This invention relates to a carrier control system and more particularly to a system for controlling the movement of overhead cranes, locomotives and the like from a remote position. In the operation of a crane, for example, the crane must move along its tracks, the crane trolley must move transversely to the crane bridge, and the hoist must move up and down. The crane operator normally sits in the cab of the crane and a workman on the ground gives hand signals to him for the necessary movement. Because visibility is not always perfect and because of blind spots, the crane operator may not receive or understand the signals when it is given. This can result in delay and/or accidents. In order to overcome these disadvantages it has been suggested that a remote control be provided to operate the crane from the ground. However, controls of which we have knowledge require separate components for each direction of movement and each speed for each motor. Thus, the weight and cost of the control is excessive.

It is therefore an object of our invention to provide a remote control system which utilizes proportional control to reduce the number of components required.

Another object is to provide such a control which is much cheaper and lighter than remote controls previously.

These and other objects will be more apparent after referring to the following specification and attached drawings, in which:

FIGURE 1 is a schematic view of the transmitter of our invention;

FIGURE 2 is a schematic view of the receiver of our invention;

FIGURE 3 is a schematic view showing a safety receiver associated with our invention;

FIGURE 4 is a schematic view showing the controls for the motors; and

FIGURE 5 is a schematic view of a crane with certain control parts shown thereon.

Referring more particularly to FIGURE 1 of the drawings, reference numeral 2 indicates a transmitter which is carried by the operator. The transmitter includes four variable frequency multi-vibrators 4A, 4B, 4C and 4D. These may be of any standard type such as that shown on page 156 of the General Electric Transistor Manual, Sixth edition. Except for the values of the various components multi-vibrators 4A, 4B, 4C and 4D are identical so that only one will be described in detail. The multi-vibrators are powered by a battery 6 or other low voltage power source.

The multi-vibrator 4A includes a resistor 8 and transistor 10 connected in series with each other and resistor 12 and transistor 14 connected in series with each other and in parallel with resistor 8 and transistor 10. Connected between resistor 8 and transistor 10 is a capacitor 16 and a variable resistance 18. Connected between resistor 12 and transistor 14 is a tuning circuit consisting of capacitor 20 and variable resistor 22. The output of transistor 10 is connected through a fixed resistance 24 to the capacitor 20. The output of transistor 14 is connected through a fixed resistance 26 to the capacitor 16. Fixed resistances 24, 26, 28, 30 and 34 are connected across resistances 34 and 26. A fixed resistance 32 is connected between the positive terminal of battery 6 and between the resistances 28 and 30. The values of elements 16, 18, 24 and 28 are the same as the values of elements 20, 22, 26 and 30 respectively. The transistors 10 and 14 are type 2N1404 or equivalent. Arms 18A and 22A are mechanically interconnected so that the effective value of resistor 18 will also be the same as that of resistor 22.

Multi-vibrator 4D differs from multi-vibrator 4A in that the variable resistors 18 and 22 are omitted. Output switches 32A, 32B, 32C and 32D are provided for the multi-vibrators 4A, 4B, 4C and 4D respectively.

The outputs of the multi-vibrators are selectively connected to audio amplifier 34 which may be of any standard type.

As shown, it includes a resistor 36, transistor 38, resistor 40 and transistor 42 connected in series. The transistor 38 is connected to power source 6 through transistor 44. Biasing resistor 46 and current resistor 48 are connected across the emitter 42E and base 42B, of transistor 44. A resistor 50 is connected to the collector 42C. The output of audio amplifier 34 is connected to a radio frequency amplifier 52 which together with oscillator 54 form a transmitter. This may be a standard type such as that shown on page 361 of Texas Instrument's publication entitled Transistor Circuit Design having Library of Congress Catalog Card No. 62-19766, However, it is preferred to use the transmitter shown. The radio frequency amplifier 52 includes a transistor 55 having its emitter 55E connected to the output of amplifier 34. The emitter 55E is also connected to the negative terminal of battery 6 through a fixed resistor 58. Negative terminal of battery 6 is also connected to base 56B through resistors 60 and 62 and capacitor 64. Positive terminal of battery 6 is connected between resistors 60 and 62 through resistor 66 and also to collector 56C through a tuned circuit consisting of variable capacitor 68 and primary 70 of a transformer 70. Secondary 76S of transformer 70 is connected through a coil 72 to an antenna 74. The oscillator 54 includes a transformer 75 having its secondary 76S connected to base 56B through condenser 64. Secondary 76S is connected to the negative terminal of battery 6 through a resistor 78 and capacitor 80 connected in parallel. Capacitor 82 is connected across primary 76P. Negative terminal of battery 6 is connected to primary 76P through resistor 84 and transistor 86. Negative terminal of battery 6 is also connected through a resistor 88 to base 86B of transistor 86 and through resistor 90 to the positive terminal of battery 6. Oscillator crystal 92 is connected across the base 86B and collector 86C.

