May 2, 1933. J. P. BUCKLEY 1,906,736

AIRWAY SYSTEM

Filed Sept. 17, 1929 2 Sheets-Sheet 1

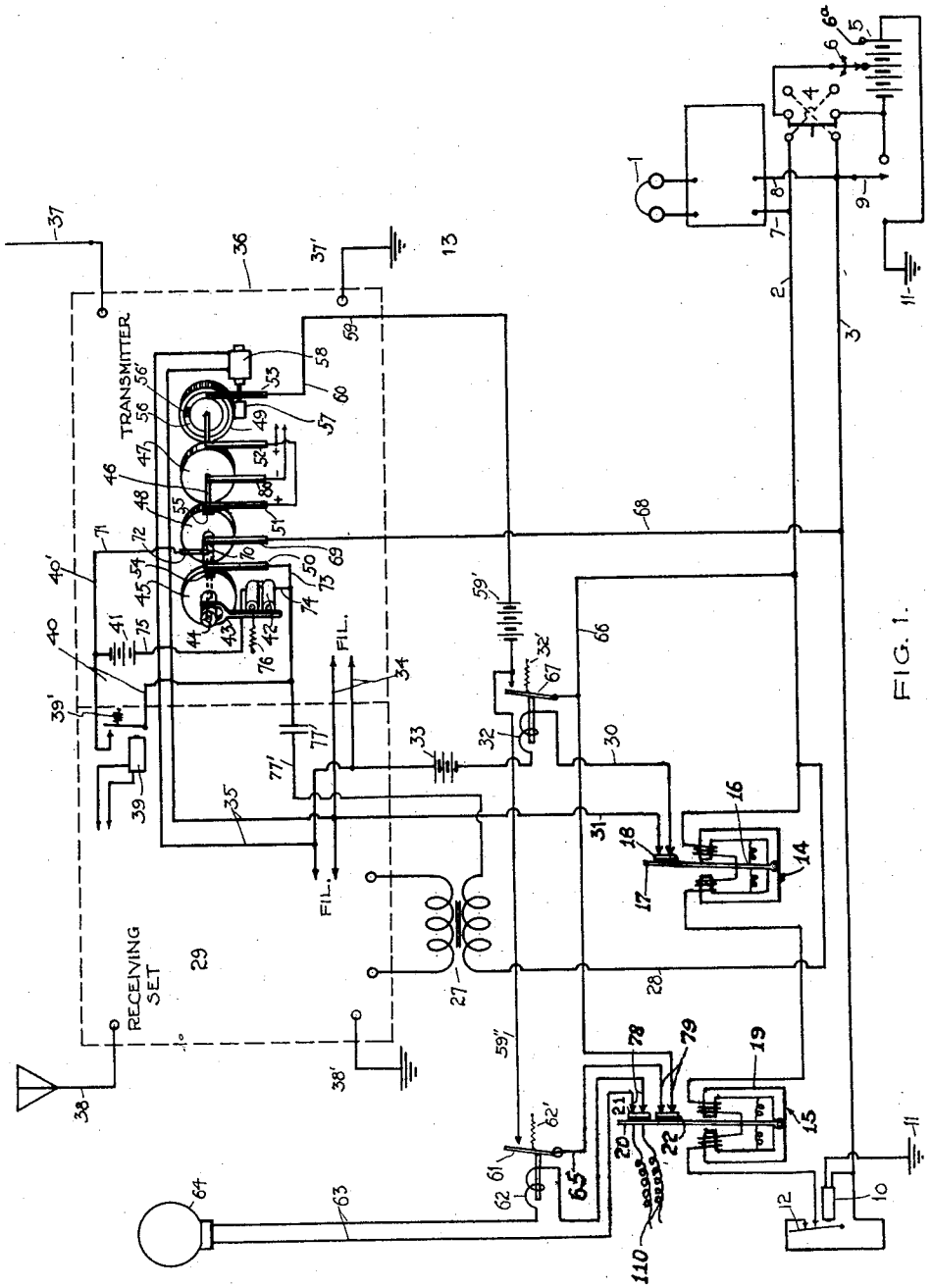

FIG. 1.

