

June 11, 1940.

W. R. KOCH

2,203,871

RADIO TRAFFIC CONTROL

Filed Oct. 13, 1936

5 Sheets-Sheet 1

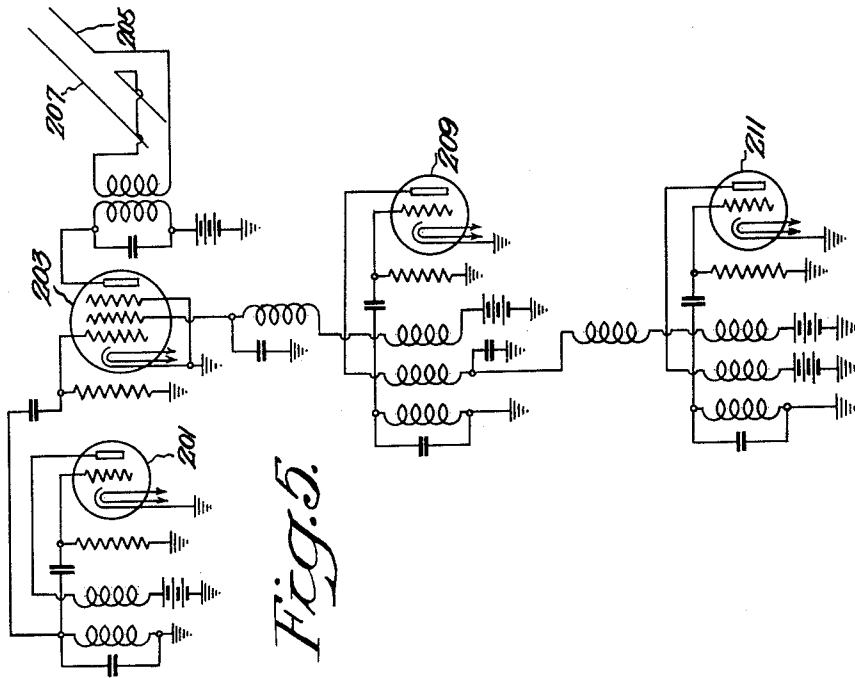


Fig. 5.

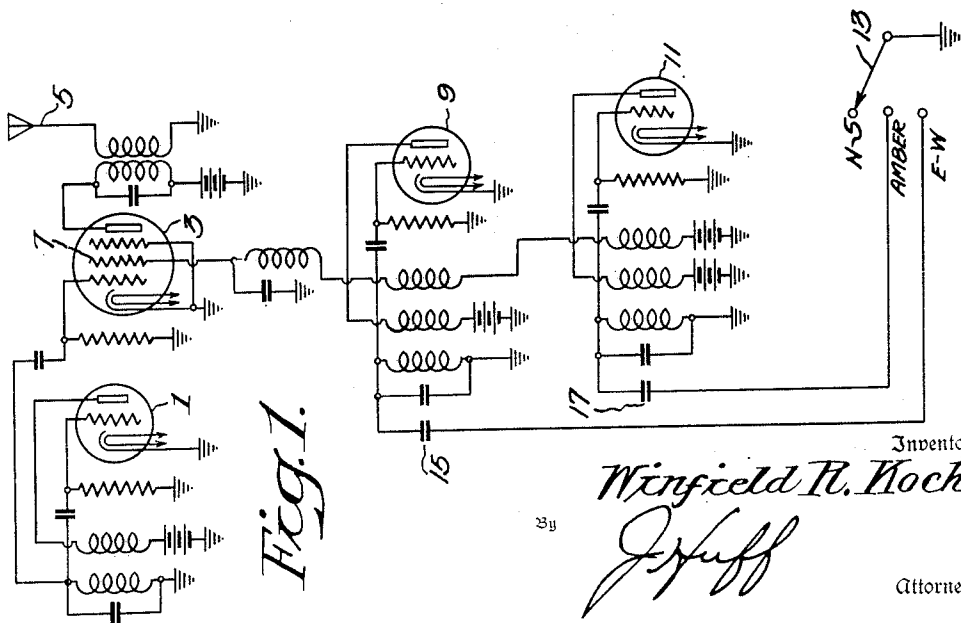


Fig. 1.

