

Sept. 8, 1959

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2,903,674

REMOTE EMERGENCY TRAFFIC CONTROL SYSTEM

Filed Aug. 30, 1954

3 Sheets-Sheet 1

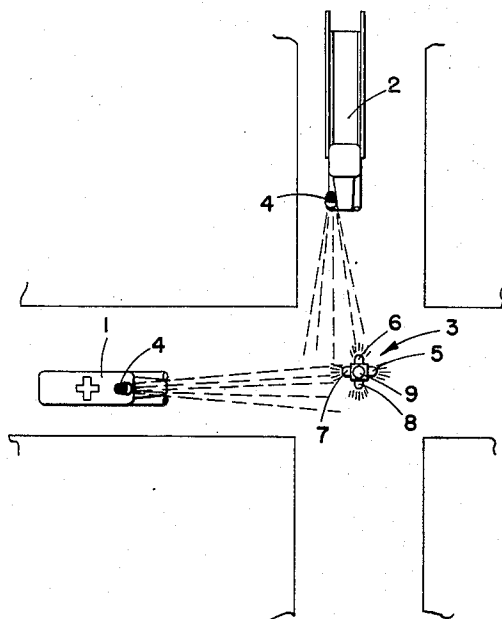


FIG. 1

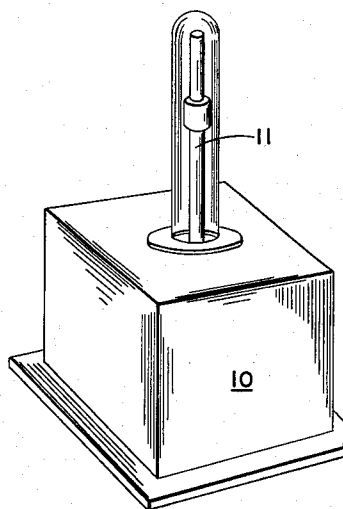


FIG. 3

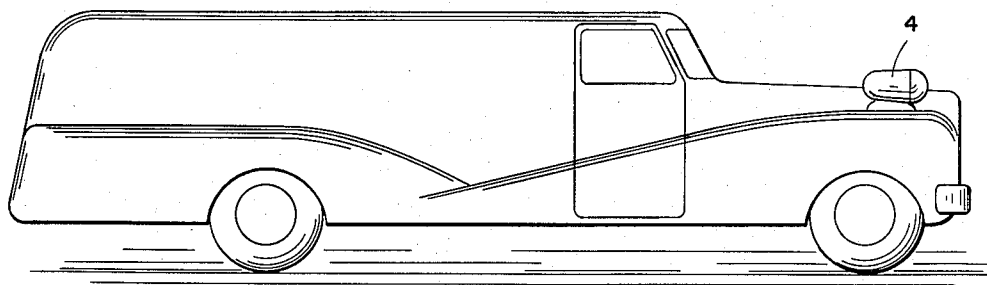


FIG. 2

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3 Sheets-Sheet 2

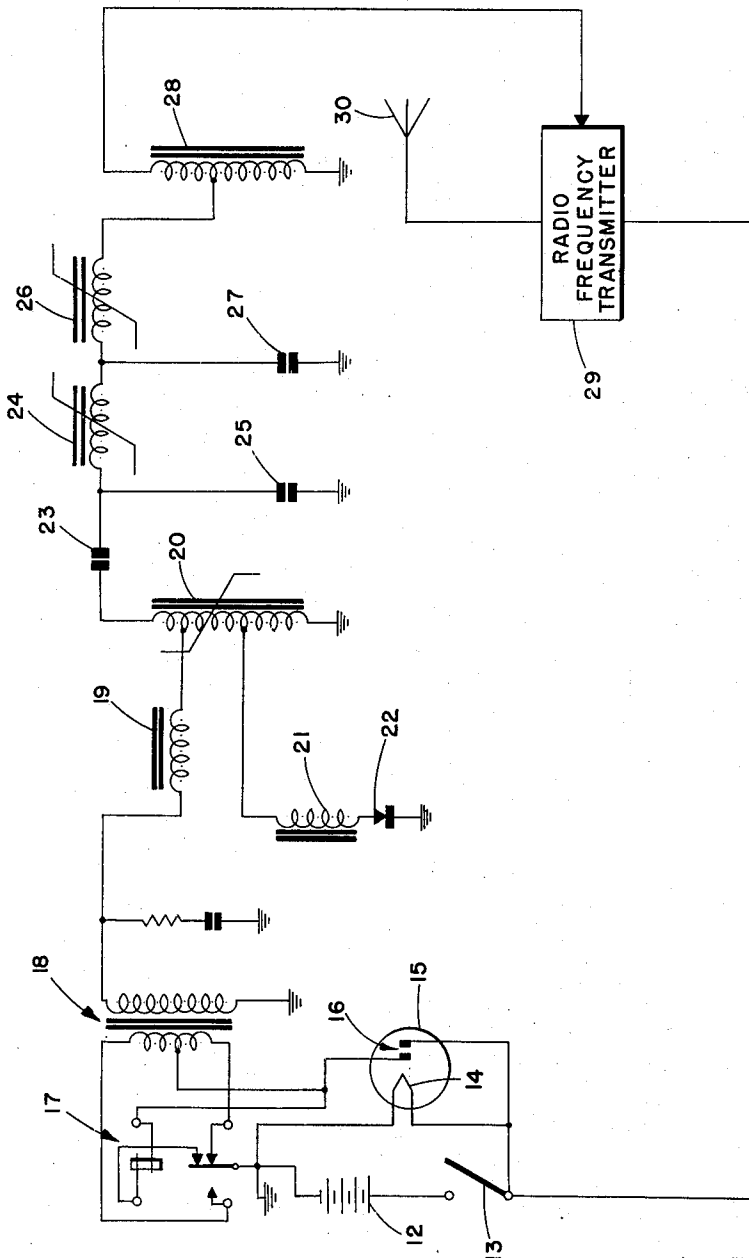


FIG. 4

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3 Sheets-Sheet 3

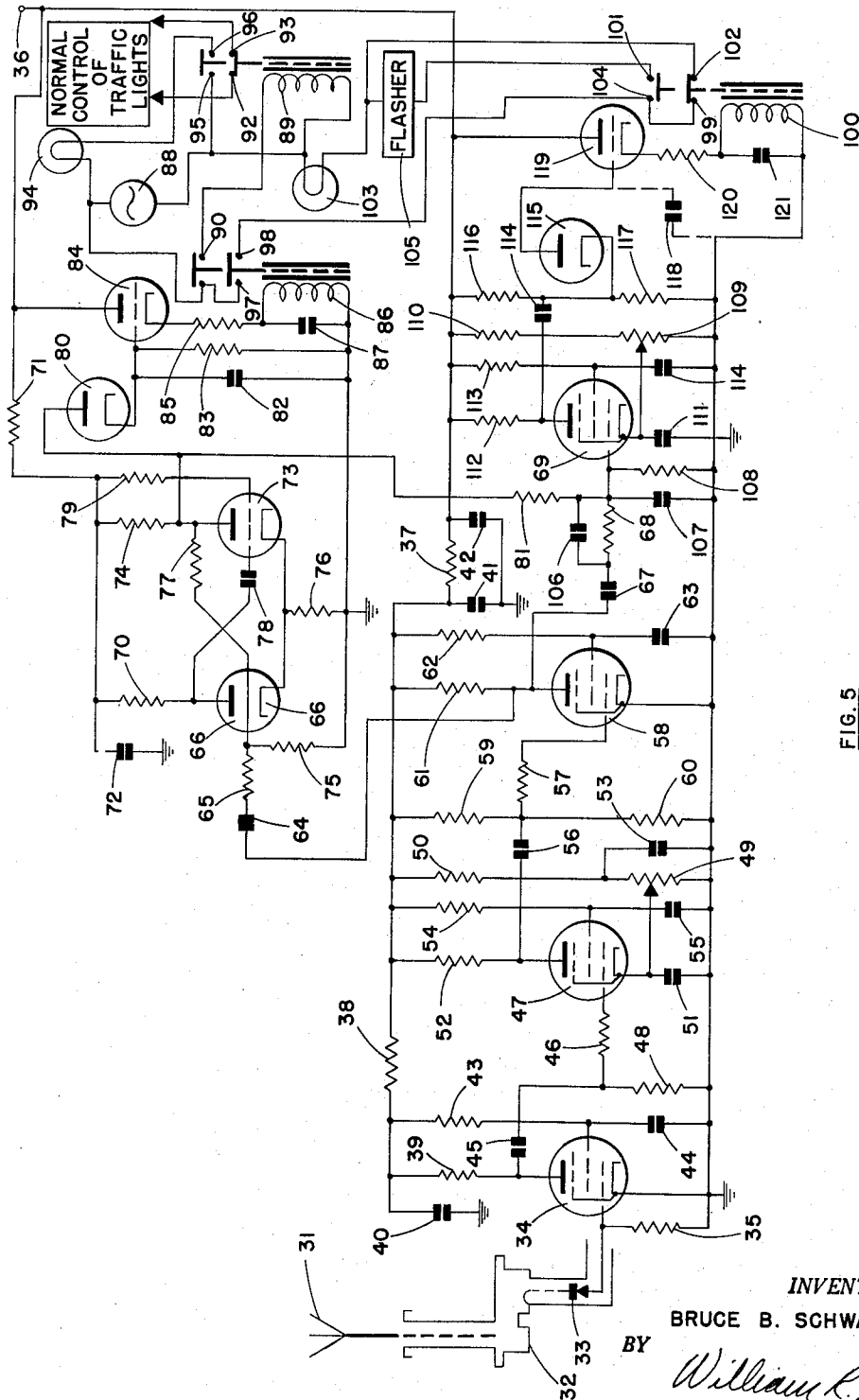


FIG. 5

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REMOTE EMERGENCY TRAFFIC CONTROL SYSTEM

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Application August 30, 1954, Serial No. 452,747

4 Claims. (Cl. 340—33)

This invention pertains to means for remotely indicating the approach of emergency vehicles and more particularly means for remotely actuating a signal at intersections approached by said vehicles.

Conventional sirens and other alarm signals upon emergency vehicles have a signal which carries only a limited distance ahead of the vehicle. For example, in a downtown portion of a large city, buildings and traffic noise frequently muffle the sound of sirens or bells so that traffic approaching from a side street does not hear the warning signal. This invention contemplates radio transmitter means of a particular kind carried upon