John P. Buckley
Inventor

May 2, 1933. J. P. BUCKLEY 1,906,736

AIRWAY SYSTEM

Filed Sept. 17, 1929 2 Sheets-Sheet 2

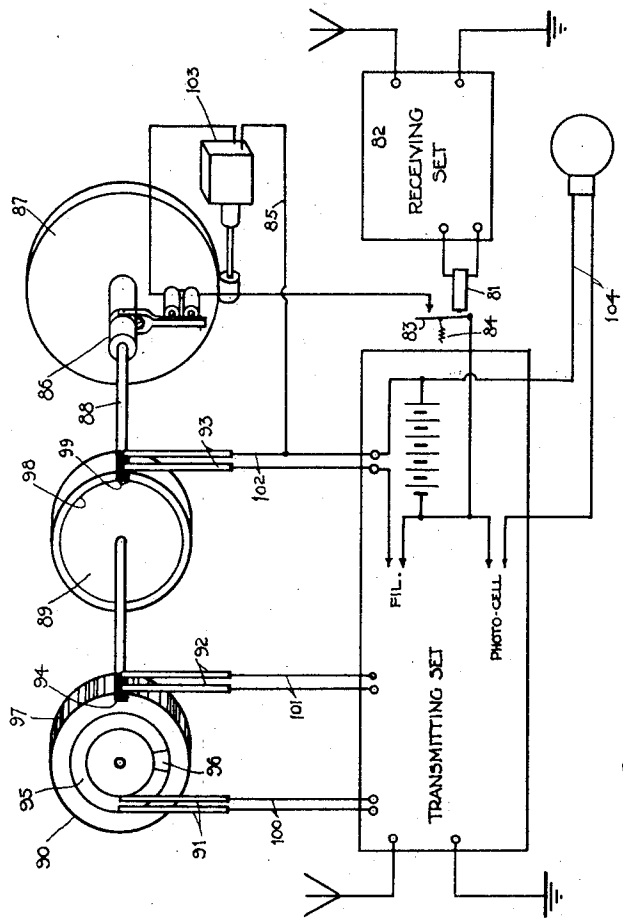

FIG. 2.

John P. Buckley
Inventor

Patented May 2, 1933 1,906,736

UNITED STATES PATENT OFFICE

JOHN P. BUCKLEY, OF WASHINGTON, DISTRICT OF COLUMBIA

AIRWAY SYSTEM

Application filed September 17, 1929. Serial No. 393,236.

This invention relates to airways such as are governed by radiobeacons.

Many such beacons are now being installed between cities for the purpose of providing an air course over which an aircraft may directly fly.

The radiobeacons are placed between predetermined points at fixed distances apart, such as for example, two hundred miles. To render the system more effective as well as to indicate emergency landing fields, marker beacons are placed at selected positions along the course such as every twenty-five miles along the system.

Such marker beacons, however, are under the supervision of one or more attendants, their reliability equaling only the amount of attention which may be given by the human element in such cases.

My invention simplifies the practice heretofore known and obviates the expense of attendance; assures a more reliable signaling system between the pilot and beacon; provides low-power transmission apparatus for long distance communication, particularly from an aircraft to a remote station, together with means for operating a danger signal when an aircraft has entered a predetermined zone, thereby creating an aerial block system, a signaling circuit for "burn-outs," and a remote control for the actuating members of the sets and beacon lights.

With these and other objects in view, the invention consists in the novel construction, arrangement and formation of parts as will be hereinafter more specially described, claimed and illustrated in the accompanying drawings, in which:

Fig. 1 is a plan view of the system showing the various controls of the farthest marker beacon along the airway.

Fig. 2 is a modification of the invention showing how an aircraft may automatically control the beacons instead of having the beacons controlled from a remote station as in Fig. 1.