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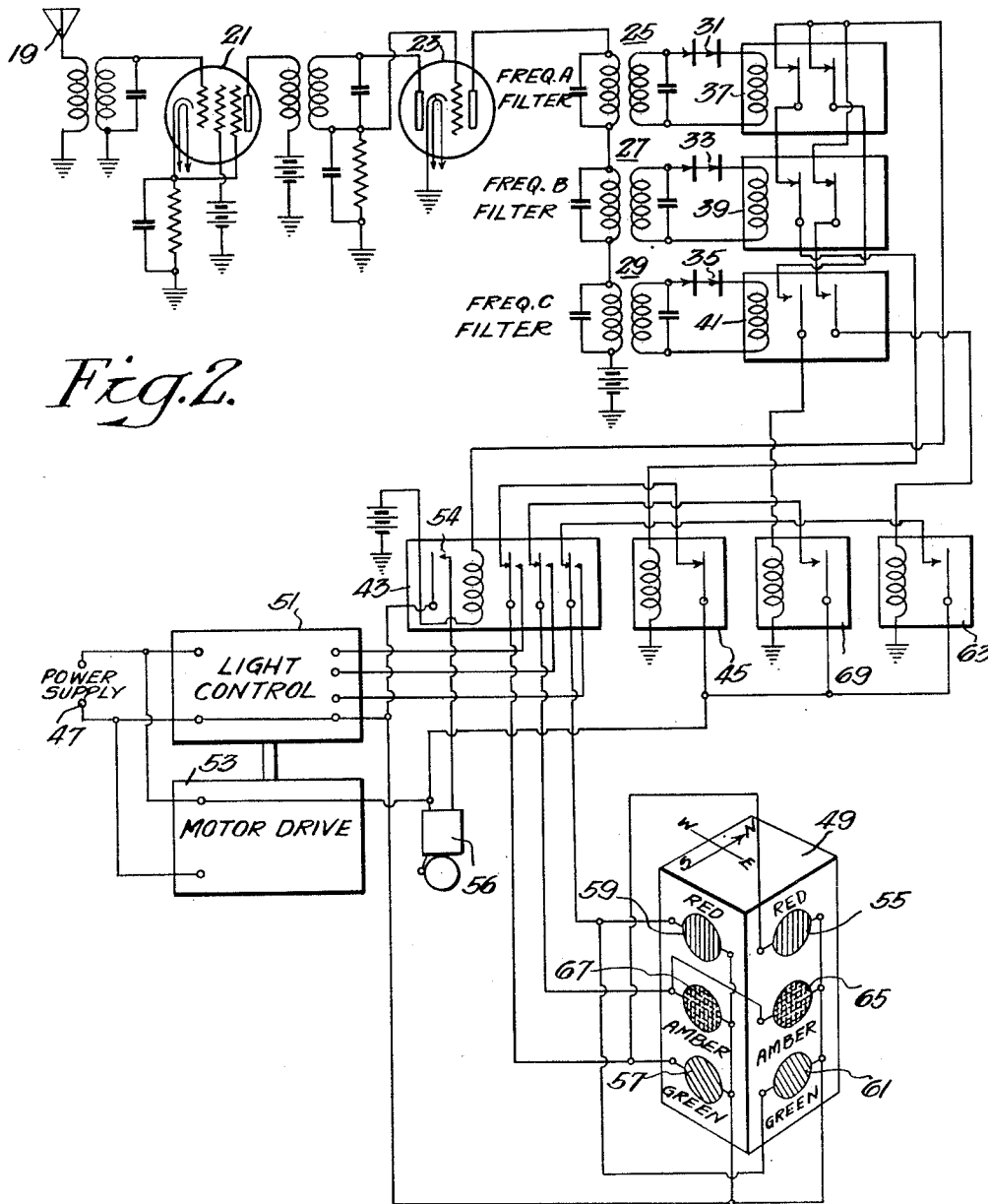
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5 Sheets-Sheet 2



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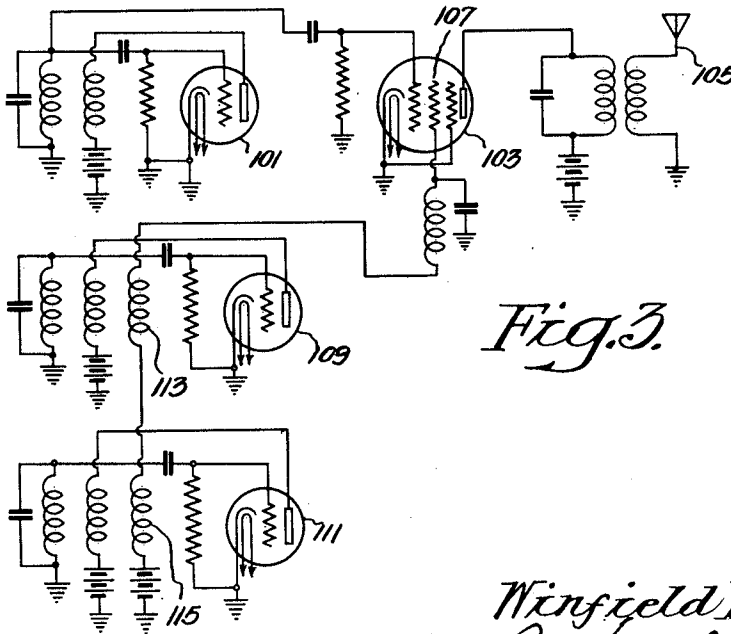
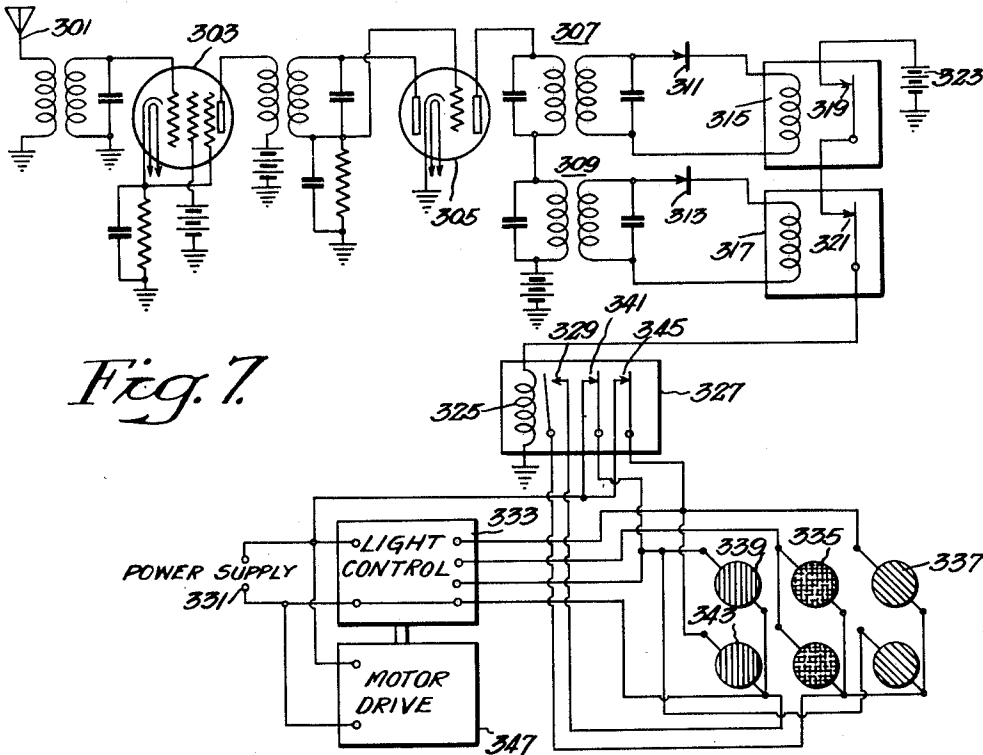
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Filed Oct. 13, 1936

