April 25, 1961 J. E. HENDERSON 2,981,878

REMOTE RADIO CONTROL SYSTEM

Filed Sept. 14, 1956 2 Sheets-Sheet 1

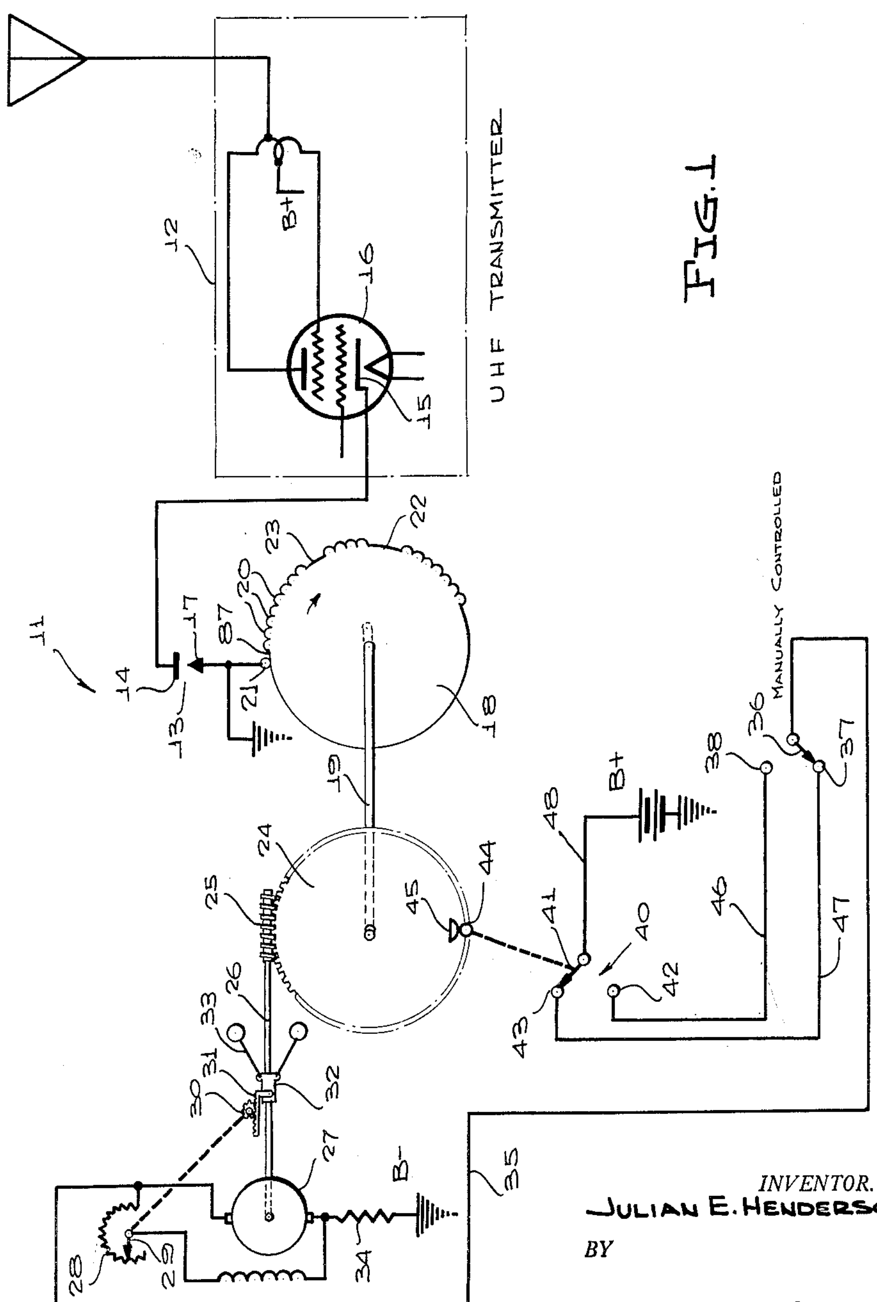

FIG. 1

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2 Sheets-Sheet 2

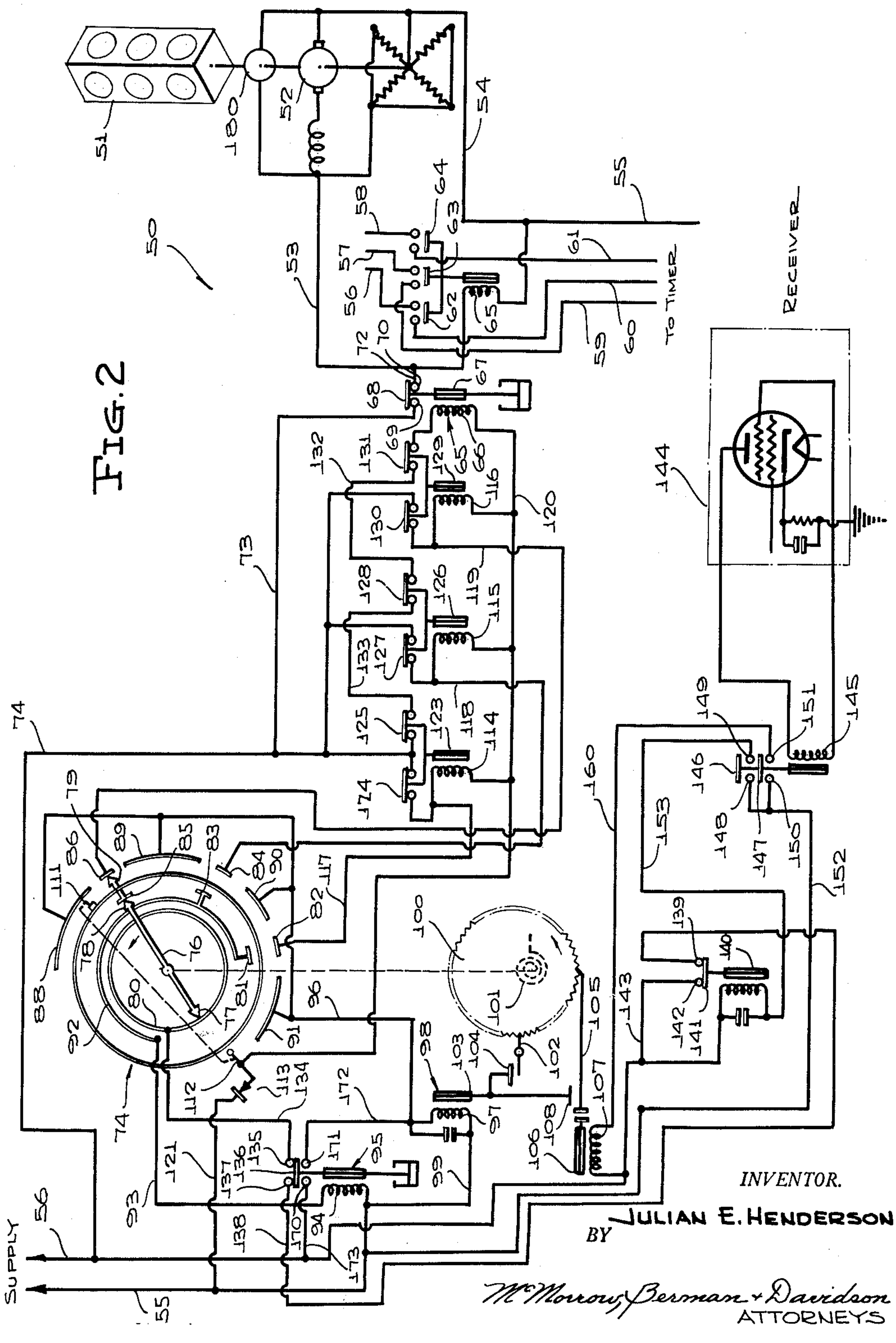

FIG. 2

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REMOTE RADIO CONTROL SYSTEM

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This invention relates to remote control systems, and more particularly to a system of remote radio control wherein the unit of equipment to be operated is controllable by authorized persons only.

A main object of the invention is to provide a novel and improved remote radio control system whereby a unit of equipment may be operated by authorized persons only, the system employing a combination of radio frequency impulses transmitted at a definite speed and with definite timing, and the remote unit of equipment being protected so that it can be operated only if the transmitted radio frequency impulses have the correct speed and time relationship.

A further object of the invention is to provide an improved remote control system for use in operating remote equipment by authorized persons only, for example, for remotely controlling a traffic intersection control light, the improved system involving simple components, being easy to install, and being reliable in operation.

A still further object of the invention is to provide an improved remote control system for operating remote units of equipment by authorized persons only, for example, for operating a traffic intersection control light from a moving emergency vehicle, such as a police vehicle, the system being such that a police or other emergency vehicle equipped with a suitable transmitter authorized for use in the system may control traffic intersection signal devices along the intended route of travel of the emergency vehicle so as to stop all traffic at the traffic intersections prior to the arrival of the emergency vehicle, greatly reducing the possibility of collisions of the emergency vehicle with cross street traffic, and allowing the emergency vehicle to proceed along its intended route at maximum speed.

A still further object of the invention is to provide an improved system of remote radio control of traffic intersection signal lights by an emergency vehicle, such as a police car, ambulance, or the like, the system being arranged so that control of the traffic intersection signals is limited only to vehicles operated by authorized persons and provided with suitable coding means, whereby an authorized emergency vehicle is enabled to produce a combination of radio frequency impulses, generated at a definite speed and with definite timing, each of the controlled traffic intersection units being provided with suitable receivers responsive only to the proper combination of radio frequency impulses and sensitive to the timing of said impulses, whereby the traffic intersection control units can be controlled by the emergency vehicle in a manner to stop all traffic at the intersections associated therewith and to clear said intersections so that the emergency vehicle may proceed without interruption to its destination and without the possibility of collision with cross street traffic.

