88 has, for example, a time period of five seconds, transmitter car 14 can be driven forward by depressing, releasing and depressing switch 76 within the five second period and holding switch 76 depressed beyond the five second period. It is thereafter stopped by releasing switch 76. Transmitter car 14 can also be driven backward (toward indicator car 16) by depressing, releasing, depressing, releasing and depressing switch 76 within the five second period and holding switch 76 depressed beyond the five second period. It is thereafter stopped by releasing switch 76.

In the light of the foregoing description, it is apparent that a new and improved railroad track alignment indicating system has been provided. Additionally, it will be seen that an all-infrared-controlled system has been provided which includes means for remotely controlling the positions of different portions of the alignment indicating device. In the exemplary arrangement, the amount of movement of the first car is limited only by the strength of the infrared beam transmitter 70. Since both of the infrared transmitters 22 and 70 are modulated at prescribed differing frequencies, it will be apparent that the system constructed in accordance with the present invention is immune to extraneous infrared beams.

What is claimed is:

1. In a railroad track alignment indicating device, the combination which comprises:

- (a) an infrared transmitter mounted for movement along the track at a predetermined lateral spacing from one of the rails thereof and positioned to direct an infrared signal modulated at a prescribed "frequency along the track;
- (b) an infrared receiver tuned to receive at least said prescribed frequency and mounted for movement along the track at the same predetermined lateral spacing from said one of said rails thereof and positioned to receive infrared energy from said transmitter and to produce an output signal dependent upon imbalances in infrared energy impinging upon selected portions thereof;
- (c) a shadow mask device mounted for movement along the track and positioned between said trans-

mitter and said receiver, said shadow mask device controlling by lateral movement the infrared energy from said transmitter impinging on said receiver;

(d) means for continuously and automatically adjusting the lateral position of the shadow mask device, independent of track position adjacent the shadow mask device, and continuously responsive to said output signal to remove said imbalances; and

(e) means for indicating the amount of lateral spacing of said shadow mask device from the portion of said one of said rails adjacent said shadow mask device as compared with said predetermined lateral spacing;

whereby the lateral position of said shadow mask device when said imbalances are removed, as compared with said predetermined lateral spacing, provides a quantitative indication of the lateral alignment of the portion of said one of said rails adjacent said shadow mask device relative to the portions of said one of said rails adjacent said transmitter and said receiver.

2. The device as recited in claim 1 wherein said receiver and said shadow mask device are mounted a prescribed distance apart on concurrently movable carriage means and said transmitter is mounted on a separate, independently movable carriage.

3. The device as recited in claim 1 wherein said receiver includes a pair of juxtaposed photocells and the receiver functions to produce a null output signal when equal amounts of the infrared beam are projected onto the respective photocells and functions to produce a differential output signal when unequal amounts of the infrared beam are projected onto the photocells, said shadow mask device causing equal amounts of the infrared beam to be projected onto the photocells when the track portions adjacent said shadow mask device are aligned and causing unequal amounts of the infrared beam to be projected on the photocells when the track portions are misaligned.

4. The device as recited in claim 3 wherein said means for adjusting the position of said shadow mask device functions responsive to a differential output signal from said receiver to horizontally adjust the shadow mask device until a null output is produced.

5. The device is recited in claim 1 wherein said receiver, said shadow mask device and said transmitter are mounted on separate cars and the cars for said receiver and said shadow mask device are attached for concurrent movement.

6. The device as recited in claim 5 wherein means are provided for positioning the cars relative to a selected rail of the track.

7. The device as recited in claim 2 wherein a second infrared transmitter is mounted on said concurrently movable carriage means, which is operable to direct a coded infrared control signal which is modulated at a second prescribed frequency along the track toward said separate, independently movable carriage, a second infrared receiver is mounted on said separate, independently movable carriage which is tuned to the frequency of modulation of the coded control signal from said second infrared transmitter for producing a coded output signal determined by the coding of the coded control signal, and means are provided for responding to said coded output signal to drive the transmitter car in a direction relative to the shadow mask car as determined by the coding thereof.

8. The device as recited in claim 7 wherein means are provided which are operable by an operator to code the infrared signal produced by said second infrared transmitter.

9. The device as recited in claim 7 wherein said second infrared receiver responds only to coded infrared signals transmitted within prescribed time periods.

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