The numeral 1 designates a telephone receiver in a remote station serving, in this instance, as one end of the electrical conductors 2 and 3, to which is connected the double-pole switch 4, which reversibly controls the current from batteries 5, when electrically connected to the battery by switch 6.

The leads 7 and 8, connect the receiver to the electrical conductors, while the switch 9, when turned to the right puts on a battery source over the conductor 3, relay 10, and ground return 11.

The armature 12, electrically closes a circuit through the electrical conductors 2 and 3 when the relay is energized.

The numeral 13 designates a marker beacon, in this instance, the farthest one of the system, showing the relationship of the beacon's circuit to the electrical conductors 2 and 3, in which the polarized relays 14 and 15, are in series with conductor 2. The armature 16, which is free to be drawn forwardly or backwardly, is connected with the switch arm 17. The upper portion carries a metallic plate 18 suitably insulated from switch arm 17.

The armature 19 is connected with switch arm 20, in like manner. Near the top of the arm 20 and fixed thereto are two metallic connecting blocks 21 and 22 suitably insulated from the arm 20 as indicated.

Fig. 1 shows the system on, the lighting circuit to beacon light 64 as controlled by arm 20, the filament circuits of the receiving, transmitting sets and the motor circuit, as controlled by arm 17, and the monitoring circuit for signaling "burn-outs," as controlled by relay 32 and 62; the springs 32′ and 62′ oppositely opposing the relays when energized.

The receiving set 29 is maintained continuously energized so that the relay 39 is continuously in condition for operation against the action of the spring 39′. The relay tongue is thus receptively poised, so that the signal of an aircraft, on entering the zone, will actuate the relay by an overbalance of the power of the spring in favor of the magnet, at which time the circuit 40, and subsequently the circuit 40′ becomes energized as the brush 50 is released from the insulation block 54. It is noted that the two circuits control the magnet and armature 42 and 43, which magnets are oppositely opposed by spring 76, and in turn the keyed clutch 44, which in meshing with its counterpart on disc 45,

causes the said disc together with the connecting sleeve 70 and its block signal disc 48, to revolve with the shaft 46, the circuit 40; composed of brush 72, wire 71, source 41, wires 74 and 75, brush 50, disc 45, and sleeve 70, shorting the circuit 40, continues to hold the block signal on until one revolution will have taken place, when the insulation block will have again turned under the brush 50. During this interval the aircraft will have gained the far side of the zone releasing the relay 39 for a subsequent signaling impulse.

The secondary circuit of the transformer 27 is identified on one side by wire 28, which loops around the coil and connects with the conductor 2, returning from the receivers 1, by way of conductor 3, and upwardly over wire 68, to brush 69, thence over sleeve 70 to disc 45, and brush 50, thence to wire 73, condenser 77 and to the coil by wire 77′.

Connecting the filament circuits of the receiving and transmitting sets and the motor circuit are the two wires 30 and 31, in which there is disposed in series the relay 32 and the source 33. The motor circuit completes itself through the motor 58, as shown, while the filament circuits are broken off as at point marked "Fil.", the transmitter filament leads being identified by numeral 34.

The shaft 46, also supports the disc 47, and the gear 49, the disc having the code letter identifying the station on its periphery while the gear meshing with worm-gear 57 of the motor 58 is provided with a metallic ring 56, broken on top by a signal letter 56′ in such a way as to interrupt the monitoring circuit when energized.

The monitoring circuit, controlled by the relays 32 and 62, is completed by the wires 68, brush 69, sleeve 70, shaft 46, disc 49, ring 56, and signal letter 56′, brush 53, wires 60, and 59, source 59′, wire 59″, armature 61, wire 65, plate 22, wire 66, contacting with the base of armature 67 and thence to conductor 2, to receiver 1, and return over conductor 3, to wire 68.