A still further object of the invention is to provide an improved system for remote radio control of units of equipment from an emergency vehicle, or similar control station, the system being provided with means for generating radio frequency impulses in a definite sequence and in a definite time relationship, the receiving units being arranged to respond to the impulses and being provided with means rendering the receivers immune to incorrect signals and being arranged to reject such incorrect signals.

Further objects and advantages of the invention will become apparent from the following description and claims, and from the accompanying drawings, wherein:

Figure 1 is a schematic diagram generally illustrating a radio frequency code transmitter forming part of the improved remote radio control system of the present invention.

Figure 2 is a schematic diagram illustrating the electrical connections of a remote controlled receiver adapted to be operated by the transmitter shown in Figure 1 and connected so as to control a motor driven revolving traffic signal at a street intersection.

Referring to the drawings, and more particularly to Figure 1, **11** generally designates a code signal transmitter employed in an improved radio remote control system according to the present invention. The transmitter **11** is adapted to be installed in an emergency vehicle, for example, a police car, and comprises an ultra high frequency transmitter **12** adapted to provide a suitable ultra high frequency carrier wave, said carrier wave being keyed by a code switch device **13** which comprises a fixed contact **14** connected to the cathode **15** of the transmitter output tube **16**, or connected in any suitable manner in a portion of the transmitter circuit suitable for keying. The movable contact **17** of switch device **13** is connected to ground, completing the cathode circuit of the tube **16**, in the typical keying circuit illustrated in Figure 1.

The movable contact **17** of the keying switch **13** is actuated by a changeable code disc **18** mounted on a shaft **19**, the code disc **18** being formed at its periphery with spaced groups of pulsing lugs **20**, each engageable with a follower element **21** responsive to the rotation of the cam disc **18**, to move the switch contact **17** into engagement with the stationary switch contact **14**. Thus, in the typical code disc **18** illustrated, there are three groups of pulsing lugs **20**, comprising a first group of seven evenly spaced lugs, a second group of four evenly spaced lugs separated from the first group by a first definite interval **22**, and a third group of nine pulsing lugs separated from the second group by a second definite interval **23**.

Shaft **19** is driven by a worm gear **24** which is in turn driven by a worm **25** meshing therewith and mounted on a shaft **26** driven by an electric motor **27**. A rheostat **28** is provided in the field circuit of motor **27**, the movable contact **29** of said rheostat being coupled to a centrifugally controlled pinion gear **30** operated by a rack **31** mounted on a sleeve **32**. The sleeve **32** is provided with the pivoted weights **33** which are arranged to change the position of sleeve **32** in a conventional manner along the shaft **26**, in accordance with changes in speed of the motor **27**, the arrangement being such as to move the contact **29** of rheostat **28** to compensate for variations in motor speed with respect to a specified value, whereby the motor speed is corrected and the shaft **26** is held, within narrow limits, at a specified speed.

As shown, one terminal of motor **27** is connected through a resistor **34** to the grounded motor vehicle battery terminal. The other terminal of the motor **27** is connected by a wire **35** to the movable pole **36** of a manually operated single pole double throw switch having the respective stationary contacts **37** and **38**. The switch may be mounted in any convenient location, for example, on the dashboard of the emergency vehicle, so that it may be employed to manually initiate the transmission of a set of code pulses.

A second single pole double throw switch, shown at 40, is provided with a pole 41 and respective stationary contacts 42 and 43. The pole 41 is mechanically coupled to a movable actuating element 44, mounted in any suitable manner adjacent the periphery of the worm gear 24, said element 44 comprising, for example, a plunger, lever, link bar, or any other suitable movable element which may be mechanically coupled to the switch arm 41. The element 44 is engageable by a cam 45 mounted on the worm gear 24, whereby the switch arm 41 is actuated from a position engaging the contact 43 to a position engaging the contact 42 responsive to the engagement of the cam 45 with the movable element 44 as the worm gear 24 rotates clockwise to a position such as that shown in Figure 1. Similarly, if pole 41 happens to be in engagement with contact 42, the element 44 will move pole 41 into engagement with contact 43 responsive to the engagement of the element 44 by the cam 45. Therefore, it will be readily apparent that the device 40 is employed as a limit switch to control rotation of the worm gear 24 and to operate so as to change its condition automatically when the element 44 is engaged by the cam 45.