5 Sheets-Sheet 3



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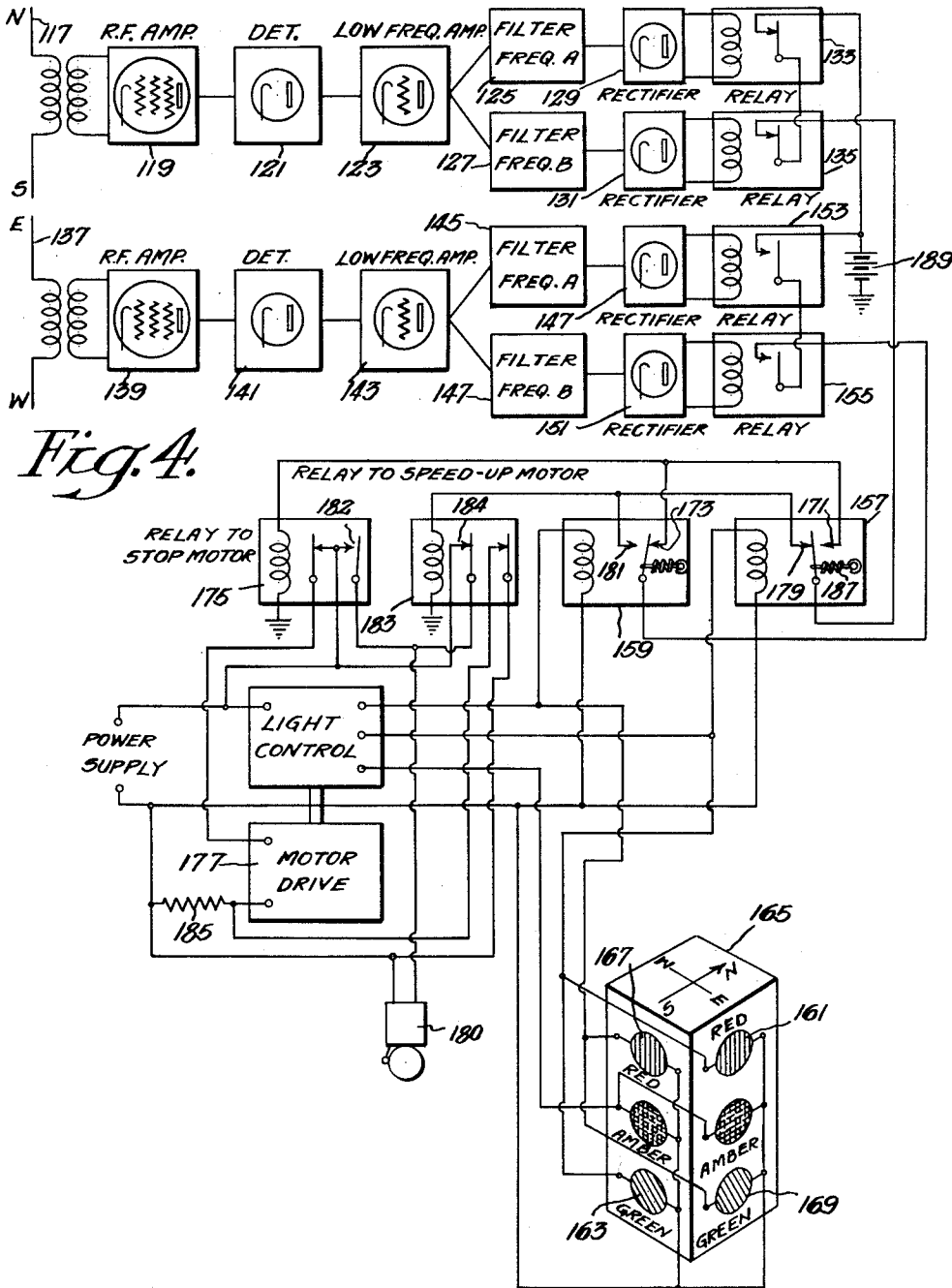
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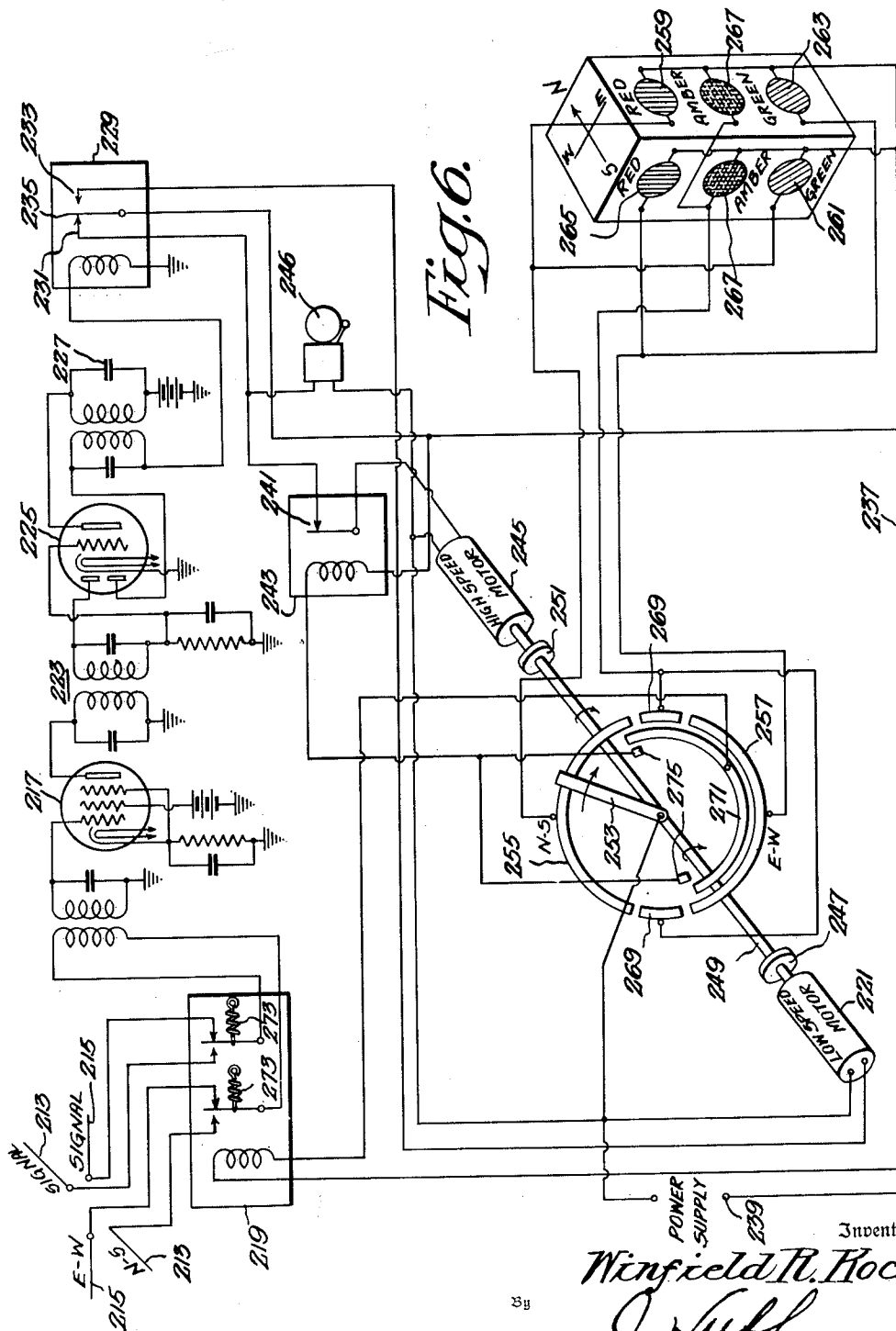
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RADIO TRAFFIC CONTROL