The circuit to beacon light 64 is shown as controlled by arm 20, through source 110, with terminals 21, engaging the set's stationary contacts 78 and 79, from which point the wires 63 connect with the lamp 64.

To operate the light circuit a greater voltage is required to move the armature 19 than that used for the armature 16; this is accomplished by moving the switch 6 of the remote control station to the tap 6*a* of the batteries. When "Off" as during daytime, the arm also breaks the relay circuit of the monitoring system which only operates when the light is energized.

The antennæ 37 and 38, and the grounds 37′ and 38′ of the transmitter 36, and the receiver 29, are of the usual design. In practice, to energize the system the switch 9 of the remote control station is thrown to the right. This movement completes the relay circuit composed of conductor 3 and the ground return 11. The armature of the relay having established a metallic bridge across the two conductors at their farthest end, the double-pole switch 4 may now be thrown forwardly to energize the polarized relay 14. This action is for the purpose of controlling the filaments and motor control as shown.

In series with one wire, there is a relay which becomes normally closed when the filaments and motor circuits are on.

Should it be evening time when the beacon light must be lighted, the double-pole switch is again thrown forwardly and while so held the switch 6 may be moved over the taps which contact with the batteries for higher voltage, which alone may cause the armature 19 to throw its arm. The light service also has a relay in its circuit which is normally closed when the light is energized.

The purpose of the relay together with the relay of the filament circuit is to provide signaling means through an electric source which automatically is held open when the service is "On" and closed when the service fails to function. In the case of the light circuit, as during the daytime, provision is made to prevent the signal from traversing that particular block by having the arm break the circuit on breaking the light service.

The monitoring circuit controlled by the two relays is provided with a signal letter for identifying that particular beacon indicated by numeral 56′ on disc 49, the brush 69 providing a return circuit to the source through the shaft. The shaft also supports loosely two discs bound together by a sleeve and revolvably controlled by an electromagnetic clutch which in turn is controlled by a relay of the receiving set. The circuit energizing the electromagnetic clutch is put on when the relay overpowers its spring on becoming fully sensitized by an aircraft's signal. An auxiliary circuit shown as 40′ is provided to short the relay circuit through the electromagnetic clutch until one complete revolution of the shaft will have taken place, by which time the aircraft will have gained the farthest side of the zone, when the whole will again resume its normal condition, that is, receptively for another aircraft's signal.

It will be seen that the beacon's letter is normally broadcasted and so spaced by interval of time as to be followed by a series of dots when the clutch is closed by the passage of an aircraft, which dots and dashes continue to be broadcast by the transmitter until a resetting takes place, when without disturbing the beacon's letter, the block signaling dots will cease as the brush encounters the insulation block.

During this time of the block signal, the pilot in the aircraft may switch over from

the "signal" notch and communicate with the remote station through the receiving set via the conductors.

Fig. 2 is a modified form of the invention wherein an aircraft in flying over a beacon course, through its own signal, may automatically switch on a marker beacon. This is accomplished similarly, as shown in Fig. 1. The relay 81 becomes energized through the receiver 82, causing the armature 83, held backwardly by spring 84, to close the circuit 85, controlling the electromagnetic clutch 86, the companion part of the clutch forming a part of gear 87, which is mounted on shaft 88, supporting the discs 89 and 90. Contacting therewith, as shown, are brushes 91, 92 and 93.

The metallic disc 90 is provided with an insulation block 94, and an insulation ring 95 with a segmentary metallic piece 96 on the ring. On the periphery of the disc, dots and dashes 97 representing the beacon's letter, are successively placed in order.

The insulation disc 89 has a metallic band 98, broken as at points 99. The transmitter is provided with a multiplicity of power amplifying stages which may be rendered effective in varying degrees to control the transmission range. The circuit 100 leads to a portion of the transmitting set, which when connected to the main portion of the set transmits the signal much farther away by employing a larger number of the power amplifier stages. This is done momentarily when the metallic piece 96 contacts with the brushes 91 in the course of one revolution of the shaft 88. The circuit 101 serves to make and break the current into dots and dashes. The circuit 102 represents the filament control, while circuit 85 controls the motor 103, and the electromagnetic clutch 86, through the relay 81.