From Figure 1, it will be seen that switch contact 42 is connected by a wire 46 to the contact 38 of the manually controlled switch. Similarly, the switch contact 43 is connected by a wire 47 to the contact 37 of the manually controlled switch. With pole 36 in engagement with contact 37, as illustrated, the motor 27 will be energized by a circuit comprising the positive terminal of the battery, connected by a wire 48 to pole 41, contact 43, wire 47, pole 36, wire 35, the motor 27, register 34, and the battery. This circuit will be opened when cam 45 engages movable element 44, as above described, throwing switch pole 41 into engagement with contact 42. Operation of the motor 27 is thus terminated. To energize motor 27 for another cycle of rotation of worm gear 24, it is merely necessary to manually move switch pole 36 into engagement with contact 38, whereby an energizing circuit for the motor will again be established, through the battery, wire 48, pole 41, contact 42, wire 46, contact 38, pole 36, wire 35, the motor and ground. This circuit will be opened at the end of the cycle of rotation of gear 24 by the engagement of cam 45 with element 44, which moves the switch pole 41 into position for a subsequent cycle of operation.

When motor 27 is energized, the keying switch 13 is closed seven times in regular sequence, as the member 21 is successively engaged by the first group of pulsing lugs 20, remains open for an interval, corresponding to the length of the interval 22, which in the case illustrated represents a period equal to the period taken up by three of the pulses, is then sequentially closed four more times, providing four more regularly spaced pulses, then remains open for a period represented by the interval 23 and then is sequentially closed nine more times, as the member 21 is engaged by the last group of pulse lugs 20. No more pulses are produced, since thereafter member 21 engages the smooth periphery of the disc 18, allowing keying switch 13 to remain open.

Tube 16 may be connected in the transmitter in any suitable manner, as above explained, for example may be the oscillator tube of the transmitter, and the keying switch 13 may be connected in the cathode return circuit of the oscillator. Since the cathode return circuit is open when the switch 13 is open, there are no signals generated at this time. However, when the movable contact 17 engages the stationary contact 14 of the keying switch, the oscillating circuit becomes active, providing the code pulses.

Referring now to Figure 2, 50 generally designates a remotely controlled receiver adapted to place a street intersection traffic signal 51 in an emergency condition

responsive to the transmission of a proper set of coded ultra high frequency radio pulses from the transmitter 11.

The traffic signal 51 is rotatably mounted in any suitable manner, and may be rotated at times by an electric motor 52 which is provided with the respective power input conductors 53 and 54. The wire 54 is connected to the common line wire 55 of a three-phase supply system, comprising the phase line wires 56, 57 and 58 which are normally connected to respective conductors 59, 60 and 61 leading to the normal timing circuit of the intersection signal device 51 through respective switch poles 62, 63 and 64. The switch poles 62, 63 and 64 are controlled by a common solenoid 65', said solenoid being normally deenergized and the switch poles 62, 63 and 64 normally engaging their contacts to connect the traffic signal input wires 59, 60 and 61 to the line wires 56, 57 and 58. However, when solenoid 65' becomes energized, the switches 62, 63 and 64 open, disconnecting the normal timing circuit of the traffic signal 51.

As shown, solenoid 65' is connected in parallel with motor 52, so as to be energized simultaneously therewith, one terminal of the solenoid being connected to the neutral wire 55 and the other terminal being connected to the wire 53.

Wire 53 is connected through the contacts of a normally deenergized relay 65 to one of the line wires, for example, the line wire 56, since the wires 56 and 55 define a single phase supply source adapted to supply the motor 52 with driving power. Thus the relay 65 comprises a winding 66, an armature 67, a movable pole 68, and a pair of stationary contacts 69 and 70 engageable by the pole 68 when the solenoid 66 is energized. The relay 65 is of the slow-acting type, for example, is of the dashpot type, whereby the pole 68 remains in closed position for a predetermined period of time after the solenoid winding 66 becomes deenergized, for example, a period of thirty seconds. Thus, after the motor 52 and the relay device 65 have become energized, namely, by the energization of the relay 65, the traffic signal 51 will be rotated by said motor with its normal timing circuit disconnected, and such rotation will continue for a period of thirty seconds, for example, after winding 66 becomes deenergized.

A suitable warning lamp may be provided in the traffic signal device 51 which is wired in parallel with the motor 52, so as to be illuminated simultaneously with the operation of the motor 52, for example, to provide a red warning indication concurrently with the rotation of the signal device 51.

As shown, the switch contact 70 is connected to the wire 53, by a conductor 72. The switch contact 69 is connected to the supply wire 56 by wires 73 and 74.

