

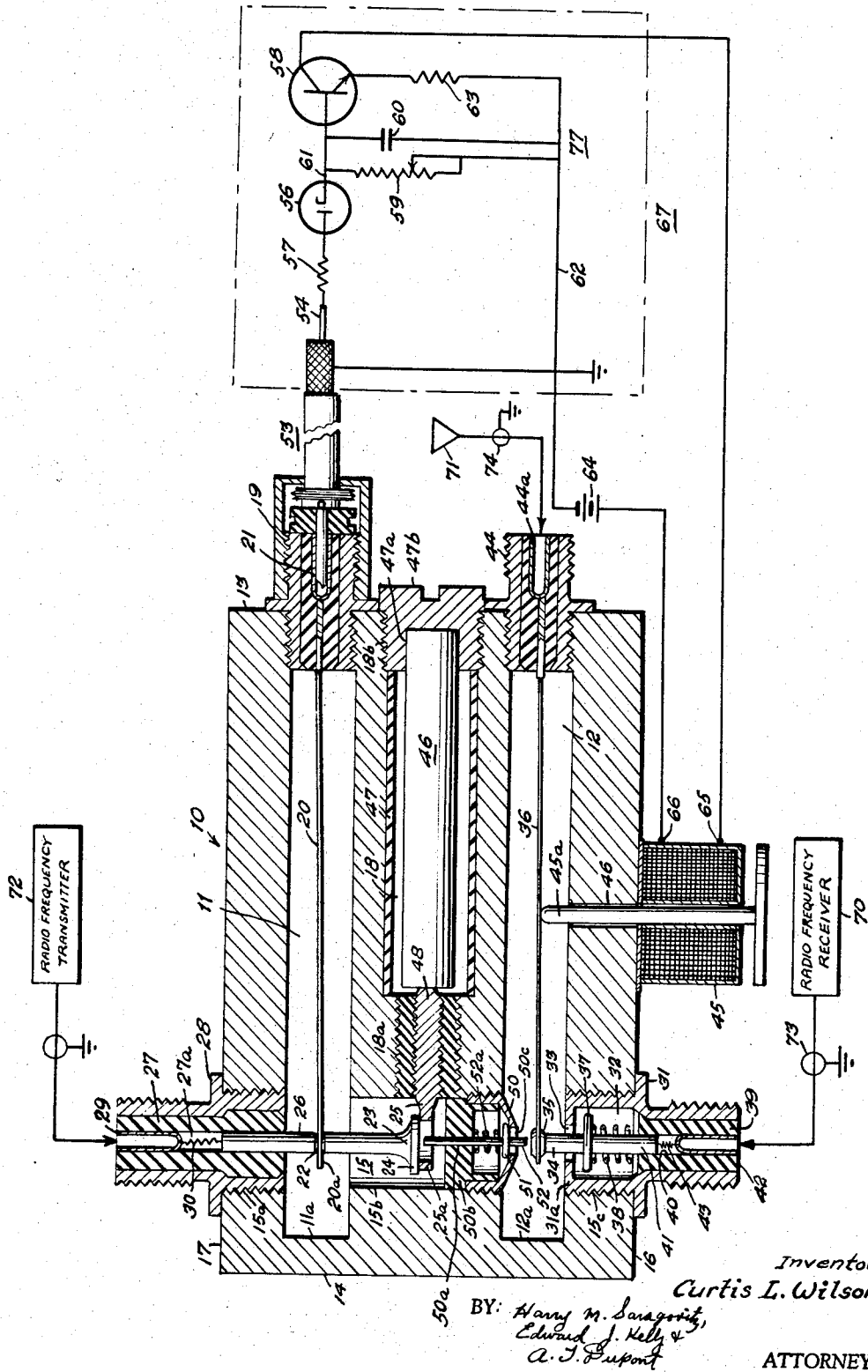
March 12, 1968

C. L. WILSON

3,373,360

AUTOMATIC COAXIAL SWITCH

Filed Jan. 27, 1966



1

3,373,360

**AUTOMATIC COAXIAL SWITCH**  
Curtis L. Wilson, 3103 Elizabeth, Space 25,  
Pueblo, Colo. 81003  
Filed Jan. 27, 1966, Ser. No. 523,476  
3 Claims. (Cl. 325-22)

This invention relates to coaxial type of switch and more particularly to an automatic coaxial switch for automatically switching an antenna or antenna feed line from a radio receiver to a radio transmitter and vice versa.