The wires 104 lead to the transmitting set and connect with a photo-cell circuit, by which means the lamp circuit is completed when tripped by the photo-cell, as during dark hours. The operator in the home office desiring to start the system which may be composed of one or more stations along an airway closes switch 9. This action energizes magnet 10 through battery 5, inductor 3, and ground return 11. The armature 12, having closed the circuit of wires 2 and 3, the double pole switch 4 may now be thrown forward. At this instant all of the polarized relays 14 along the line become energized, closing the circuits controlling the receiving and transmitting sets including the motor by closing of contacts at 18. The filaments of the two sets are now "On" and the motor being energized, the station's letter is broadcasted continuously until an airplane enters its zone when the signals in the form of long dashes from the airplane will actuate the receiving set 29, and in turn the relay 39, thereby closing the circuit 40 controlling the magnet 42. This action couples the metallic disc 45, its cylindrical shaft 70, and the block signal disc 48 revolvably supported on shaft 46 which is controlled by motor 58 to broadcast a series of dots during the silent short period of the broadcasting of the station's letter; that is, alternately, as the discs complete one revolution. This action also closes the receiving set circuit through conductor 2, wire 28, transformer 27, wire 77', condenser 77, wire 73, brush 50, disc 45, cylindrical shaft 70, brush 69, wire 68, and conductor 3, then to the home station until the insulation block 54 is encountered completing one revolution under control of circuit 40'.

The relays 32 and 62 control a tell tale circuit to the home office when the radio sets or light system have been made incomplete by burn outs, etc. To place the light system on, the switch 6 is operated at the home office. This produces a greater current over the conductors to operate polarized relay 15. To turn the system off, reverse switch 4 and polarized relays 14 and 15 are both restored to normal position. The station's letter and the block signals are transmitted on the same frequency, different from that of the telegraphic code signals and speech.

In the modified system shown in Fig. 2, the receiving set 82 is continuously or intermittently on under clock control. The aircraft on entering the zone energizes receiving set 82 and through its relay 81 closes the circuit 85 controlling the motor. The circuit 102 is then put on as the metallic disc revolves. At the same time, the circuit 101, broadcasts its letter and incidentally the position of the beacon. During the revolution of the shaft 88, a stronger circuit is momentarily put on by contacts 96, strong enough to signal the home office that the aircraft is now passing over its zone, to again resume its directional signal until the motor and clutch circuit is broken by space or insulation block 99 of disc 89.

Having thus described the invention what I claim as new and desire to be secured by Letters Patent is:

1. An airway illuminating and radio system comprising in combination with a beacon station including a transmitter and receiver, illuminating means, a source of power, a remote station, a line wire circuit connecting said remote station and said beacon station, a plurality of relays connected in said line wire circuit, one of said relays operating to control the energization of said illuminating means from said source of power, and another of said relays operating to control the energization of said transmitter and receiver, means at said remote station for observing signaling energy incident upon said receiver and transmitted over said line wire circuit, and means at said remote station for

selectively actuating said relays for independently controlling the energization of said illuminating means or the energization of said transmitter and receiver.

2. An airway illuminating and radio system comprising in combination with a beacon station including a transmitter and receiver, illuminating means, a source of power, a remote station, a line wire circuit extending between said remote station and said beacon station, signal observing means connected with said line wire circuit at said remote station, a plurality of relays connected in said line wire circuit, said relays being selectively responsive to energy transmitted over said line wire circuit from said remote station, one of said relays operating to control the energization of said transmitter and receiver, and another of said relays operating to control the energization of said illuminating means independently of the transmission of signaling energy from the receiver at said beacon station to said remote station.