Designated generally at 75 is a step-driven switch device adapted to be operated substantially in step with the pulsing disc 18 and the worm gear 24 of the controlling transmitter 11. The switch device 75 comprises a suitable support on which is rotatably mounted a switch arm 76 having a first contact brush element 77, a second contact brush element 78 and a third contact brush element 79. Contact brush element 77 engages a continuous contact ring 80. Contact brush elements 78 and 79 are engageable with spaced pairs of arcuate contact segments 81, 82, 83, 84, and 85, 86, spaced around the axis of rotation of switch arm 76 in the same manner as the terminations of the respective groups of pulsing lugs 20 on the code disc 18. Thus, the contact segments 81, 82 are spaced at an angular position corresponding to the location of the interval 22 on code disc 18. The arcuate contact segments 83 and 84 are spaced at an angular position corresponding to the location of the interval 23 on code disc 18. The last pair of arcuate contact segments 85, 86 are located at an angular position corresponding to the end of the last group of pulsing lugs 20, namely, to the location on code disc 18 designated at 87 in Figure 1.

Additional arcuate contact elements 88, 89, 90 and 91, engageable by the brush element 79 are provided on the switch device 75, spaced in the manner illustrated in Figure 2, and located in the path of movement of the contact brush 79 as the switch arm 76 is rotated.

An arcuate conductor ring 92 interconnects the contact elements 81, 83 and 85, said conductor 92 being connected to a wire 93. Wire 93 is connected to one terminal of the winding 94 of a slow-acting relay 95, the other terminal of winding 94 being connected to the line wire 55.

The arcuate contact segments 88, 89, 90 and 91 are connected together to a common conductor 96 which is connected to one terminal of the winding 97 of a reset relay 98, the other terminal of the winding 97 being connected by a wire 99 to the line wire 55.

The rotary switch arm 76 is rigidly connected to a ratchet disc 100 so as to be rotated simultaneously with said ratchet disc. The ratchet disc 100 is biased in a clockwise direction, as viewed in Figure 2, by a suitable spiral spring 101 connected between the disc and its support. A pivoted pawl 102 engages the toothed periphery of the ratchet disc 100 and normally prevents return of the disc under the biasing force of the spiral spring 101. The pawl 102 may be rotated to a disengaged position with respect to the periphery of the ratchet disc 100, to reelase the ratchet disc, responsive to the energization of the reset relay 98, said relay being provided with a plunger 103 having an arm 104 engageable with the outer end of the pivoted pawl 102 to rotate said pawl away from the periphery of the ratchet disc 100.

The periphery of the ratchet disc 100 is engaged by a resilient pawl 105 rigidly secured at its end to the movable plunger 106 of a solenoid 107, said solenoid being suitably mounted so that when energized, the pawl 105 engages the ratchet disc and rotates said ratchet disc one step counterclockwise, as viewed in Figure 2. An abutment element 108 on the plunger 103 of the reset solenoid 98 is engageable with the resilient pawl arm 105, responsive to the energization of the reset solenoid winding 97, to deflect the pawl arm 105 away from and out of engagement with the periphery of the ratchet disc 100.

As will be readily apparent, when the reset solenoid 98 is energized, the actuating pawl 105 and the retaining pawl 102 are disengaged from the ratchet disc 100, allowing the ratchet disc to return to a normal position thereof under the biasing action of the spiral spring 101.

An arm 111 is rotatably mounted on the same support as and is rigidly coupled to the switch arm 76, the arm 111 being rotatable with the ratchet disc 100 into engagement with the movable arm 112 of a limit switch 113, said limit switch being opened responsive to the engagement of the arm 111 with the movable element 112 as the ratchet disc 100 is returned to its normal position by the biasing spring 101, as above described.

Designated at 114, 115 and 116 are respective control relays which must be sequentially energized in order to ultimately energize the signal-operating relay 65. As shown, one terminal of the winding of the relay 114 is connected by a wire 117 to the arcuate contact 82. One terminal of the winding of the relay 115 is connected by a wire 118 to the arcuate contact 84. One terminal of the winding of the relay 116 is connected by a wire 119 to the arcuate contact 86. The remaining terminals of the windings of the relays 114, 115 and 116 are connected to a common wire 120, to which is also connected one terminal of the winding 66 of relay 65. The wire 120 is connected through the limit switch 113 and a wire 121 to the line wire 55.

Relay 114 is provided with an armature 123 which controls a pair of switches 124 and 125, the switches being opened when the relay 114 is deenergized and being closed responsive to the energization of the relay. Relay 115 is provided with an armature 126 controlling a pair of switches 127 and 128, said switches being opened when the relay is deenergized and being closed responsive to the energization of the relay. The relay 116 is provided with an armature 129 controlling a pair of switches 130 and 131, said switches being opened when the relay is deenergized.

