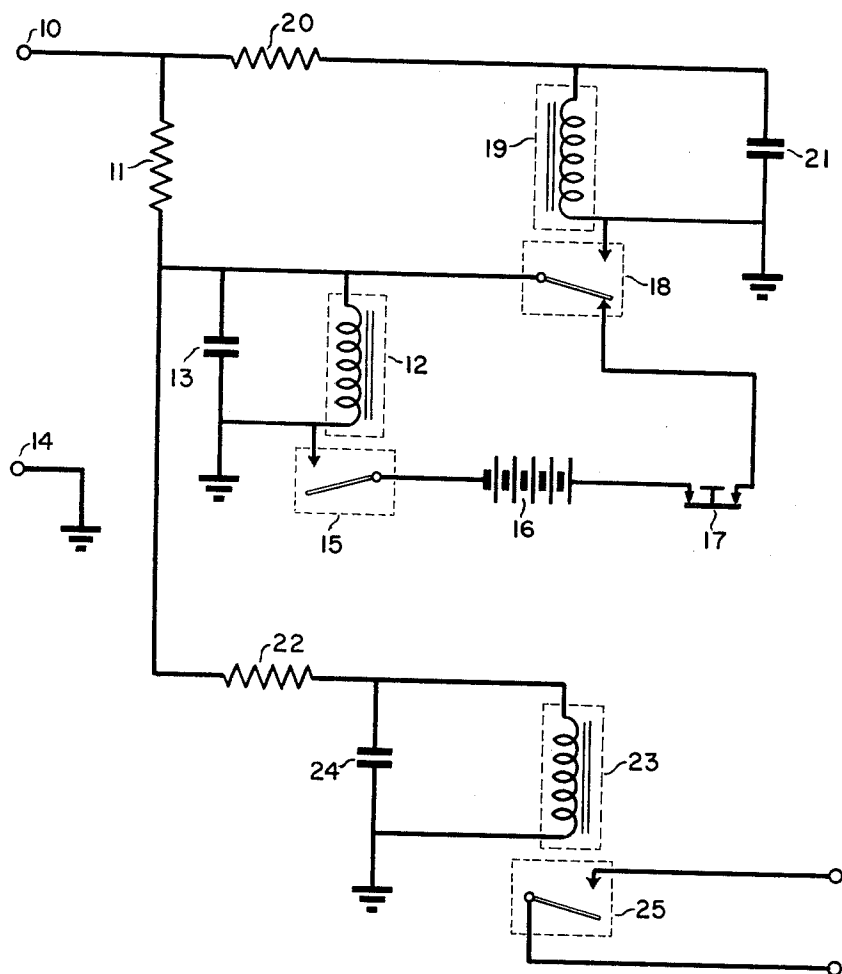


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J. P. SHANKLIN
PULSE LENGTH MEASUREMENT

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Inventor

JOHN P. SHANKLIN

By *Robert T. Tillman*
Attorney

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PULSE LENGTH MEASUREMENT

John P. Shanklin, Baltimore, Md., assignor to
Bendix Aviation Corporation, Towson, Md., a
corporation of Delaware

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This invention is directed to electrical relays. More specifically it is directed to relays responding only to pulses of electrical energy having a preselected width or duration.

In selective calling systems, wherein it is desired to energize one of a plurality of circuits from a remote point over a single communications channel, several arrangements are known. In one of these systems, frequency selective filters at the receiving terminal actuate the circuit corresponding to the frequency of the received energy. Another general class of selective calling system is that used in the dial telephone system wherein the transmitter produces a series of short electrical pulses, and a stepping circuit at the receiving end counts the pulses, and actuates the circuit corresponding to the number of pulses received.

It is an object of this invention to provide a selective calling system wherein selection is made on the basis of pulse duration rather than pulse count as in the telephone system. It will be manifest that the instant invention may be used either to multiply the number of channels available in either the "frequency selective" or the "counting" systems, or alone as a simple poly-channel arrangement.

This object is attained by the use of a plurality of relays and time-delay circuits wherein a first relay is energized when it receives a pulse having greater duration than a predetermined minimum, and a second relay prevents the first from operating if the pulse has greater duration than a predetermined maximum.

Other and further objects and advantages will more fully appear from the following detailed description when the same is read in connection with the accompanying drawing wherein there is illustrated a pulse-duration selective relay system in accordance with the instant invention.