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5 Sheets-Sheet 5



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2,203,871

RADIO TRAFFIC CONTROL

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Application October 13, 1936, Serial No. 105,357

11 Claims. (Cl. 177—337)

My invention relates to radio traffic control and more particularly to a mobile radio transmitting system which may be used on a moving vehicle to assume a remote temporary control of an automatically operated traffic signal, including a suitable radio receiver, and to restore the automatic control after exercising the aforementioned temporary control.

Substantial numbers of traffic accidents have been caused by vehicles, such as fire apparatus, ambulances, police cars, and the like, which, because of the emergency nature of their calls, often disregard the traffic signal lights and operate contrary to the conventional traffic stop and go signals. I propose to equip such vehicles with a radio control which will assume remote temporary control of traffic signals. Under such circumstances, the vehicles, so equipped, can operate the traffic signals as they are approached not only to facilitate their own progress but also to protect other traffic. After the period of temporary control, automatic control is restored. By means of a novel arrangement of the transmitters and receivers unauthorized interference with the traffic control lights is prevented.

One of the objects of my invention is to provide means for controlling traffic signals from a mobile vehicle.

Another object is to provide means for temporarily controlling an automatically controlled traffic signal light by means of a radio frequency wave which is suitably modulated to prevent unauthorized interference with said traffic lights.

Another object is to provide means for selectively controlling radio traffic signal lights from a mobile position.

A further object is to provide means for automatically assuming temporary control of traffic signals to facilitate the safe movement of authorized vehicles and to signal other vehicles to stop.

Other objects will be apparent from the accompanying specification and drawings in which

Fig. 1 is the schematic diagram of the transmitter, and Fig. 2 is the schematic diagram of the receiver of one embodiment of my invention.

Fig. 3 is a circuit diagram of a transmitter and Fig. 4 is a circuit diagram of a receiver for a modification of the radio traffic control of Figs. 1 and 2.

Figs. 5 and 6 represent, respectively, the circuit diagrams of a transmitter and a receiver which may be used in a further modification of my invention, and

Fig. 7 is a schematic circuit diagram of a modification of the receiver of Fig. 2.