As above stated, one terminal of the winding 66 of relay 65 is connected to the wire 120. The other terminal of said winding is connected through the switch 131 to a wire 132. Wire 132 is connected through the switch 128 to a wire 133. Wire 133 is connected through switch 125 to the wire 74, and thence to the line wire 56. Thus, the relay 65 will be energized when all of the relays 114, 115 and 116 are energized and when the reset switch 113 is closed. The energizing circuit for relay 65 thus comprises line wire 56, wire 74, switch 125, wire 133, switch 128, wire 132, switch 131, winding 66, wire 120, reset switch 113, wire 121 and line wire 55. The continuous contact ring 80 is connected to a wire 134, which is in turn connected to an upper contact 135 of the slow-acting relay 95. The armature pole 136 of relay 95 normally engages the contact 135 and an opposing contact 137, connecting wire 134 to a wire 138. Wire 138 is connected to the contact 139 of a normally deenergized, slow-closing relay 140, the switch pole 141 of the armature of relay 140 engaging the contact 139 and an opposing contact 142 when the relay is deenergized, and disengaging from the contacts 139 and 142 responsive to the energization of said relay. After the switch pole 141 of relay 140 has become disengaged from the contacts 142 and 139, responsive to the energization of the relay 140, a predetermined time period is required for pole 141 to again engage contacts 139 and 142, after relay 140 becomes deenergized, for example, a period of 1.5 seconds.

Assuming relay 140 to be deenergized, as shown, the wire 138 is connected through the pole 141 and contacts 139 and 142 to a wire 143 which is connected in turn to the line wire 56. Thus, ring 80 is normally connected through wire 134, switch pole 136, wire 138, switch pole 141, and wire 143 to line wire 56. Therefore, relay 114 becomes energized when contact brush 79 engages the arcuate contact 82 by a circuit comprising line wire 55, wire 121, limit switch 113, wire 120, the winding of relay 114, wire 117, arcuate contact 82, brush element 79, contact arm 76, brush element 77, ring 80, wire 134, switch pole 136, wire 138, switch pole 141, wire 143, and line wire 56. The energization of relay 114 also completes a holding circuit for the relay including the switch 124 comprising line wire 56, wire 74, switch 124, the relay winding, wire 120, reset switch 113, wire 121, and line wire 55.

Relay 115 becomes energized in a similar manner when contact brush 79 engages arcuate contact 84, and establishes a holding circuit which includes the switch 127. In a similar manner, the relay 116 becomes energized when the contact brush 79 engages the arcuate contact segment 86, and establishes a holding circuit including the switch 130.

An ultra high frequency radio receiver 144 is provided at the intersection to be controlled, said receiver being tuned to the frequency of the transmitter 12 on the emergency vehicle and being provided in its output circuit with a relay 145 controlling a pair of switch arms 146 and 147, as shown. The upper switch arm 146 is engageable with a pair of contacts 148 and 149 and the lower switch arm 147 is engageable with a pair of contacts 150 and 151, responsive to the energization of the relay 145 by a radio signal of proper frequency.

The contacts 148 and 150 are connected together to a common wire 152 which is in turn connected to the line wire 55. Contact 149 is connected to a wire 153 which is, in turn, connected to one terminal of the winding of the slow-closing relay **140**. As shown, the other terminal of the winding of relay **140** is connected to the line wire **56**. Thus, relay **140** receives current when pole **146** engages the contacts **148** and **149** by a circuit comprising line **55**, wire **152**, contact **148**, pole **146**, contact **149**, wire **153**, the winding of relay **140**, and the line wire **56**. This opens the circuit to the contact ring **80**, by the disengagement of pole **141** from the contacts **142** and **139**, whereby none of the relays **114**, **115** and **116** can become energized while a pulse is being received, and can only become energized a predetermined period of time after termination of a pulse, required for the closure of the contacts of relay **140**, since said relay is slow-closing and has a time period of 1.5 seconds, for example, required for closure of its contacts.

When relay **145** becomes energized, by the reception of a pulse, pole **147** engages contacts **150** and **151**, energizing the winding of relay **107** by a circuit comprising line wire **56**, the winding of relay **107**, a wire **160** from said winding to contact **151**, pole **147**, contact **150**, wire **152**, and line wire **55**. Each pulse causes the plunger **106** to move pawl **105** to the right, as viewed in Figure 2, causing the ratchet disc **100** to rotate through one step.