An object of the invention is an automatic transmit-receive coaxial switch which completely isolates the radio receiver from radio frequency energy generated by the radio transmitter.

Another object of the invention is an automatic transmit-receive switch including adjustable time delay means.

A further object of the invention is an automatic transmit-receive switch having adjustable time delay means and means therein whereby a dummy load is placed across the output of the transmitter during switch transient period.

A still further object of the invention is an automatic transmit-receive switch operable by circuit means in response to radio frequency energy generated by the radio transmitter.

The specific nature of the invention as well as other objects and advantages thereof will clearly appear from the following description and accompanying drawing in which the sole figure is a longitudinal sectional view of the invention in conjunction with a schematic diagram of the control circuit forming a part thereof.

Referring now to the drawing, the housing 10 may consist of a block of aluminum provided with spaced bores 11 and 12 along the longitudinal axis of housing 10 and extending from the front surface 13 to approximately the rear surface 14 of the housing 10. A transverse bore 15 extends from side surface 16 to the opposite side surface 17 of housing 10 and intersects bores 11 and 12 adjacent their closed end 11a and 12a forming bores 15a, 15b and 15c. Intermediate bores 11 and 12 there is formed bore 18 having a reduced threaded portion 18a opening on bore 15b and a threaded portion 18b inwardly of the front surface 13.

Coaxial connector 19 which is inserted in the open end of bore 11 is provided with a spring reed 20 having one end connected to the center contact 21 of connector 19 and its other end formed with a fork 20a in engagement with groove 22 of plunger 23. Spring reed 20 is tensioned so that it urges the head 24 of plunger 23 in bore 15b towards the longitudinal center of housing 10 and in contact with a connector member 25. The stem 26 of plunger 23 is slidable in the bore 27a formed in the insulator 27 of coaxial connector 28 which is in threaded engagement with bore 15a. The stem 26 is connected to the center contact 29 of coaxial connector 28 by means of flexible conductor 30. A coaxial connector 31 comprising the radio receiver 70 input means, positioned in bore 15c is formed with a chamber 32, the end wall 31a of which is perforated as at 33 through which one end of a plunger 34 extends into bore 12 and is normally in contact with a contact 35 formed on the free end of spring reed 36. The plunger 34 is provided with a flange 37. A bias spring 38 is positioned around the plunger in chamber 32 between flange 37 and the insulation 39 urges the plunger 34 into bore 12 and seals the coaxial connector 31 against radio frequency energy when flange 37 is pressed against the wall 31a or in other words, the radio receiver 70 input means 31 is shorted to ground. The plunger 34 is slidable in the bore 40 formed in insulation 39 and has its end 41 connected to center con-

2

tact 42 by means of flexible connector 43. Spring reed 36 is stressed so that its free end to which contact 35 is affixed asserts a force against plunger 34 in opposition to the force exerted by spring 38 against the flange 37 of plunger 34 whereby the antenna 71 is connected to the radio receiver to the exclusion of the radio transmitter 72 as will be subsequently described. The opposite end of spring reed 36 is fixed in the insulation of coaxial connector 44 and in electrical contact with the center contact 44a thereof. The coaxial connector 44 may be affixed in the open end of bore 12 in any well known manner. A plunger solenoid 45 is fastened to side surface 16 of housing 10 and has its plunger 45a extending through bore 46 in the housing into bore 12 and in contact with spring reed 36. The bore 18 has positioned therein a termination resistor 46 between a cap 47b which is threaded into the bore 18 from front surface 13 and recessed as at 47a to receive one end of said load resistor. An insulating sleeve 47 in bore 18 prevents the resistor from shorting against the walls of bore 18. An insulator 48 which is threaded into the reduced portion 18a of bore 18 has a centrally disposed contact member 25 formed therein with one end in contact with the opposite end of the load resistor and the other end formed into a ring member 25a disposed along the centerline of plunger 26 and in contact with the head 24 of said plunger when the switch is in receive or normal position. A threaded cup member 50 provided with an insulated plug closure 50b having a centrally located perforation 50a formed therein has a perforation 50c in its bottom wall in alignment with perforation 50a and plungers 34 and 26. The bottom of cup 50 extends into bore 12 and in combination with flange 51 of the spring loaded plunger 52 which is slidably fixed in perforations 50a and 50c forms a radio frequency shield between the receiver input and transmitter input coaxial connectors 31 and 28, respectively, when the switch is in the normal or receive position. One end of plunger 52 extends into bore 12 for cooperation with reed spring 36 and the opposite end into the ring member 25a for cooperation with plunger 26.