For convenience, throughout the specification, it may be understood that the traffic signal lights are the conventional red, amber, and green lights which are usually employed at cross streets, and such streets will be assumed to extend in a north and south, and east and west direction. It may also be understood that I prefer to employ ultra high frequency waves of a length of the order of a meter as such waves have a limited sphere of propagation, are readily received and transmitted with small antennas, are not generally subject to atmospheric and other interference and are especially suited to the solution of the problems involved in radio traffic control.

Referring to Fig. 1 which is a schematic diagram of a radio transmitter, an ultra high frequency thermionic oscillator 1 is connected to a suitable amplifier 3 which is coupled to an antenna 5. The antenna 5 may be a small dipole which is suitably mounted, along with the balance of the transmitter, on the vehicle from which traffic control is to be exercised. The amplified carrier is modulated by a control grid 7 or the like which is coupled to a pair of generators 9, 11.

These generators are arranged to give two different audio or supersonic frequencies A and B when the switch 13 is open. Either of these frequencies may be changed to a third frequency C when the switch is connected to include the capacitors 15, 17 in the respective oscillator circuits as shown. Thus the transmitter radiates an ultra high frequency wave which may be modulated by tone frequencies A and B, A and C or B and C by an appropriate manual adjustment of the switch 13.

A circuit diagram of a suitable device for receiving the modulated carrier wave, radiated from the transmitter of Fig. 1, is shown in Fig. 2. The receiver is preferably located at or near the traffic signal. An antenna 19 is located at approximately the intersection of the streets protected by the traffic signal. The antenna 19 is coupled to a radio frequency amplifier 21 which is also coupled to a detector and audio frequency amplifier 23. Three filters 25, 27 and 29, respectively tuned to pass the modulation frequencies A, B, and C, are serially connected in the output circuit of the audio, or modulation frequency, amplifier. Each of the filters includes a suitable rectifier 31, 33, 35 and a relay 37, 39, 41. Each relay is arranged with a pair of contacts which are open circuited when no audio or other modulation frequency is impressed on the carrier wave.

In the operation of this system, hereinafter

known as the first system, it will first be assumed that currents of modulation frequencies A and B are being rectified to create currents which close relays 37 and 39. One of the contacts of relay 37, through a serial connection with one of the contacts of relay 39, completes the circuits of a two position triple contact relay 43 and a relay 45 which completes the power circuit 47 to the traffic signal 49. The two position multiple contact relay 43, in the position shown, disconnects the normal automatic light control 51 and its motor drive 53 from the traffic signal 49. The relay 45, completing the circuit from the power source 47, energizes the east-west red traffic light 55 and the north-south green traffic light 57.

It will be observed that the circuits to the north-south red traffic light 59, and the east-west green traffic light 61, controlled by relay 63, are open. The amber lights 65, 67 are also open circuited by their control relay 69. If desired, additional set of contacts 54 may be included in the relay 43 to operate a sound alarm signal 56 whenever the normal automatic control is disconnected and the remote control in operation.

If the transmitter is modulated by frequencies A and C instead of A and B, the rectifiers 31, 35 derive currents for energizing relays 37, 41, connected respectively to these rectifiers, while the relay 39 connected to the remaining rectifier 33 is open circuited. The two position relay 43 is operated, as in the previously described operation by frequencies A—B, to remove the automatic control 51 and connect the relay 69 which operates the amber lights 65. Both sets of red and green lights are not energized because the relays 39, 45 and 63 are open circuited.

The modulation of the carrier wave by audio frequencies B—C is received, demodulated and rectified by the radio receiver and rectifiers 33, 35. The rectified currents close the relays 39, 41 which complete the circuits of the two position relay 43 and the relay 63 which controls the north-south red light 59 and the east-west green light 61. Since no audio currents of frequency A are received, the relay 37 will be de-energized which in turn opens the circuits of relays 45 and 69 which respectively control the amber lights 65, 67, the north-south green light 57 and the east-west red light 55.

In the illustration of Fig. 2, and in corresponding figures through the specification, the traffic signal is shown with signal lights on the southerly and easterly portions of the signal, these lights are also visible in the northerly and westerly portions of the signal. From the foregoing description it can be seen that the radio transmitter is manually controlled by three modulation frequencies. The modulation frequencies A, B and C are operated in pairs A, B; or A, C; or B, C.

The carrier waves, modulated by a pair of said frequencies, are used to interrupt the automatic control of a traffic signal light, and temporarily establish a manual remote control for east-west, north-south or amber caution signals. The foregoing system is not readily subject to unauthorized control because of the several combinations of carrier frequency and modulation frequencies which are required and which are interlocking as previously described.

While the foregoing system offers a desirable means for remotely and manually controlling traffic signals, in many cases an automatic re-

mote control is preferable. Such a system, hereinafter called the second system, is schematically illustrated by the circuit diagrams of the transmitter, Fig. 3, and the receiver, Fig. 4. In the second system means are provided for the automatic remote control of east-west or north-south traffic from a vehicle with authorized equipment.

The transmitter for the second system is illustrated schematically in Fig. 3 in which an ultra high frequency oscillator 101 is connected to a radio frequency amplifier 103, which is coupled to a horizontally positioned dipole antenna 105. The amplifier 103 includes a control electrode 107 which is connected to a pair of generators 109, 111 through coupling coils 113, 115. The generators each develop alternating currents of audio or supersonic frequencies A, B, which continuously modulate the ultra high frequency carrier currents. The waves radiated by these currents are horizontally polarized by the orientation of the dipole antenna. The entire apparatus is installed on the vehicle, or the like, from which remote control of traffic signals is to be exercised.