3. An airway illumination and radio beacon system comprising a lighting device, a source of power for energizing said lighting device, a relay having contacts adapted to open or close the circuit between said source of power and said lighting device. a radio beacon unit including a transmitter and receiver, a power source for energizing the power circuits of said radio transmitter and receiver, a relay for completing or interrupting the circuit between said last mentioned power source and the power circuits of said transmitter and receiver, a remote control station, a line wire circuit extending between said remote control station, said lighting device and said radio beacon station, signal observing means at said remote control station connected with said line wire circuit, connections between said line wire circuit and the output of said receiving apparatus at said beacon station, and means connected with said line wire circuit and actuated from said remote control station for controlling the energization of said lighting device from said first mentioned power source and controlling the energization of said transmitter and receiving apparatus from said second mentioned power source.

4. An airway illuminating and radio beacon system comprising a lighting device, a radio beacon station including transmitting and receiving apparatus, a remote station, a line wire circuit extending between said remote station, said radio beacon station and said lighting device, and means controlled from said remote station for rendering said lighting device operative or inoperative, and separate means controlled from said remote station for controlling the operation of said transmitting and receiving apparatus at said beacon station.

5. An airway illuminating and radio beacon system comprising a lighting device and a radio transmitter and receiver, a remote control station, a line wire circuit interconnecting said remote control station, said lighting device and said radio beacon station, and relays individual to said lighting device and said radio beacon station and connected with the line wire circuit, said relays being selectively controllable from said remote station for governing the operation of said lighting device and said transmitting and receiving apparatus.

6. An airway illuminating and radio beacon system comprising a lighting device, a source of potential for energizing said lighting device, a circuit controller connecting said source of potential with said lighting device, a radio beacon station including a transmitter and receiver, power circuits for said transmitter and receiver, a source of potential for energizing said power circuits, a circuit controller for disconnecting said last mentioned source of potential with the power circuits of said transmitter and receiver, a line wire circuit, a remote control station connected with said line wire circuit, connections between said line wire circuit and each of said circuit controllers, and means at said remote control station for selectively controlling the operation of said circuit controllers for the independent energization of said lighting device and the energization of said transmitting and receiving apparatus.

7. An airway system comprising a beacon station including radio receiving and transmitting apparatus, an illuminating system, a source of power, a remote station, a line wire system interconnecting said beacon station and said remote station for controlling the said receiving and transmitting means from said remote station, a signal observing means at said remote station operative by signal current transmitted over said line wire system from said radio receiving apparatus, means at said remote station for controlling the operation of said radio receiving and transmitting apparatus and separate means controlled from said remote station for controlling the connection of said source of power with said illuminating system.

8. An airway system comprising a beacon station including a radio receiving and transmitting apparatus, illuminating means, a source of potential for energizing said illuminating means, a remote station, an electrical circuit extending between said remote station, said illuminating means and said beacon station, connections between said electrical circuit and said receiving apparatus at said beacon station, signal observing means connected with said electrical circuit at said remote station, a source of potential at said remote station, means for selectively transmitting energy of selected polarity from said remote station to said beacon station over said

electrical circuit and separate relays connected in said electrical circuit and selectively operative by the energy thus transmitted for controlling the connection betwen said source of potential and said illuminating means and for independently controlling the operation of said radio receiving and transmitting apparatus.

9. An airway system comprising a beacon station including radio receiving and transmitting apparatus, illuminating means, a source of potential for energizing said illuminating means, a remote station, an electrical circuit extending between said remote station, said illuminating means and said beacon station, means at said remote station for controlling the polarity of the circuit through said electrical circuit, a plurality of relays responsive to current pulses of different polarity transmitted over said electrical circuit for selectively actuating said relays, electromagnetic controls operated by said relays, means operated by one of said controls for conditioning said transmitting and receiving apparatus, means operated by another of said controls for controlling the connection between said source and said illuminating means according to the polarity of the pulses transmitted over said electrical circuit.

In testimony whereof he affixes his signature.

JOHN P. BUCKLEY.