A safety channel transmitter 94 is also connected to battery 6 and except for values of the components is the same as the transmitter 52, 54. Hence, the parts thereof will not be described in detail. However, it should be noted that the oscillator crystal 92 of transmitter 94 must have a different frequency than crystal 92.

While the invention may be used to operate any type of mobile equipment, it will be described with reference to an overhead crane carried on rails 98. The crane includes a bridge 100 which moves along the rails 98, a trolley 102 which moves transversely to the bridge, and a hoist 104 mounted on the trolley 102. The bridge 100 is moved by means of a motor 106 having a control panel 108 for determining the direction and speed of movement.

The trolley 102 is moved across the bridge 100 by means of a motor 110 whose speed and direction of movement are determined by means of a control panel 112. The hoist 104 is raised and lowered by means of a motor 114, the speed and direction of movement of which is controlled by means of a control panel 116. The parts of the crane so far described are conventional.

Mounted on the bridge 100 is a superheterodyne receiver 118. This may be a conventional device such as is shown on page 115 of the G.E. Transistor Manual referred to above. As shown in FIGURE 2, the receiver 118 consists of a radio frequency amplifier and mixer 120, an oscillator 122, and
an intermediate frequency amplifier 124. The amplifier and mixer 120 includes a receiving antenna 126 which is connected to the positive terminal of a low-power D.C. power source 128 through a coil 130 and variable capacitor 132 connected in parallel and also through a variable capacitor 134. As shown in FIGURE 4 power source 128 consists of four batteries or other power sources 128A, 128B, 128C and 128D connected in series. A transistor 136 has its emitter 136E connected to the positive terminal of the power source 128 and its collector 136C connected to the negative terminal of power source 128 through primary 138P of transformer 138 and a resistor 140.

Oscillator 132 includes a capacitor 142 connected between base 135B of transistor 136 and coil 144. The negative terminal of power source 128 is connected to collector 146C of transistor 146 through coil 144. Emitter 146E is connected to the positive terminal of power source 128 through two circuits, one consisting of coil 148 and capacitor 150 connected in parallel and the other consisting of resistor 152 and capacitor 154 connected in parallel. Base 146B is connected to the positive terminal of power source 128 through a parallel circuit consisting of resistor 156 and crystal oscillator 158. Base 146B is also connected to the negative terminal of power source 128 through resistor 160.

The intermediate frequency amplifier 124 includes a transistor 162 having its base 162B connected to the secondary 138S. Emitter 162E is connected to the negative terminal of power source 128 through resistor 164. Collector 162C is connected to primary 166P of transformer 166. Primary 165P is connected to the positive terminal of power source 128 through resistors 168 and 170. Primary 166P is connected to the negative terminal of power source 128 through a capacitor 172 and resistor 164. Resistor 174 and capacitor 176 are connected in parallel with resistor 168 and capacitor 172. Secondary 166S is connected to base 178B of transistor 178. Emitter 178E is connected to the negative terminal of power source 128 through a resistor 180 and capacitor 182 connected in parallel. Secondary 166S is connected to the negative terminal of power source 128 through resistor 184 and capacitor 186 connected in parallel. Secondary 166S is connected to the positive terminal of power source 128 through resistors 188 and 170. Collector 179C is connected to primary 190P of transformer 190. Secondary 190S is connected to detector 192, which includes a transistor 194 having its base 194B connected to the positive terminal of power source 128. Collector 194C is connected to emitter 196, to the negative terminal of power source 128 through a resistor 198, and to the positive terminal of power source 128 through capacitor 200. The secondary 190S is also connected to a manual magnetic disconnect 202.