emergency vehicles for the purpose of turning all signals at intersections approached by the vehicle to a red display. Alternative signals such as sirens positioned at the intersection, for example, may be controlled.

In order that the driver of the approaching emergency vehicle may know that he has control of the traffic lights, an auxiliary light is lighted and positioned where he may see it. Alternatively, some other known signal may be used to notify the driver of his control.

When two emergency vehicles approach the same set of signal lights, the device of this invention causes the auxiliary light to flash alternately on and off. Some other signal device such as a distinctive colored light could be used to indicate that two emergency vehicles are approaching the intersection.

It is therefore an object of this invention to provide means for controlling traffic signals from an emergency vehicle within a predetermined distance ahead in the direction of travel of the vehicle.

It is another object of this invention to provide mobile radio means for controlling traffic signals ahead in the direction of travel of said radio means.

It is yet another object of this invention to provide means mountable upon a moving vehicle for controlling traffic signals.

It is yet another object of this invention to provide radio means in combination with moving vehicle and radio receiver means for controlling the traffic light display at an intersection.

It is yet another object of this invention to provide means for remotely controlling traffic signals in combination with means for indicating that said control obtains.

It is still another object of this invention to provide radio transmitter means mounted upon a plurality of emergency vehicles in combination with radio receiver means for controlling the traffic light display upon a street and auxiliary signal means for indicating that said traffic light display is controlled and for indicating that at least two transmitters are controlling said display.

It is still another object of this invention to provide a novel high frequency radio transmitter means for generating a pulsed transmission having a predetermined pulse length and repetition rate.

It is yet another object of this invention to provide re-

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ceiver means adapted to receive pulsed radio signals, connected to control a traffic light display.

It is still another object of this invention to provide radio frequency means adapted to indicate when only one transmitted signal is received.

It is yet another object of this invention to provide novel receiver means adapted to indicate when at least two transmitted signals having a carrier frequency and having a predetermined pulse repetition rate and time duration are received.