In operation, when the first train of pulses are transmitted, caused by keying of the transmitter by a first group of pulsing lugs **20**, the relay **140** at the intersection to be controlled becomes energized and opens its contacts, by the disengagement of pole **141** from contacts **142** and **139**, while at the same time the ratchet wheel **100** is actuated by the pawl **105** stepwise until the contact brush **79** comes into engagement with the arcuate contact **82**. The pulses then cease for a period of time, by the provision of the interval **22** on the code disc **18** at the transmitter, allowing sufficient time for relay **140** to close its contacts, whereby the energizing circuit, above described for relay **114** is completed. Relay **114** becomes energized, closing its switch elements **124** and **125**, establishing the holding circuit for the relay. The pulsing resumes, until the brush element **79** engages the arcuate contact **84** at the position corresponding to the location of the interval **23** on the code disc **18**. Again sufficient time is provided for the relay **140** to release its pole **141** and close its contacts, whereupon the second sequential relay **115** becomes energized, closing the switches **127** and **128**. The pulsing contineus, until the final group of pulses terminates, at which point the brush element **79** engages the arcuate contact **86**. After the time period required for the closure of the contacts of relay **140**, the relay **116** becomes energized, closing its switches **130** and **131**. This establishes the energizing circuit for the winding **66** of relay **65**, as above described, causing plunger **67** to move the pole **68** into bridging contact with the contacts **69** and **70**, energizing the relay **65'**. This opens the normal timing circuits of the traffic signal at the poles **62**, **63** and **64**, and at the same time energizes the motor **52**, causing the signal **51** to become illuminated and to rotate, providing the desired warning indication at the intersection.

After a predetermined time period, namely, the period of time required for the slow-acting relay **95** to move its pole **136** from contacts **137**, **135** to the lower contacts, shown at **170**, **171**, thereof the ratchet disc **100** is released and returned to its reset position. As shown, the reset relay **98** has its upper terminal connected by a wire **172** to the contact **171**. The contact **170** is connected by a wire **173** to the line wire **56**. Thus, after the time required to move pole **136** downwardly sufficiently to bridge contacts **170** and **171** and to disengage from contacts **137**, **135**, has elapsed, reset relay **98** becomes energized and its abutment elements **104** and **108** engage the poles **102** and **105** to release the ratchet disc **100**, in the manner above described.

The release of the ratchet disc causes the contact arm **76** and the abutment arm **111** to return to their normal positions, said abutment arm **111** engaging the reset switch element **112** and opening the circuits of relays **114**, **115**, **116** and **65**. Said relays become deenergized, but the pole **68** of the slow releasing relay **66** remains in contact with the contacts **69** and **70** for a predetermined period of time, for example, for a period of thirty seconds, after winding **66** is deenergized, to continue the rotation of the illuminated signal device **51** for said period of time. After the required period of time has elapsed, pole **68** disengages from contacts **69** and **70**, deenergizing the motor **52** and deenergizing the relay **65**, restoring the timing circuits to their normal conditions and restoring the traffic signal to its ordinary mode of operation.

The energizing circuit for the slow-acting relay **95** comprises line wire **55**, winding **94**, wire **93**, ring **92**, contact element **85**, contact brush **78**, switch arm **76**, contact brush **77**, ring **80**, wire **134**, contact **135**, pole **136**, contact **137**, wire **138**, contact **139**, pole **141**, wire **143**, and line wire **56**. As above pointed out, a time delay is provided for the initiation of the signal action because of the time period required for switch pole **141** to engage contacts **142** and **139** after relay **140** is deenergized. A further time period is provided because of the slow action of relay **95**, and under normal conditions of operation of the system, the signal action begins in this further time period. At the end of this further time period, the pole **136** is moved away from contacts **137**, **135**, opening the circuit of the winding **94** of relay **95**, but at the same time bridging contacts **170** and **171**, causing the reset relay **98** to be energized through a circuit comprising line wire **56**, wire **173**, contact **170**, pole **136**, contact **171**, wire **172**, the winding **97** of the reset relay **98**, wire **99** and line wire **55**. This provides the above described resetting action and restores the parts to their normal conditions.

As will be readily apparent, it is very difficult for unauthorized persons to operate the remote traffic signals in the manner above described, since a specific combination of pulses and specific timing relationships between the pulses must be provided in order to sequentially energize relays **114**, **115** and **116** and to distinguish between the different time periods of the relays **140** and **95**.

Thus, if an unauthorized person is successful in pulsing the receiver **144** in a manner such as to cause the brush contact element **79** to engage one of the arcuate contacts **82**, **84** or **86**, for example, the arcuate contact **82**, and allows the contact brush **79** to dwell on arcuate contact **82** for a period of time longer than that incorporated in the proper code disc **18**, at the interval **22**, the slow-acting relay **95** becomes energized for a sufficiently long period of time to move its pole **136** into bridging contact with the contact elements **170** and **171**, causing the reset relay **98** to become energized and return the rotary switch member **76** to its normal position. Similarly, if an unauthorized person employs a series of pulses such as to rotate the switch arm **76** to a position wherein the brush contact member **79** engages one of the arcuate contacts **88**, **89**, **90** or **91** and allows contact element **79** to dwell thereon for a sufficient length of time to allow relay **140** to close the switch contacts **141**, **142**, **139**, which occurs after a series of pulses is terminated, reset relay **98** becomes energized through a circuit comprising line wire **55**, wire **99**, winding **97**, wire **96**, one of the arcuate contact segments **88**, **89**, **90** or **91**, contact brush **79**, switch arm **76**, contact brush **77**, ring **80**, wire **134**, contact **135**, pole **136**, contact **137**, wire **138**, contact **139**, pole **141**, contact **142**, wire **143**, and line wire **56**.