The receiver for the second system is schematically illustrated in Fig. 4. A horizontally positioned dipole antenna 117, which may be pointed north and south, and preferably arranged in a plane parallel to the plane including the controlling transmitting antenna, is connected through a radio frequency amplifier 119, to a detector 121 and a low or modulation frequency amplifier 123. The output circuit of the amplifier 123 is connected to a pair of filters 125, 127 which respectively pass currents of frequencies A and B. The filters 125, 127 are respectively serially connected to rectifiers 129, 131 and relays 133, 135.

A second dipole antenna 137, horizontally positioned and pointing east-west in a plane which is at right angles to the plane of the first dipole antenna 117, is connected through a second radio frequency amplifier 139 to a detector 141 and a low or modulation frequency amplifier 143. The output circuit of the low frequency amplifier 143 includes a pair of filters 145, 147 which respectively pass currents of the two modulation frequencies A, B. The filters 145, 147 are respectively serially connected to rectifiers 149, 151, and relays 153, 155.

The relays 133, 135 have contacts which are serially connected to the movable contact of a biased relay 157. The relays 153, 155 have contacts which are serially connected to the movable contact of a second biased relay 159. The energizing coil of the first 157 of the two biased relays is connected across the east-west red light 161 and the north-south green light 163 of a traffic signal 165. The energizing coil of the second biased relay 159 is connected across the north-south red light 167 and the east-west green light 169 of the traffic signal 165. The fixed contacts 171, 173 of relays 157, 159 are connected together and through the energizing coil of a relay 175 which open circuits the motor drive 177 which controls the normal automatic operation of the lights. The other pair of fixed contacts 179, 181 are connected together and to a relay 183 which short circuits a series resistance 185 in the motor drive 177 circuit to increase the motor speed. An audible alarm signal 180 may be operated to audibly indicate operation of the remote automatic traffic control. The alarm is actuated by the signal light power supply which is connected to the alarm by auxiliary contacts

182, 184 which are respectively incorporated in relays 175, 183.

The operation of the second system is as follows: Assume that the north-south oriented receiving antenna 117 is energized by the modulated carrier waves radiated by a transmitting antenna 105 disposed parallel to the receiving antenna and carried by an east-west bound vehicle. The modulated carrier will be amplified, demodulated, and the demodulated currents amplified by the receiving system 117, 119, 121, 123. The amplified demodulated currents will be filtered and rectified to thereby energize relays 133 and 135 whose contacts will be closed as shown.

If the traffic signal 165 happens to be on red for east-west traffic, the relay 157 will be energized because it is connected to the east-west red light 161. Thus energized, the relay coil will overcome the force exerted by the biasing spring 187 and contact 179 closed to complete the circuit from the local battery 189 through the coil of the relay 183 which then short circuits the resistance 185 and speeds up the motor drive to turn on the green light which signals "go" to the east-west bound vehicle.

During this operation the relay 159, which is connected to the second radio receiver 137, 139, 141, etc., through relays 153, 155, has no effect because these relays are open circuited, as shown, when the receiver is not actuated by a control signal. After the east-west green light 169 is energized the biasing spring 187 will cause contact 171 to be engaged which in turn completes the relay circuit 175 to open circuit the motor drive 177 and maintain the east-west green signal light for the east-west bound vehicle. The range of the radio transmitter is preferably limited to a relatively short distance so that the remote control will have no effect after the vehicle has driven a short distance beyond the traffic light. After the transmission is thus reduced in its effect, the traffic signal will be automatically restored to its normal control.

If the east-west bound vehicle is approaching a green light 169, the relay 157 will not be energized but the biasing spring 187 will cause the contact 171, which is connected to the relay 175, to be completed. The relay 175 is thus energized from the local battery 189 and open circuits the motor drive 177. With the motor drive open, the traffic signal will be maintained "green" for the east-west vehicle until it passes beyond the signal and beyond its range of control. The relay 159, connected to the north-south red light, will be energized during the maintenance of the east-west green light 169 because this relay 159 is connected thereto but the connection will not be effective because the receiver relays 153, 155 are open circuited.

Just as the operation for east-west bound traffic has been described, so may the operation for north-south bound traffic be traced: In the latter case the relays 133, 135 are opened, and the relays 153, 155 are controlled by reception over the receiver 137, 139, 141, etc. The amber or caution light is preferably adjusted for a time interval which is so short that it will offer substantially no delay to the automatic remote control, or the amber signal may be eliminated. If two vehicles, each equipped with remote control, are approaching the signal on east-west and north-south courses, one of the vehicles will assume control by operating the relay to stop the motor. That is, the vehicle which has the "green" or "go" signal will have control and the other

vehicle must obey the "red" or "stop" signal. As in the case of the first system, the present system offers secrecy provisions in that a combination of carrier and modulation frequencies are required to operate the traffic signal.

Circuit diagrams for a transmitter, Fig. 5, and a receiver, Fig. 6, illustrate another modification, hereinafter called the third system, of my invention. In Fig. 5 an ultra high frequency oscillator 201 is coupled to a high frequency amplifier 203 which is in turn coupled to a dipole antenna 205. A parasitic reflecting antenna 207 is suitably positioned with respect to the dipole to direct the waves radiated therefrom. The carrier currents are modulated by an intermediate frequency oscillator 209 which is in turn modulated by a low frequency oscillator 211. Thus the transmitter radiates waves of ultra high frequency which are modulated by a modulated intermediate frequency amplifier. This apparatus is suitably installed on the vehicles which are to automatically and remotely control traffic signals.