It is still another object of this invention to provide electronic means for distinguishing a single received pulsed radio frequency carrier from a plurality of received pulsed carriers of the same carrier frequency, each said pulsed carrier having the same repetition rate and substantially the same pulse width.

Other objects of invention will become apparent from the following description taken in connection with the accompanying drawings, in which:

Fig. 1 is a plan view of a typical downtown intersection of a modern city showing two emergency vehicles, carrying transmitting devices of this invention, approaching traffic signal lights controlled by the signal device of this invention;

Fig. 2 is a view of a typical emergency vehicle showing the means by which a transmitter device is mounted on said vehicle;

Fig. 3 is a view of a typical box-like structure with openings for an antenna for housing the receiving device of this invention;

Fig. 4 is a schematic diagram of a typical pulsed high frequency transmitter device utilizing a magnetic modulator which is adapted to operate from a low voltage source; and

Fig. 5 is a preferred embodiment of the receiving device of this invention adapted to control a signal light display and to control an auxiliary signal device.

As shown in Fig. 1, two emergency vehicles 1 and 2 are approaching intersection 3 at the same time. Both vehicles 1 and 2 have a transmitting device 4 of this invention positioned to be directed in a forward direction. Each transmitting device 4 is adapted to cause all traffic signal lights within a predetermined distance in a forward direction thereof to display red in all directions, as explained hereinafter. Hence, in Fig. 1, traffic signal lights 5, 6, 7, and 8 are turned to a red display by virtue of the signals from device 4 upon vehicles 1 and 2. A receiving device of this invention is associated with traffic signal lights 5, 6, 7, and 8 and adapted when a signal is received to cause lights 5, 6, 7, and 8 to turn red. In addition, an auxiliary light or other signal device 9 is energized by virtue of the received signal from either of transmitting devices 4 upon vehicles 1 and 2. When at least two transmitter devices 4, as shown in Fig. 1, are directed at the receiving device associated with lights 5, 6, 7, and 8, said receiving device causes auxiliary light 9 to flash on and off. Alternatively, it may cause some other distinctive signal to appear, such as, for example, an audible or some other visual signal. A schematic diagram of a typical electronic circuit for transmitter device 4 is shown in Fig. 5. A receiving circuit which is adapted to achieve the desired result of this invention is shown in Fig. 6.

A closer view of the mounting of transmitter device 4 upon an emergency vehicle is shown in Fig. 2. A typical housing for the receiver device is shown at 10 in Fig. 3. Antenna 11 which extends out of casing 10 is preferably a non-directional antenna.

Any radio frequency may be used as a carrier but, because of their directional characteristics, it is desirable to use very high frequencies. In the preferred em-

bodiment of this invention, frequencies of the order of 2475 megacycles are used.

A typical modulator of the preferred type for use in the transmitter device of this invention is shown in Fig. 4. This modulator is similar to that described and claimed in patent application, Serial Number 277,196, filed March 18, 1952, for "Magnetic Pulse Generator," in the names of Eugene R. Ingersoll et al.

A source of voltage such as an automobile battery is shown at 12. Switch 13 is connected in series with battery 12 to close the circuit when the transmitter device is to be energized. Filament 14 of time delay device 15 is connected to be energized when switch 13 is closed. Device 15 is a thermostatic device whereby when filament 14 reaches a predetermined temperature, contacts 16 close. Vibrator device 17, of a conventional type, is connected through contacts 16 and switch 13 across battery 12. Vibrator device 17 interrupts the voltage applied thereto from battery 12 to generate a pulsating direct-current voltage at its output terminals. The output terminals of vibrator 17 are connected across the primary winding of transformer 18. An alternating voltage is generated across the secondary winding of transformer 18. The frequency of this source of alternating voltage may be, for example, 120 cycles per-second. The output terminals of transformer 18 are connected through choke coil 19 across saturable reactor 20. The inductance of choke coil 19 is predetermined to cause the circuit of which it is a part to resonate at the supply frequency. Choke coil 21 and rectifier 22 are connected between a tap on the winding of saturable reactor 20 and the ground terminal to generate a biasing current in the winding of reactor 20 to thereby prevent the generation of negative pulses. Saturable reactor 20 acts as an autotransformer. When the magnitude of the incoming signal applied to reactor 20 from choke coil 19 causes reactor 20 to saturate, the reactance of reactor 20 reduces to substantially zero. The output terminals of reactor 20 are connected through condenser 23 to the input of saturable reactor 24. Condenser 25 is connected across the input terminals to reactor 24. Saturable reactors 24 and 26 are connected in series, with their junction by-passed to ground through condenser 27. The output terminals of saturable reactor 26 are connected to the input of pulse transformer 28 which is connected as an autotransformer. The electrical pulses of the output of pulse transformer 28 are connected to radio frequency transmitter 29 to modulate said transmitter. The pulsed radio frequency output of transmitter 29 is connected to antenna 30 to radiate said pulses.