Referring now to the accompanying drawing, there is illustrated an input terminal 10 connected through a resistor 11 to a terminal of a relay coil 12. A condenser 13 is connected in shunt with the coil 12, and the remaining terminal thereof is connected to ground. A second input terminal 14 is also connected to ground. The relay coil 12 is arranged, by virtue of a pair of normally-open contacts 15 to ground a terminal of a battery 16. The remaining terminal of the battery 16 is connected through a normally-closed switch 17 and through a pair of normally-closed contacts on a relay contact assembly 18 to the junction of the resistor 11 and the coil 12. A second set of contacts, normally-open, on the as-

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sembly 18 is arranged to close a circuit shorting the coil 12 when the coil 19 associated therewith is energized. One terminal of the coil 19 is connected to ground, and the other terminal is connected to the input terminal 10 through a resistor 20. A condenser 21 is connected in shunt with the coil 19. The junction of the resistor 11 and the coil 12 is connected to ground through a series circuit comprising a resistor 22 and a relay coil 23, and a condenser 24 is connected between the junction of the resistor 22 and the coil 23 and ground. A set of switch contacts 25 is associated with the relay coil 23, and may be connected as control terminals to an external circuit.

In operation signal pulses of various durations, but having constant amplitude, are applied to the input terminals 10, 14. The resistor 11 and the condenser 13 form a delay circuit so that input signals will not energize the coil 12 sufficiently to close the contacts 15 unless they exceed a minimum duration t_1 which, by way of example, can be taken as two seconds. Similarly the resistor 20 and the condenser 21 form a second delay circuit so that input signals will not energize the coil 19 sufficiently to operate the contact assembly 18 unless they exceed a second, greater, duration t_2 such as three seconds. The coil 23 is connected in shunt with the coil 12 through a delay network comprising the resistor 22 and the condenser 24, so that the contacts 25 will not be energized unless energizing current passes through the coil 12 for a third minimum duration t_3 which, can be taken as four seconds.

If a pulse having a duration less than t_1 , t_2 , or t_3 is applied to the input terminals it can be seen that none of the relays will operate, and the entire circuit will remain in a de-energized state.

If a pulse having a duration greater than t_1 , but less than t_2 or t_3 is applied to the input terminals it can be seen that the contacts 15 will close, and current from the battery 16 will flow through the switch assembly 18 and will hold the coil 12 in an energized condition regardless of the eventual cessation of the pulse. After the battery current has energized the coil for a time t_4 such that $t_1 + t_4 = t_3$, the coil 23 will operate the switch 25, and the external circuit will be actuated. The battery will hold the coils 12 and 23 in an energized state until the switch 17 is manually opened to "reset" the system. The coil 19 is energized from the battery when the system is in the "locked-on" state, but insufficient current flows through the coil 19 to actuate the contact assembly 18 because of the voltage drop through the resistors 11 and 20 which are in-

cluded in the series circuit. Relay coil 23 cannot be operated solely by a signal pulse of a duration less than T_2 because of the long time constant of the circuit comprising the components 11, 13, 22 and 24. Pulses of sufficient duration to cause coil 19 to operate switch 18 do not reach coil 23, which is short circuited by operation of the switch.

If a pulse having a duration greater than t_2 is applied to the input terminals, the switch contacts 15 are closed at time t_1 , as before, but the coil 19 is energized sufficiently at time t_2 to operate the switch assembly 18, to de-energize the coil 12. This action takes place before the coil 23 has become sufficiently energized, and no effect is produced in the external circuit.

Thus, by proper choice of the various time constants it can be seen that the above-described circuit will select pulses having a duration between predetermined limits, and will be unaffected by signals not included in that range. Similar arrangements having different time constants may be connected to the same set of input terminals so that a plurality of output circuits may be controlled from a single communications circuit.

The use of electron tubes at one or more points in the circuit to increase the efficacy of the system may be advisable if greatest accuracy is to be attained. Inasmuch as relays are shown for purposes of illustration only, vacuum tube, or thyatron circuits may be used without departing from the scope and spirit of the invention.

What is claimed is:

1. In a pulse-responsive electrical relay system: a first relay having a first time constant circuit operatively associated with the energizing coil thereof; a second relay having a second time constant circuit operatively associated with the energizing coil thereof; a third relay having a third time constant circuit operatively associated with the energizing coil thereof; a source of pulse signals of differing durations; and a source of relatively constant voltage; circuit connections from said source of pulse signals through said first time constant circuit to said first relay coil; circuit connections from said source of pulse signals through said second time constant circuit to said second relay coil; whereby said first relay is momentarily actuated by pulse signals having a duration greater than a preselected minimum, and said second relay is momentarily actuated by pulse signals having a duration greater than a preselected maximum; switch means associated with said first relay whereby a holding current derived from said source of constant voltage is applied to the said first relay coil during the interval between the actuation of said first and second relays; switch means operated by the actuation of said second relay to disconnect said source of constant voltage from said system; and circuit connections between said first relay coil and said third relay coil including said third time constant circuit applying current from said source of constant voltage to said third relay whereby said third relay is actuated if said first relay coil is energized by said holding current for a period of time greater than a second preselected minimum.