The limiter 196 includes a capacitor 204 connected to base 206B of transistor 206 and also through a capacitor 208 and resistor 210 connected in series to the negative terminal of power source 128. Emitter 206E is connected through resistor 214 to emitter 212E of transistor 212. Collector 212C is connected to the negative terminal of power source 128 through a resistor 216 and to the primary 218P of transformer 218. A shaper 220 includes secondary 216S, connected through a choke 222 to primary 224P of transformer 224.

The output of shaper 220 is connected to discriminators 226A, 226B, 226C and 226D. The discriminators 226A, 226B and 226C are identical except for values of the components. Hence, only discriminator 226A will be described in detail. Discriminator 226A includes two discriminators 228A and 228B. Secondary 228S is connected to transistor 232. Secondary 230S is connected to transistor 234. Capacitors 236 and 238 are connected across secondary 228S and 230S, respectively. The center tap of power source 128 is connected through resistor 240 to emitters 232E and 234E. Condensers 242 and 244 are connected to the positive terminal of power source 128. Emitters 232E and 234E are connected through resistor 246 to a servo amplifier 248A. The output of discriminator 226B is connected to servo amplifier 248B, and the output of discriminator 226C is connected to servo amplifier 248C.

Discriminator 226D includes a single tunable transformer 250 having its secondary 252S connected to the positive terminal of power source 128. A capacitor 254 is in parallel with secondary 252S. The signal strength may be varied by means of an adjustable resistor 256 connected in parallel with capacitor 254. Secondary 252S is connected to transistor 258. Collector 258C is connected to base 260B of transistor 260 through a resistor 262. Collectors 258C and 260C are connected to the negative terminal of power source 128 through resistors 264 and 266, respectively. A resistor 268 is connected between base 260B and emitter 260E. Collector 260C is connected to base 270B of transistor 270 through a resistor 272. Capacitor 274 is connected to the positive terminal of power source 128 between collector 260C and resistor 272. Relay coil 276 having a normally open contact 276C is connected to collector 276C. Contact 276C is connected in series with a bell 278 to power source L1, L2.

Manual magnetic disconnect 202 includes a transistor 280 having its base 280B connected through resistor 282 to secondary 190S. Collector 280C is connected to the negative terminal of power source 128 through a resistor 284 and to base 286B of a transistor 286 through resistor 288. A resistor 290 is connected between base 286B and resistor 289 to secondary 190S. Collector 286C is connected to the negative terminal of power source 128 through a resistor 292 and to base 294B of transistor 294 through a resistor 296. Capacitor 298 is connected between collector 286C and resistor 298 to the positive terminal of power source 128. Collector 294C is connected to relay coil 300 having a normally open contact 300C. The contact 300C is connected in the circuit leading from power source L1, L2 to control panels 310, 312, and 316.

Also mounted on the bridge 100 is a safety heterodyne receiver 302 and auxiliary relay panel disconnect 304 which are shown in FIGURE 3. The receiver 302 and the disconnect 304 are the same as receiver 118 and disconnect 202 except for values of the individual components. Hence, no detailed description thereof need be given. Relay coil 309C of disconnect 304 has a normally open contact 309C which is located in the connection of line L1, L2 leading to the control panels 346A, 346B and 346C.

The servo amplifiers 248A, 248B and 248C are identical so that only one will be described in detail. Servo amplifier 248A includes a transistor 306 having its collector 306C connected through resistor 308 to the positive terminal of voltage source 128 and to base 310B of transistor 310. Emitter 308E and collector 310C are connected together through capacitor 312. Emitter 310E is connected to the positive terminal of power source 128. Collector 310C is connected to base 314B of transistor 314. Collector 314C is connected to the positive terminal of a voltage source 128 through resistor 316. Collector 318C of transistor 318 is connected to the negative terminal of power source 128. Base 318B is connected to the negative terminal through resistor 318E. Collector 318E is connected to the positive terminal through resistor 322. Emitter 318E is connected to base 324B of transistor 324. Collector 324C is connected to the negative terminal of power source 128. Collector 328C and resistor 330 are connected in series across collector 318C and emitter 318E. Emitter 324E is connected to collector 314C through resistors 332 and 334. Resistors 332 and 336 are connected across emitter 324E and collector 324C. Emitters 334E and 324E are connected to motor 338. Capacitor 340 is connected across motor 338. The center tap
of power source 128 is connected to motor 338. Variable resistor 342 is connected to power source 128. Arm 342A of variable resistor 342 is connected to emitter 306E. The motor 338 is mechanically connected to arm 344A of a segmented rotary switch 344 and also is mechanically connected to arm 342A of variable resistor 342. As shown, this switch has eight contacts 344C. A relay coil is associated with each contact and the coils which are indicated as IF, 2F, 3F, 4F, 1R, 2R, 3R and 4R are located on intermediate relay panel 346A. The first four relay coils are used to provide four different forward speeds and the last four coils to provide four different reverse speeds. The contacts of these relay coils control the flow of current from power source 1L to relay coils 1A, 2A, 3F, M, P, R and K which are located on control panel 108. The contacts of these relays control the operation of motor 106. The control panels 108 and 346A are conventional and form no part of the present invention and since the construction and operation thereof is understood by those skilled in the art, no further description thereof will be given. In like manner the outputs of discriminators 226B and 226C are connected to servo amplifiers 248B and 248C, respectively; and the servo amplifiers 248B and 248C are connected to intermediate relay panels 346B and 346C, respectively which in turn are connected to control panels 112 and 116 respectively. It will be noted that unless both contacts 300C and 300D are closed, no operation of the motors 106, 110 and 114 can occur.