When an alternating current voltage is applied to the input terminals of reactor 20 from the output of choke coil 19, a current flows through condenser 23 and charges condenser 25 during a small portion of the input cycle. Reactors 24 and 26 have constants which are predetermined to cause current to flow therethrough in a successively shorter and shorter period so that the time duration of the pulse appearing at the output of transformer 28 is very short, for example, on the order of 5 microseconds. These pulses, applied to transmitter 29, cause transmitter 29 to generate radio frequency bursts or pulses of time duration, for example, of 5 microseconds which appear on antenna 30 separated by time durations of, for example, 8340 microseconds.

The preferred receiver for use in this invention is shown in Fig. 6. Radio frequency signals are received from one or more transmitters of the type shown and described in connection with Fig. 5. Alternatively, other kinds of transmitters and modulators may be used. The form of the incoming radio frequency signal is the only important point insofar as the receiver is concerned.

Radio frequency signals are intercepted by antenna 31. Inasmuch as the preferred transmitter of this invention transmits radio frequency signals of the order

of 2475 megacycles, a very high frequency resonant cavity 32 is utilized. Obviously, in a lower frequency circuit some kind of a tuned inductance-capacity circuit would be preferred. Radio frequency tuning element 32 is connected to a detector, such as diode 33. Diode 33 is also connected to the control grid of pentode 34. Resistor 35 is connected between the control grid of pentode 34 and the ground terminal to act as a return path through the frame of resonant cavity 32 for diode 33. A source of voltage (not shown) is connected between terminal 36 and the ground terminal. The plate of tube 34 is connected through resistors 37, 38, and 39 to terminal 36. Condensers 40, 41, and 42 are filter condensers to prevent changes in plate current of the various tubes from affecting the voltages applied to the other tubes. The suppressor grid and cathode of tube 34 are connected together to the ground terminal. The screen grid of tube 34 is connected through resistors 43, 38, and 37 to terminal 36. Condenser 44 is connected between the screen grid of tube 34 and the ground terminal, and has a predetermined capacity to cause tube 34 to amplify pulses which have a predetermined time duration, for example, of the order of 5 microseconds. The output from tube 34 is connected from the plate thereof through condenser 45 and resistor 46 to the control grid of tube 47. Resistor 48 is connected between the junction of condenser 45 and resistor 46 and the ground terminal. The value of resistor 46 is adjusted to prevent driving the control grid of tube 47 positive. Resistor 48 is a load resistor across which the voltage applied to the control grid of tube 47 is developed. The suppressor grid and cathode of tube 47 are connected together and to the movable arm of potentiometer 49. Potentiometer 49, resistor 50 and resistor 37 are connected across terminal 36 and the ground terminal to supply a substantially constant biasing voltage to the cathode of tube 47. Condenser 51 is connected between the cathode of tube 47 and the ground terminal to prevent instantaneous variations of signal voltage from affecting the bias voltage of the cathode of tube 47. Condenser 53 is connected across the stationary terminals of potentiometer 49 to act as a filtering condenser to prevent variations in supply voltage from affecting the bias voltage on the cathode of tube 47. The plate of tube 47 is connected through resistors 52 and 37 to terminal 36. The screen grid of tube 47 is connected through resistors 54 and 37 to terminal 36. Condenser 55 is connected between the screen grid of tube 47 and the ground terminal to cause tube 47 to amplify pulses which have a predetermined time duration, for example, of the order of 5 microseconds. The output of tube 47 is connected from the plate thereof through condenser 56 and resistor 57 to the control grid of tube 58. Resistor 57 is inserted in the circuit to limit the flow of grid current to the control grid of tube 58. The junction between condenser 56 and resistor 57 is maintained at a constant potential by means of a voltage divider comprising resistors 37, 59, and 60 connected between terminal 36 and the ground terminal. The junction between resistors 59 and 60 is connected to the junction between condenser 56 and resistor 57. The suppressor grid and cathode of tube 58 are connected together to the ground terminal. The plate of tube 58 is connected through resistors 37 and 61 to terminal 36. The screen grid of tube 58 is connected through resistors 37 and 62 to terminal 36. Condenser 63 is connected between the screen grid of tube 58 and the ground terminal to increase the amplification of tube 58 for pulses which have, for example, a time duration of the order of 5 microseconds.