From the foregoing description, it will be readily apparent that it would be extremely difficult to determine the proper combination of pulses and their time relationship by any unauthorized person, and that it would be very difficult for such an unauthorized person to actuate the remote intersection signals in the manner above described by any trial and error method.

As will be also apparent, the coding may be changed, as desired, by changing the coding disc 18 employed on the transmitters of the emergency vehicles, and by similarly changing the rotary switch assemblies 75 at the locations containing the traffic signals.

As shown in Figure 2, and as above explained, suitable lamp means, such as the lamp 180, shown in the figure, may be wired in parallel with the motor 52, so as to be energized simultaneously therewith, said lamp means being suitably located inside the housing of the signal unit 51 so as to illuminate the red section of the signal unit when energized.

While a specific embodiment of an improved remote radio control system for use by emergency vehicles to control traffic intersection signals has been disclosed in the foregoing description, it will be understood that various modifications within the spirit of the invention may occur to those skilled in the art. Therefore, it is intended that no limitations be placed on the invention except as defined by the scope of the appended claims.

What is claimed is:

1. In a radio-controlled traffic signal system, a switch device operating in steps from a starting position toward a circuit-closing position responsive to the reception of a predetermined number of relatively short pulses in a definite code pattern, comprising groups of identical short pulses separated by definite relatively long time intervals, a relay device, means to energize said relay device responsive to the switch device reaching said circuit-closing position, a slow-acting relay, the time required for operation of said slow-acting relay being greater than said relatively long time intervals, means responsive to the operation of said slow-acting relay to return said switch device to said starting position, means to initiate operation of said slow-acting relay responsive to said switch device reaching said circuit-closing position, a signal motor, means to operate said signal motor responsive to the energization of said relay device, and means maintaining said signal motor in operation a predetermined period of time after said relay device becomes deenergized.

2. In a radio-controlled traffic signal system, a switch device operating in steps from a starting position toward a circuit-closing position responsive to the reception of a predetermined number of relatively short pulses in a definite code pattern, comprising groups of identical short pulses separated by definite relatively long time intervals, a plurality of relay devices, means to energize said relay devices in sequence as the switch device passes through successive predetermined positions between its starting position and said circuit-closing position, a final relay device, means to energize said final relay device responsive to the completion of said sequence of energization of all of said first-named relay devices, a slow-acting relay, the time required for operation of said slow-acting relay being greater than said relatively long time intervals, means responsive to the operation of said slow-acting relay to return said switch device to said starting position, means to initiate operation of said slow-acting relay responsive to

said switch device reaching said circuit-closing position, a signal motor, means to operate said signal motor responsive to the energization of said final relay device, means deenergizing said relay devices a predetermined time after they become energized, and means maintaining said signal motor in operation a predetermined period of time after said final relay device becomes deenergized.

3. In a remote radio-controlled traffic signal system, a rotary switch device having a starting position, a final circuit-closing position, and a plurality of intermediate circuit-closing positions, means operating said switch device in steps from said starting position through said intermediate circuit-closing positions to said final circuit-closing position responsive to the reception of a series of radio pulses in a predetermined definite time sequence comprising groups of relatively short pulses separated by definite relatively long time intervals, a plurality of relay devices, means to energize said relay devices in a predetermined sequence as the switch device passes through said circuit-closing positions, a signal motor, means energizing said signal motor responsive to the completion of said sequence, a slow-acting relay, the time required for operation of said slow-acting relay being greater than said relatively long time intervals, means responsive to the operation of said slow-acting relay to return said switch device to said starting position, means to initiate operation of said slow-acting relay responsive to the completion of said sequence, means to deenergize said relay devices a predetermined time after the completion of said sequence, and means maintaining said signal motor energized a predetermined period of time after said relay devices become deenergized.

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1,655,689	Chavueau	Jan. 10, 1928
1,760,479	Colman	May 27, 1930
1,973,691	Friendly	Sept. 11, 1934
1,995,272	Brixner	Mar. 19, 1935
2,095,688	Ballentine	Oct. 12, 1937
2,203,871	Koch	June 11, 1940
2,309,743	Bougham	Feb. 2, 1943
2,355,607	Shepherd	Aug. 15, 1944
2,514,889	McGoffin	July 11, 1950
2,563,127	McGoffin	Aug. 7, 1951
2,578,347	Gagnaire	Dec. 11, 1951
2,655,644	Rees	Oct. 13, 1953
2,698,426	Rosen	Dec. 28, 1954
2,826,752	Hendricks et al.	Mar. 11, 1958
2,832,060	Hendricks et al.	Apr. 22, 1958

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