A control circuit 67 which is operable in response to the radio frequency energy generated by radio transmitter 72 coupled to coaxial connector 28 to switch the automatic transmit-receive switch from receiver position to the transmit position has its input coupled to coaxial connector 19 by means of a coaxial cable as generally indicated by reference number 53. The center conductor 54 of the coaxial cable is connected to the anode of the diode rectifier 56 through current limiting resistor 57 and the cathode of diode 56 is connected to the base electrode of transistor 58 by means of conductor 61. An RC timing network formed by the parallel connected variable resistor 59 and capacitor 60 is connected from conductor 61 to the common circuit 62. Stabilizing resistor 63 connects the emitter electrode of transistor 58 to common circuit 62. The metallic shield member of cable 55 and one pole of potential source 64 are also connected to the common circuit. The collector electrode of transistor 58 is coupled to terminal 65 of plunger-solenoid 45. The other terminal 66 of plunger-solenoid 45 being connected to another pole of potential source 64.

By referring to the drawings it can be seen that the automatic transmit-receive switch of the invention is in the receive or normal position. The coaxial feeder cable 74 couples, by means of a coaxial plug not shown, the antenna 71 to coaxial connector 44 and the radio frequency receiver 70 is coupled by means of coaxial cable 73 to coaxial connector 31 in the same manner. The radio frequency transmitter 72 is coupled to coaxial connector 28 in a similar manner. In the receive position of the switch, contact 35 of spring reed 36 is in contact

with the spring loaded plunger 34 whereby the antenna is connected to the receiver to the exclusion of the radio frequency transmitter 72. Spring loaded plunger 52 is normally urged in a direction towards the contact 35 and in the receive position its flange 51 is in contact with the inside surface of cup 50 to form a radio frequency shield to shield the receiver from the radio frequency energy generated by the transmitter. Plunger 52 remains in this position until the receiver input is shorted to ground by flange 37 of plunger 34 during the switch over to transmit position. When the transmitter is energized and its output is coupled by means of coaxial cable 75 to coaxial connector 28 to reed 20 and coaxial connector 19 through plunger 23 and thence to control circuit 67 through coaxial cable 53. At the same time the transmitter's output is applied across termination resistor 46 until plunger solenoid 45 functions in response to collector current of transistor 58 in accordance with the time delay of the RC circuit consisting of variable resistor 59 and capacitor 60. The radio frequency energy of the transmitter is applied through coaxial cable 53 or other well known means to diode rectifier 56 through current limiting resistor 57. The rectified output of diode 56 charges capacitor 60 of the RC network 77 connected from the base electrode to the emitter resistor 63 of transistor 58. The capacitor output is applied to said base electrode, causing the transistor 58 to conduct whereby the collector current thereof flows through the winding of plunger-solenoid 45 which in response thereto pushes spring reed 36 away from plunger 34 and into contact with plunger 52 causing it to push plunger 52 through ring member 25a and to engage plunger 23 thereby connecting the antenna through spring reed 36 and plunger 23 to the radio transmitter. The plunger 52 continues to move under the force applied to it by plunger-solenoid 45 through spring reed 36 and pushes plunger 23 out of contact with ring member 25a whereupon termination resistor 46 is disconnected from the radio transmitter. When spring reed 36 engages plunger 52, it is disengaged from plunger 34 permitting spring 38 to urge plunger 34 further into longitudinal bore 12 until flange 37 contacts wall 31a whereby the receiver input is shorted to ground and protected from the radio frequency energy generated by the radio transmitter.

Although a specific embodiment of the invention has been illustrated and described, it will be understood that this is but illustrative and that various modifications may be made therein without departing from the spirit of the invention and the scope of the appended claims.