The output of tube 58 is connected from the plate thereof through condenser 64 and resistor 65 to the grid of tube 66. The output of tube 58 is also connected through condenser 67 and resistor 68 to the control grid of tube 69. The plate of tube 66 is connected through

resistors 70 and 71 to terminal 36. Condenser 72 is a filter condenser to prevent changes in current from causing a change in supply voltage. The plate of tube 73 is connected through resistors 71 and 74 to terminal 36. The grid of tube 66 is connected through resistor 75 to the ground terminal. The cathodes of tubes 66 and 73 are connected together. Resistor 76 is connected between the cathodes of tubes 66 and 73 on the one hand, and the ground terminal. Resistor 77 is connected between the plate of tube 73 and the grid of tube 66. Condenser 78 is connected between the plate of tube 66 and the grid of tube 73. The grid of tube 73 is connected through resistors 71 and 79 to terminal 36. Tubes 66 and 73, together with their associated circuitry, comprise a monostable multivibrator.

Before a pulse is received on the grid of tube 66, tube 73 normally conducts because of the positive voltage upon the grid thereof. When a pulse is received upon the grid of tube 66, current starts to flow through tube 66, thereby decreasing the potential of the plate of tube 66. The sudden decrease of potential upon the plate of tube 66 is transferred to the grid of tube 73 through condenser 78. Tube 73 is momentarily cut off and stops conducting. After a period of time, which in the preferred embodiment of this invention is of the order of 7500 microseconds, condenser 78 discharges through tube 66 and resistors 76 and 70, and tube 73 again starts to conduct. When tube 73 conducts, the grid of tube 66 is driven negative by virtue of the direct connection through resistor 77. Hence, in summary, when a pulse is received at the grid of tube 66, tube 66 conducts for a period of the order of 7500 microseconds, at which time tube 73 again starts conducting, to place the circuit in condition to be receptive to the influence of another pulse upon the grid of tube 66.

The plate of tube 73 is connected to the plate of diode 80 and through resistor 81 to the control grid of tube 69. During the period when tube 73 is extinguished, the plate voltage thereof jumps to an increased value. Because of the increased voltage applied to the plate of tube 80, tube 80 conducts and charges condenser 82. Resistor 83, which may be merely the leakage resistance between the grid and cathode of tube 84, leaks the charge off of condenser 82 at a very slow rate. Hence, when a series of pulses are received by the receiver, the fact that for a short period of time tube 80 does not conduct does not effect the operation of tube 84. Condenser 82 stores the charge which it receives, and the time constant of condenser 82 and resistor 83 is such that, provided a series of pulses are received at the input of the receiver, the grid of tube 84 is maintained at a conducting potential.

The plate of tube 84 is connected to terminal 36. The cathode of tube 84 is connected through resistor 85 and relay winding 86 to the ground terminal. Condenser 87 is connected across winding 86 to prevent voltage transients resulting from changes in inductance of winding 86 from effecting the other circuitry of the receiver. Winding 86 is connected in the cathode circuit of tube 84 and is therefore energized whenever tube 84 conducts, which is only when a series of pulses are applied at the grid of tube 66. Further, a series of pulses are applied at the grid of tube 66 only when a series of pulses are received at antenna 31.

The switching contacts of relay winding 86 may be connected to operate any kind of device which is to be remotely controlled and, in particular, to operate any kind of signal device, and even more particularly, to turn all traffic lights at an intersection or along a street to a red display in all directions.