The receiver for the third system is schematically illustrated in Fig. 6. This receiver is preferably located adjacent the traffic signal which is to be remotely controlled. In any event the dipole antennas 213, 215 should be located near the traffic signal. One of these dipoles 213 is made selectively responsive to signals from transmitters on north-south bound vehicles. The other is made selectively responsive to signals from transmitters on east-west bound vehicles. These antennas 213, 215 are alternately connected to an ultra high frequency amplifier 217 by means of a two position relay 219 which is actuated in synchronism with the normal automatic low speed signal control motor 221. The ultra high frequency amplifier is coupled through an intermediate frequency transformer 223 to a demodulator, low frequency amplifier and rectifier 225.

The output of the low frequency amplifier is filtered by a filter 227 which passes current of frequencies equal to the low frequency modulating currents from the transmitter. The rectified currents actuate a two position relay 229 which includes two fixed contacts 231, 233 and a movable contact 235. The movable contact 235 is connected to the common lead 237 of the power source 239. The first fixed contact 231 is connected to the contact 241 of a relay 243 which controls the operation of a high speed motor 245. The second fixed contact 233 is connected to the low speed motor 221.

The low speed motor 221 is mechanically coupled through a ratchet, or "free wheeling" device 247 to a shaft 249. The high speed motor 245 is also connected through a ratchet 251 to the shaft 249. A rotating connector 253 is arranged to be driven by the shaft. The connector 253 makes contact with the commutators 255-257 which respectively operate the east-west red "stop" lights 259, north-south green "go" lights 261 and the east-west green "go" lights 263, north-south red "stop" lights 265. The amber lights 267 are controlled by the commutators 269.

The N-S signal antenna 213 is connected when the connector 253 connects with the commutator 271 whereby the relay 219 is energized. The biasing springs 273 operate to connect the E-W signal antenna 215 when the relay 219 is not energized. A pair of commutators 275 are arranged to disconnect the relay 243 for a brief moment before the normal amber or "caution" signal 267 is flashed. The ratchet connec-

tions 247, 251 are arranged so that either of the two motors 221, 245 may be operated without interfering with each other. A warning bell 246 may be included to give out warning signals whenever the automatic remote control is functioning.

The operation of the third system is as follows: With the connector 253 in the position shown, the east-west light 259 is red, and the north-south light 261 is green. The E—W signal antenna is in operative connection. If a vehicle bound east-west with the transmitter of Fig. 5 is approaching the red or stop signal, the waves from the transmitter will operate the receiver to thereby close the contact 231 of relay 229 as shown. The contact 241 of the relay 243 is likewise closed and therefore power will be applied to the high speed motor 245 which will quickly turn the connector 253 to just before the amber signal commutator 275 position where the high speed motor relay 243 will be energized to stop the motor; at the same time the N—S signal antenna 213 will be connected. This will shut off the received signal and contact 233 of relay 229 will be completed to restore to normal control the slow speed motor 221 which will operate the east-west green signal to permit the vehicle to pass.

Had the east-west signal been on green, the connector 253 would have been on the commutators 257 and 271 which establish connections to the east-west green light 263, and the connection to the two position relay 219. This relay 219 would disconnect the E—W signal antenna 215 so that the remote control transmitter approaching on the east-west course would have no effect on the signal which is already green and in the desired "go" position. The normal low speed motor control 221 would turn the connector 253, continuing the east-west signal light 263. At the instant when the connector 253 leaves the commutator 271 the E—W signal antenna 215 will be connected, the signals will disconnect the low speed motor 221 but the high speed motor 245 will be prevented from operating because relay 243 will be energized by the connector 253 completing contact with one of the small commutators 275.

Thus it may be seen that the third system provides means for remotely and automatically speeding up the operation of a traffic signal which is set "red" or "stop" with respect to an approaching vehicle. Through suitable means the same traffic signal, if set "green" or "go" with respect to the approaching vehicle, may be held on "green" by the same automatic remote control until the vehicle has passed the signal light. While I have only described the operation of the third system for vehicles on east-west courses, it should be understood that the operation is similar for north-south traffic control. If two vehicles are approaching from east-west and north-south directions, and each is equipped with automatic control, the vehicle which is approaching on the "green" or "go" signal will maintain control and the other vehicle will be confronted with the "stop" or "red" signal light.

While I prefer to operate the signal lights to show red and green in the conventional manner and speed up or delay such lights by automatic or manual remote control, there may be instances when it is preferable to turn the signal to display red lights for both north-south and east-west bound traffic. Slight modifications in the receiver connections of the several systems may be made to accomplish such type of remote con-

trol. By way of example, Fig. 7 shows a modification of the receiver used in the first system whereby the traffic signals are remotely operated to the "stop" or red light positions for traffic bound both north-south and east-west.

In Fig. 7 an antenna 301 is coupled to a radio frequency amplifier 303 which is in turn coupled to a demodulator and a low frequency amplifier 305. A pair of filters 307, 309 designed to respectively pass modulation frequencies A, B are connected in the output circuit of the low frequency amplifier. The outputs of the filters, respectively, include rectifiers 311, 313 and relays 315, 317.

The contacts 319, 321 of these relays are serially connected to include a local battery 323 and the energizing coil 325 of a three contact relay 327. The first contact 329 of this relay is in the common lead from the power supply 331 and light control box 333 to the amber 335 and green 337 lights. One red signal light 339 is through the second set of contacts 341 of the relay 327 to the power source 331. The other red signal light 343 is connected through the third set of contacts 345 of the relay 327 to the power source 331.