#### I claim:

1. An automatic coaxial transmit-receive switch comprising in combination a rectangular metal block provided with first and second spaced longitudinal bores extending from the front surface of said block to approximately the rear surface of said block, a transverse bore formed in said block adjacent the closed ends of and intersecting said first and second longitudinal bores and extending from one side of said block to the opposite side of said block; a first coaxial connector affixed in said transverse bore for coupling a radio receiver to said switch, said first coaxial connector formed with a housing comprising a base member extending from said one side to said first longitudinal bore, a spring loaded plunger slidably mounted in said first coaxial connector and provided with a flange member for contacting the inside surface of said housing whereby the input of said radio receiver is shorted to ground when said switch is in the transmit position, said plunger having one end connected to the center contact means of said first coaxial connector by flexible conductor means and extending through a perforation in the base of said housing into said first longitudinal bore; a second coaxial connector for coupling a radio transmitter to said switch affixed in said transverse bore with its base member extending from said opposite side to said second longitudinal bore, a plunger slidably

mounted in said second coaxial connector having one end connected to the center contact means of said second coaxial connector, said plunger passing through said second longitudinal bore and terminating in the transverse bore between said first and second longitudinal bores, a circumferential groove formed in that portion of said plunger in the said second longitudinal bore; a third coaxial connector affixed in the open end of said second longitudinal bore, a spring reed positioned in said second longitudinal bore, said spring reed having one end affixed in said third coaxial connector and in contact with the center contact means thereof, the opposite end of said spring reed being split and in engagement with said circumferential groove, said spring reed being stressed to normally urge said plunger into the portion of said transverse bore between said first and second longitudinal bores; a cup member formed with a centrally perforated bottom wall extending into said first longitudinal bore and opposite the housing of said first coaxial connector, said cup member having an insulated closure with a central bore, a second spring loaded plunger slidably mounted in the central bore of said closure having one end extending into said transverse bore in alignment with said plunger and its opposite end extending into said first longitudinal bore in alignment with said first spring loaded plunger, a flange formed on the portion of said second spring loaded plunger within said cup member being normally urged against the inside surface of said bottom providing a closure for the perforation in said bottom wall; a fourth coaxial connector affixed in the open end of said first longitudinal bore for connecting an antenna thereto, a second spring reed positioned in said first longitudinal bore having one end affixed in said fourth coaxial connector and in contact with the center contact means thereof and its opposite end provided with contact means in alignment with said first and second spring loaded plungers, said second spring reed stressed so that its contact means normally engages said first spring loaded plunger, a plunger-solenoid affixed to said one side of said housing, a bore in said housing extending from said one side to said first longitudinal bore through which the plunger of said plunger-solenoid passes for cooperation with said second spring reed, and means in said switch providing a resistance load for said radio transmitter until after the antenna has been switched to said radio transmitter.

2. The invention in accordance with claim 1 wherein said last mentioned means comprises in combination; a resistor in a bore in said block lined with insulation, said bore being intermediate and parallel to said first and second longitudinal bores and extending from said front surface to that portion of the transverse bore intermediate said first and second longitudinal bores, a screw cap closure in threaded engagement with said bore at said front surface having a recess therein in which is inserted one end of said resistor grounding said end to said block, an insulated plug affixed in said bore adjacent said transverse bore provided with a conductor member extending therethrough, one end of said conductor member being in contact with ungrounded end of said resistor, the other end of said conductor member termination in a ring in alignment with and normally in contact with said plunger in the transverse bore, and electronic circuit control means coupling said third coaxial connector with the winding of said plunger solenoid whereby said transmit-receive switch switches to transmit position when energized by said radio transmitter.

3. The invention in accordance with claim 2 wherein said electronic circuit control means comprises in combination; a rectifier having anode and cathode elements, a current limiting resistor, coaxial cable means connecting said second spring reed to said anode element through said current limiting resistor whereby radio frequency energy generated by said radio transmitter is applied to the anode element of said rectifier, a current amplifier

5

having base, emitter and collector electrodes, a potential source, an emitter resistance means connected to said emitter electrode, said potential source and the winding of said plunger-solenoid in series connection between said collector electrode and said emitter resistance means, conductor means coupling said cathode element and said base electrode, and an RC variable time network consisting of a parallel connected variable resistor and capacitor connected from said conductor means to the emitter resistance means, said capacitor being charged by the rectified output of said rectifier whereby a potential is applied in accordance with a predetermined time to said base electrode causing said transistor to conduct heavily

5

10

6

to energize said plunger-solenoid thereby placing said transmit-receive switch in transmit position.

#### References Cited

#### UNITED STATES PATENTS

|           |        |         |       |           |
|-----------|--------|---------|-------|-----------|
| 2,999,153 | 9/1961 | Neumann | ----- | 325—22    |
| 3,092,771 | 6/1963 | Cohn    | ----- | 325—24    |
| 3,194,921 | 7/1965 | Watts   | ----- | 200—153 X |

ROBERT L. GRIFFIN, *Primary Examiner.*

B. V. SAFOUREK, *Assistant Examiner.*