In the typical circuit shown in Fig. 5, a source of voltage 88, which need not be an alternating voltage but may be a direct voltage, is connected to one terminal of relay 89. The other terminal of relay 89 is connected through contacts 90 and 91 to the other side of voltage source 88.

Hence, when winding 86 is energized, terminals 90 and 91 are connected, thereby energizing winding 89. When winding 89 is energized, contacts 92 and 93 are opened. The circuit of which contacts 92 and 93 are a part is the normal control circuit for the traffic lights. Hence, when winding 89 is energized, the normal control of the traffic lights is disconnected. Alternatively, all of the red lights shown schematically in Fig. 5 at 94 are connected through terminals 95 and 96 across voltage source 88 so that when winding 89 is energized, all signal lights are changed to a red display. When winding 86 is energized, terminals 97 and 98 are connected, thereby placing a voltage upon terminals 98 and 99. When winding 100 is de-energized, terminals 99 and 102 are disconnected, while terminals 104 and 101 are connected, as described more fully hereinafter.

Auxiliary light 103, which may be some other kind of signaling device such as a horn or siren, or which alternatively may be some secondary device which is to be remotely controlled, is connected across voltage source 88 through terminals 97, 98, 99, and 102, or through terminals 97, 98, 104, 101 and flashing device 105. Flashing device 105 may be any one of a number of well known devices, which periodically opens and closes the circuit.

When a positive square wave signal appears upon the plate of tube 73, as described above, it also appears upon the control grid of tube 69 by virtue of the connection through the resistor 81. Condenser 106 and condenser 107 are inserted to blunt the incoming pulses to prevent overdriving of tube 69. Condenser 106 is connected across resistor 81, and condenser 107 is connected between the control grid of tube 69 and the ground terminal. The square wave signal received from the plate of tube 73 biases tube 69 so that tube 69 conducts whenever a pulse is received thereon. Hence, it follows that the first pulse received by the receiver does not cause tube 69 to conduct, but causes the plate of tube 73 to generate a square wave signal which is used to open the gate of gating tube 69 so that any subsequently received pulses cause tube 69 to conduct.

Resistor 108 is connected between the control grid of tube 69 and the ground terminal to provide a load resistance across which voltage may be generated. The suppressor grid and cathode of tube 69 are connected together to the movable arm of potentiometer 109. Resistor 110 and potentiometer 109 are connected as a voltage divider between terminal 36 and the ground terminal so that the voltage upon the cathode of tube 69 is substantially constant. Condenser 111 is a bypass condenser upon the cathode of tube 69 to prevent signal pulses from altering the bias voltage upon the cathode of tube 69. The plate of tube 69 is connected through resistor 112 to terminal 36. The screen grid of tube 69 is connected through resistor 113 to terminal 36. Condenser 114 is connected between the screen grid of tube 69 and the ground terminal to cause tube 69 to amplify pulses which have a predetermined time duration, for example, of the order of 5 microseconds.

The electrical output of tube 69 is connected from the plate thereof through condenser 114 to the cathode of tube 115. The cathode of tube 115 is maintained at a substantially constant bias potential by means of a pair of voltage dividing resistors 116 and 117 connected across terminal 36 and the ground terminal.

When a pulsed signal is passed through gating tube 69, the cathode of tube 115 is driven momentarily negative, which causes tube 115 to conduct and charge condenser 118. Condenser 118 is, in the preferred embodiment of this invention, merely the leakage capacitance between the plate of tube 115 and the grid of tube 119 on the one hand, and the ground terminal on the other.

The plate of tube 115 is connected to the grid of tube 119 so that when pulses are received upon the cathode of tube 115, condenser 118 is charged to drive

the grid of tube 119 negative to prevent conduction thereof.

The plate of tube 119 is connected to terminal 36. The cathode of tube 119 is connected through resistor 120 and winding 100 to the ground terminal. Condenser 121 is connected across winding 100 so that voltage transients resulting from the changes of inductance of winding 100 do not affect the voltages in the other parts of the circuit.