In operation, when the operator wishes to warn other workmen of movement of the crane, he moves switch 32D to the broken line position shown in FIGURE 1. When this occurs the multi-vibrator 4D oscillates and applies a signal to the audio amplifier 34 which amplifies the signal and applies it to the RF amplifier 52. This signal is modulated on the carrier frequency which is generated in the oscillator 54 and is transmitted through the air waves by means of antenna 74. This signal is picked up by antenna 126 and is amplified by the amplifier and mixer 120. The incoming frequency is mixed with a signal from oscillator 122 and applied to the intermediate frequency amplifier 124. The signal from amplifier 124 is detected by detector 192 and then is amplified and limited by the limiter 196. The limiter 196 transmits the audio portion of the wave shape signal to the speaker 220 where it is turned into a sine wave. This sine wave signal is impressed on discriminators 226A, 226B, 226C and 226D. Nothing occurs in discriminators 226A, 226B, 226C and 226D because they are not tuned to the frequency of multi-vibrator 4B. However, discriminator 226D is tuned to the frequency of multi-vibrator 4B so that relay coil 276 will be energized, thus closing its contact 276C which causes a bell 278 to ring.

Assuming that it is desired to move the bridge forward, the operator moves switch 32A to the broken line position shown in FIGURE 1 and at the same time moves the position of arms 18A and 22A of multi-vibrator 4A. In the normal position when these arms are in their center position, no signal will be transmitted that will cause operation of the bridge motor. Thus the operator must move these arms from their center position and in the particular installation being described, this movement may be made in either direction. Movement from center in one direction will cause rotation of the bridge motor 106 in one direction and movement from center in the opposite direction will cause rotation of the bridge motor in the other direction. The degree of this movement determines the speed at which the bridge motor will rotate. Assuming, for example, that it is desired to operate the bridge motor at its maximum forward speed the arms 18A and 22A will be moved through an angle which, in one particular installation, is 15°. The frequency of the signal from multi-vibrator 4A will vary in accordance with the position of the arms 18A and 22A but this frequency range is different than the frequency of multi-vibrators 4B, 4C or 4D. The output signal of multi-vibrator 4A will be sent through in the same manner as that of multi-vibrator 4D previously described. However, the frequency of this signal will be different and will be of the same frequency as that of discriminator 226A. The frequency response of transformer 228 is different than the frequency response of transformer 230 with the frequency response of transformer 228 being such as to pick up a signal which will cause movement of the bridge motor in a forward direction and with the frequency response of transformer 230 being such as to cause movement of the bridge motor in the reverse direction. Thus, the signal being generated will be picked up by transformer 228 of discriminator 226A and will be delivered to servo amplifier 248A so as to cause motor 338 of that amplifier to rotate its associated arm 342A until the potential developed by variable resistor 342 balances the signal from discriminator 226A and applied to transistor 306 at which time the motor 338 stops. When the signal is removed, the motor 338 will rotate back to its neutral condition.

While motor 338 is rotating arm 342A it also rotates arm 344A to move it to the contact associated with relay 2F. This in turn, through the control panels 346A and 108 will cause the bridge to move in the desired direction. At this time, switch 32D may also be in the line position shown and its signal will continue to be picked up and the bell 278 will continue to ring. If the switch 32D is moved to the solid line position the bell 278 will cease ringing. When the crane reaches its desired position the operator moves switch 32S to the solid line position and the movement of the crane will cease.