2. In a pulse-responsive electrical relay system: a first relay having a first time constant circuit operatively associated with the energizing coil thereof; a second relay having a second time constant circuit operatively associated with the energizing coil thereof; a third relay having

a third time constant circuit operatively associated with the energizing coil thereof; a source of pulse signals of differing durations; and a source of relatively constant voltage; circuit connections from said source of pulse signals through said first time constant circuit to said first relay coil; circuit connections from said source of pulse signals through said second time constant circuit to said second relay coil; whereby said first relay is momentarily actuated by pulse signals having a duration greater than a preselected minimum, and said second relay is momentarily actuated by pulse signals having a duration greater than a preselected maximum; switch means associated with said first relay whereby a holding current derived from said source of constant voltage is applied to the said first relay coil during the interval between the actuation of said first and second relays; switch means operated by the actuation of said second relay to disconnect said source of constant voltage from said system; and circuit connections between said first relay coil and said third relay coil including said third time constant circuit applying current from said source of constant voltage to said third relay whereby said third relay is actuated if said first relay coil is energized by said holding current for a period of time greater than a second preselected minimum; and a switch associated with said source of constant voltage whereby the said holding current may be manually interrupted.

3. In a pulse-responsive switching system: a first electrically actuated switch having a first control circuit and a first time constant circuit associated with said control circuit; a second electrically actuated switch having a second control circuit and a second time constant circuit associated with said second control circuit; a third electrically actuated switch having a third control circuit and a third time constant circuit associated with said third control circuit; a source of pulses of electrical energy, said pulses having differing durations; a second source of electrical energy having a substantially constant average amplitude; circuit connections from said source of pulses through said first time constant circuit to said first control circuit; circuit connections from said source of pulses through said second time constant circuit to said second control circuit; the time constants of said first and second time constant circuits being so selected that said first switch is momentarily actuated by pulses having a duration greater than a preselected minimum, and said second switch is momentarily actuated by pulses having a duration greater than a preselected maximum; circuit connections including said first and second switches whereby a holding current derived from said second source is applied to said first control circuit during the interval between the actuation of said first and second switches; circuit connections including said third time constant circuit between said first and third control circuits applying current from said second source of energy to said third control circuit when said holding current is applied to said first control circuit, the time constant of said third time constant circuit being so selected that said third switch is actuated if said first switch is energized by said holding current for a period of time greater than a preselected minimum.

4. In a pulse-responsive switching system: a first electrically actuated switch having a first control circuit and a first time constant circuit

associated with said control circuit; a second electrically actuated switch having a second control circuit and a second time constant circuit associated with said second control circuit; a third electrically actuated switch having a third control circuit and a third time constant circuit associated with said third control circuit; a source of pulses of electrical energy, said pulses having differing durations; a second source of electrical energy having a substantially constant average amplitude; circuit connections from said source of pulses through said first time constant circuit to said first control circuit; circuit connections from said source of pulses through said second time constant circuit to said second control circuit; the time constants of said first and second time constant circuits being so selected that said first switch is momentarily actuated by pulses having a duration greater than a preselected minimum, and said second switch is momentarily actuated by pulses having a duration greater than a preselected maximum; circuit connections including said first and second switches whereby a holding current derived from said second source is applied to said first control circuit during the interval between the actuation of said first and second switches; circuit connections including said third time constant circuit between said first and third control circuits applying current from said second source of energy to said third control circuit when said holding current is applied to said first control circuit, the time constant of said third time constant circuit being so selected that said third switch is actuated if said first switch is energized by said holding current for a period of time greater than a preselected minimum; and a

fourth switch associated with said second source whereby said holding current may be interrupted.

5. A pulse responsive electrical relay system comprising a first, a second and a third relay, a respective time constant circuit associated with each of said relays, a source of pulse signals, means applying signals from said source to said relays by way of said time constant circuits, a source of constant voltage, a switch operable by said first relay to connect said source to said system in a manner to supply holding current to said first relay and to supply current to said third relay by way of its time constant circuit, a switch operable by said second relay to disconnect said source of constant voltage from said system, the time constants of said respective time constant circuits being so selected that said first relay is operated in response to a pulse of a selected minimum duration, said second relay is operated in response to a pulse of a selected duration greater than said minimum duration and said third relay is operated in response to a pulse of said minimum duration plus the application thereto of current from said second source, for a total time which exceeds the response time of said second relay.

JOHN P. SHANKLIN.

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