Hence, normally energized winding 100 is conducting when no pulses are passed by tube 69 so that auxiliary light 103 is connected through terminals 97, 98, 99, and 102 to voltage source 88; but when pulses are passed by tube 69, tube 119 is blocked and winding 100 does not conduct, whereby auxiliary light 103 is connected through terminals 97, 98, 104, and 101 and flasher 105 to cause auxiliary light 103 to flash alternately on and off.

It is therefore seen that when only one emergency vehicle approaches the signal light with its transmitter on, that all signal lights are turned to a red display and auxiliary light 103 is turned steadily on. When two or more emergency vehicles approach the signal light, the signal lights are turned to a red display, and tube 69 is gated to pass pulses, whereby auxiliary light 103 flashes alternately on and off. Thus, there has been here provided a means for remotely controlling the display of traffic signal lights at an intersection or along a street to cause the lights to turn to a red display in all directions, and a means for determining, first, that the signal lights are under control of the approaching emergency vehicle; and, second, whether one or more than one emergency vehicle is interrogating, stimulating, exciting or commanding the receiver circuit at the same time. Hence, the streets are made more safe for emergency vehicles without danger of collision of emergency vehicles at the intersections.

Although the invention has been described and illustrated in detail, it is to be clearly understood that the same is by way of illustration and example only and is not to be taken by way of limitation, the spirit and scope of this invention being limited only by the terms of the appended claims.

I claim:

1. In combination a plurality of traffic signal lights shiftable between different displays; a plurality of mobile pulsed transmitters; an auxiliary light positioned adjacent said signal lights; first relay means connected to turn said signal lights to a red display and to cause said auxiliary light to be energized; second relay means connected to turn said signal lights to a red display and to cause said auxiliary light to flash; a radio receiver having two channels of amplification and having gating means to open said second channel when a signal is conducted through said first channel, said first channel of amplification being connected to energize said first relay means, said second channel of amplification being connected to energize said second relay means whereby when only one said transmitter is energized, said lights are turned to a red display and said auxiliary light burns steadily, but when at least two said transmitters are energized said signal lights are turned to a red display and said auxiliary light flashes on and off.

2. In combination with a plurality of traffic signal lights, an auxiliary signal device mounted adjacent said light, a radio receiver having first and second channels adapted to receive pulsed radio frequency signals, control

means coupling the output of said first channel to said lights and device to turn said signal lights red and to energize said auxiliary signal device upon receipt of a first of said pulsed signals, second control means coupling the output of said second channel to said device to cause the energy to said auxiliary signal device to be alternately turned on and off in response to a signal in said second channel, said second channel having normally closed gate valve means for blocking passage of signals through said second channel, and means coupling said first channel to said gate valve means for disabling said gate valve means to permit passage of a second of said signals through said second channel.

3. In combination with a plurality of traffic signal lights shiftable between at least red and green displays and an auxiliary light, detector means for detecting pulsed radio frequency signals of a given frequency, amplifier means connected to the output of said detector means for amplifying signal pulses which have a given pulse length, a monostable multivibrator connected to be controlled by said received pulses, electrical control means responsively connected to the output of said multivibrator for causing said signal lights to turn to a red display and lighting said auxiliary light, normally closed electrical gating means connected to be gated open in response to the output of said multivibrator and having its input connected to the output of said amplifying means, second electrical control means responsively connected to the output of said gating means and said first-mentioned electrical control means for causing said auxiliary light to turn alternately on and off.

4. In combination a plurality of traffic signal lights located at a street intersection and shiftable between at least red and green conditions; a plurality of emergency vehicles; a plurality of pulsed transmitters equal in number to said emergency vehicles mounted upon said emergency vehicles respectively; an auxiliary light positioned adjacent said signal lights; first relay means connected to maintain said signal lights in red condition and to cause said auxiliary light to light; second relay means connected to maintain said signal lights in red condition and to cause said auxiliary light to flash; a radio receiver having first and second channels of amplification; normally closed gating means for blocking said second channel, means responsive to conduction of a signal through said first channel for opening said gating means, said first channel of amplification being connected to energize said first relay means, said second channel of amplification being connected to energize said second relay means whereby when a signal from one emergency vehicle approaching said intersection is received said traffic signals are turned to a red condition and said auxiliary light burns steady, and when signals from at least two emergency vehicles approaching said intersection are received said signal lights are turned to a red condition and said auxiliary light is caused to flash.

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