If the trolley 102 is not in the desired position the operator will move switch 32B to the broken line position and move arms 18BA and 22BA of multi-vibrator 4B to the position where operation of motor 110 will be that desired. This movement also can be in four forward speeds and four reverse speeds. Assuming that it is desired to move the trolley in the fourth speed forward, the arms 18BA and 22BA would be moved through an angle of 30° and the signal will be delivered from the multi-vibrator 32B in the same manner as before. However, the frequency of this signal is only within the frequency response of discriminator 226B. Here, too, the frequency response of transformer 228B corresponds to the frequency of multi-vibrator 4B which causes movement of the trolley in the forward direction and the frequency response of transformer 230B corresponds to the frequency output of multi-vibrator 4B causing movement of the motor in the reverse direction. Hence, the output of discriminator 226B is impressed on the servo amplifier 248B causing the associated motor 335 to move its associated arm 344A to a position where relay 4F will be energized. When the trolley reaches its desired position the switch 32B will be moved to its solid line position and movement of the trolley will cease. The hoist 104 is then lowered by the operator moving switch 32C to the broken line position and moving the arms 18CA and 22CA of the multi-vibrator 4C. Assuming the motor 114 is to move at its first speed the arms 18CA and 22CA will be moved through 74°. The signal will be transmitted in the same manner as described above and picked up by transformer 228C of discriminator 226C and the output of discriminator 226C will be impressed on servo amplifier 248C with this signal being such as to move the associated motor 338 through a distance to energize relay 1F. When the hoist reaches the desired position the operator moves switch 32C to its solid line position stopping the movement of hoist. He then attaches the article to be lifted to the hoist. Assuming that the crane be returned to its original position then the described operations are repeated in reverse order. The only difference is that the position of the arms 18A, 18BA, 18CA, 22A, 22BA and 22CA will be different. In other words, these arms will be moved to the opposite side of neutral the desired amount for the desired speed of movement and the signals will be picked up by transformers 230, 230B and 230C of the discriminators 226A, 226B and
During any or all of these movements the bell 278 may be rung or not as desired. However, only one of the multi-vibrators 4A, 4B and 4C can be operated at one time. It will also be understood that this arrangement may be used to control only a single motor or other device in which case only one multi-vibrator, one discriminator and one servo amplifier need to be used. By the addition of other multi-vibrators, discriminators and servo amplifiers, additional devices can be controlled.

As soon as an RF signal is generated by crystal 92 and transmitted by antenna 74, relay coil 306 will be energized, thus closing its contact 300C. This will deliver power to controls 106, 112 and 116. However, for energization of the motors 106, 110 and 114 it is necessary that contact 300C also be closed. When a signal is sent out by antenna 74* and picked up by antenna 126 the relay coil 300C is energized and the motors 106, 110 and 114 can be operated. The frequency transmitted by antenna 74 is substantially different than that transmitted by antenna 74* so that there is little chance that the control could be operated by stray signals.

The switches 32A, 32B, and 32C function as additional safety devices for the particular installation so as to permit one movement only at any one time. However, in other installations it may be desired to operate more than one motor at the same time and this can be done by omitting the switches 32A, 32B, and 32C. In the latter case, the frequency response of the discriminators should be spaced apart sufficiently so that there is no danger of the wrong signal being picked up.

While one embodiment of our invention has been shown and described, it will be apparent that other adaptations and modifications may be made without departing from the scope of the following claims.

We claim:

1. A control for a plurality of devices mounted on a carrier comprising means for generating a plurality of ranges of variable frequencies mounted at a position remote from said carrier, one frequency range for each device, means for varying the frequency within each range, a transmitter connected to the output of said first named means, a receiver mounted on said carrier for receiving a signal from said transmitter, a plurality of discriminators connected to the output of said receiver, one tuned to the frequency of each of said discriminators and movable a distance proportional to the frequency of the associated signal, and means operable by each of said last named means for controlling the movement of its associated device.