The operation of this receiver is as follows: A modulated wave from the transmitter is received, amplified, demodulated, and amplified. The amplified demodulated currents are passed through filters 307, 309 and rectifiers 311, 313 to close the relays 315, 317, as shown. The closing of relays 315, 317 completes the circuit through the coil 325 of the three contact relay 327. The two contacts 341, 345 of this relay connected to the red lights 339, 343 complete the circuits to energize the red lights. The other contact 329 opens, as shown, and breaks the circuits to the green 337 and amber 335 lights. After the remote control device has passed beyond the control area, normal automatic control is restored to the light control box 333 and its associated driving motor 347.

While I have described three systems for remote control of traffic signals from vehicles, my invention is not to be limited to any type of vehicle as the systems may be used by airplanes, vessels, or may in fact be carried by a traffic officer. Likewise, the system is not limited to the remote control of traffic signal lights but may be applied to semaphores, audible signals, guard gates, or the like. Although I prefer to operate the several systems with two or more modulation frequencies to assure freedom from unauthorized use, the several systems may be used without such double modulation provisions.

I claim as my invention:

1. A remote traffic-control system comprising means for signaling drivers of vehicles to proceed or stop their vehicles, a mobile transmitter including means for radiating radio frequency waves, means for modulating said waves with combinations of currents of different frequencies, means for varying said combinations, means for receiving and demodulating said waves, means for separately selecting said currents of different frequencies, means for separately rectifying said selected currents, and a plurality of separate means selectively responsive to said rectified currents to control said proceed or stop signals in accordance with said variations in said combinations.

2. A remote traffic-control system comprising means for signaling drivers of vehicles to stop, go, or proceed with caution, a mobile transmitter including means for radiating a radio frequency

wave, means for selectively modulating said wave with a plurality of different frequencies, means for receiving said wave, means for demodulating said wave, means for deriving a plurality of different currents from said different modulation frequencies, and means controlled by said different currents to selectively operate said stop, go and caution signals.

3. In a device of the character of claim 2, means for automatically controlling said stop, go, and caution signals when said remote control is not in operation.

4. A traffic-control signal comprising means for automatically signaling in prearranged sequences stop, go and caution signals, a remote radio frequency wave source, means for selectively impressing a plurality of different pairs of modulation signals on said wave, means for receiving and demodulating said wave, means controlled by said demodulated waves for temporarily interrupting said automatic control, and means controlled by currents derived from said different pairs of demodulated waves for selectively operating said stop, go, and caution signals.

5. A remote traffic signal control comprising means for automatically establishing in predetermined sequences stop and go signals, means for generating and radiating a polarized radio frequency carrier, means for modulating said carrier, selective means for receiving said modulated carrier and deriving currents from the modulation components thereof, and means controlled by said currents for delaying or advancing the automatic operation of said stop and go signals.

6. A remote signal control comprising means for automatically controlling the traffic at intersecting paths by alternate stop and go signals, means mounted on selected vehicles for generating and radiating a radio frequency wave, means for modulating said radio frequency wave, means for receiving said wave, means for deriving controlling currents from the modulation components thereof, means for receiving waves from a transmitter in the other of said paths, means for deriving controlling currents from the modulation component thereof, means operated by either one of said derived currents for automatically increasing the rate of the operation changing said signal from stop to go to allow said vehicle to proceed in said path, for automatically thereafter interrupting said alternate operation and maintaining said signal on go upon approach of a vehicle containing said radio frequency generator and radiator.

7. In a traffic signal system including means for the normal operation of stop and go signals, the method of providing a right of way for a selected vehicle which comprises radiating radio waves from said vehicle, selectively receiving said waves according to the orientation of said vehicle, obtaining demodulated currents from said waves, utilizing said current to speed up the normal operation of said light so as to give a go signal for said vehicle, and thereafter auto-

matically interrupting the normal operation of said light once a "go" signal has been established and until the control by said vehicle has been removed.

8. A traffic-control system which includes a traffic-signal mechanism disposed so as to provide traffic-regulating signals for intersecting traffic lanes, means normally operating said signal mechanism to allow the alternate flow of traffic in said lanes, and means selectively responsive to a radio control signal originating in a vehicle traversing one of said lanes for interrupting said normal operation of said signal mechanism during the application of said radio signals to said selectively responsive means.

9. A traffic-control system which includes a traffic-signal mechanism disposed so as to provide traffic-regulating signals for intersecting traffic lanes, means normally operating said mechanism to allow the alternate flow of traffic in said lanes, means selectively responsive to radio control signals originating in vehicles traversing one of said lanes, other means selectively responsive to radio control signals originating in vehicles traversing the other of said lanes, means operable by said responsive means for interrupting said normal operation of said signal mechanism during the reception of a radio signal from one of said vehicles, and means for conditioning said traffic signal during the interruption of said normal operation to allow the passage of traffic in the traffic lane which said one vehicle is traversing.

10. A traffic-control system which includes a traffic-signal mechanism disposed so as to provide traffic-regulating "stop" and "go" signals for intersecting traffic lanes, means normally operating said signal mechanism to allow the alternate flow of traffic in said lanes, means selectively responsive to a radio control signal originating in a vehicle traversing one of said lanes, means operable by said selectively responsive means for accelerating said normal operation to change a "stop" signal to a "go" signal in the traffic lane traversed by said vehicle, and means for interrupting said normal operation to maintain said "go" signal during the reception of said radio control signals.

11. A traffic-control system comprising signalling means adapted to control traffic in intersecting lanes, means including a switch actuated by a low-speed motor for automatically controlling the traffic at said intersection, a high-speed motor, means responsive to a signal for operably connecting said high-speed motor to and disconnecting said low-speed motor from said switch for temporarily speeding up the operation of said system to accelerate a predetermined condition, and means thereafter stopping said automatic control to maintain said predetermined condition during the application of said signal.

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