2. A control for a plurality of motors mounted on a carrier comprising means for generating a plurality of ranges of variable frequencies mounted at a position remote from said carrier, one frequency range for each motor, means for varying the frequency within each range, a transmitter connected to the output of said first named means, a receiver mounted on said carrier for receiving a signal from said transmitter, a plurality of discriminators connected to the output of said receiver, one tuned to the frequency of each of said discriminators and movable a distance proportional to the frequency of the associated signal, and means operable by each of said last named means for controlling the movement of its associated motor.

3. A control for a plurality of motors mounted on a carrier comprising a plurality of variable frequency oscillators mounted at a position remote from said carrier, one for each motor, means for varying the frequency of each of said oscillators with the range of frequency of each oscillator being different than the range of frequency of the other oscillators, a transmitter connected to the output of said oscillators, a receiver mounted on said carrier for receiving a signal from said transmitter, a plurality of discriminators connected to the output of said receiver, one tuned to the frequency of each of said discriminators and movable a distance proportional to the frequency of the associated signal, and means operable by each of said last named means for controlling the movement of its associated motor.

4. A control according to claim 3 in which each discriminator includes two tunable transformers, one of said tunable transformers being tuned to pick up a signal from the lower half of the frequency range of the associated variable frequency oscillator and the other of said tunable transformers being tuned to pick up a signal from the upper half of the frequency range of the associated variable frequency oscillator, a servomotor connected to the output of each of the associated discriminators for movement proportional to the frequency of the associated signal, and means operable by each of said servomotors for controlling the movement of the associated motor.

5. A control for a plurality of motors mounted on a carrier comprising a plurality of variable frequency oscillators mounted at a position remote from said carrier, one for each motor, means for varying the frequency of each of said oscillators with the range of frequency of each oscillator being different than the range of frequency of the other oscillators, a transmitter connected to the output of said oscillators, a receiver mounted on said carrier including a radio frequency amplifier and mixer, an oscillator having its output connected to said radio frequency amplifier and an intermediate frequency amplifier connected to the output of said radio frequency amplifier, a detector connected to the output of said intermediate frequency amplifier, a plurality of discriminators connected to the output of said detector, one tuned to the frequency of each of said variable frequency oscillators, means connected to the output of each discriminator and movable a distance proportional to the frequency of the associated signal, and means operable by each of said last named means for controlling the movement of the associated motor.

6. A control according to claim 5 in which each discriminator includes two tunable transformers, one of said tunable transformers being tuned to pick up a signal from the lower half of the frequency range of the associated variable frequency oscillator and the other of said tunable transformers being tuned to pick up a signal from the upper half of the frequency range of the associated variable frequency oscillator, a servomotor connected to the output of each of the associated discriminators for movement proportional to the frequency of the associated signal, and means operable by each of said servomotors for controlling the movement of the associated motor.

7. A control for a carrier having a plurality of reversible motors mounted thereon comprising a plurality of variable frequency oscillators mounted at a position remote from said carrier, one for each motor, means for varying the frequency of each of said oscillators with the range of frequency of each oscillator being different than the range of frequency of the other oscillators, a transmitter including an audio amplifier connected to the output of said oscillators and a radio frequency amplifier connected to said audio amplifier, a receiver mounted on said carrier including a radio frequency amplifier and mixer, an oscillator having its output connected to said audio amplifier and an intermediate frequency amplifier connected to the output of said last named radio frequency amplifier, a detector connected to the output of said intermediate frequency amplifier, a limiter connected to the output of said detector, a shaper connected to the output of said limiter, a plurality of discriminators connected to the output of said shaper, one tuned to the frequency of each of said variable frequency range of the associated variable frequency oscillator, a servomotor connected to the output of each of said discriminators and movable a distance proportional to the frequency of the associated signal, and means operable by each of said servomotors for controlling the movement of the associated motor.
frequency range of the associated variable frequency oscillator and the other of said tunable transformers being tuned to pick up a signal from the upper half of the frequency range of the associated variable frequency oscillator, a servomotor connected to the output of each of said discriminators for movement a distance proportional to the frequency of the associated signal, and means operable by each of said servomotors for controlling the speed and direction of movement of the associated reversible motor.

8. A control according to claim 7 including a second transmitter having an output different than the output of said first-named transmitter, a second receiver for picking up a signal from said second transmitter, a pair of normally-open contacts for controlling power to said motors, means operable by a signal from said first receiver for closing one of said contacts, and means operable by a signal from said second receiver for closing the other of said contacts.

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