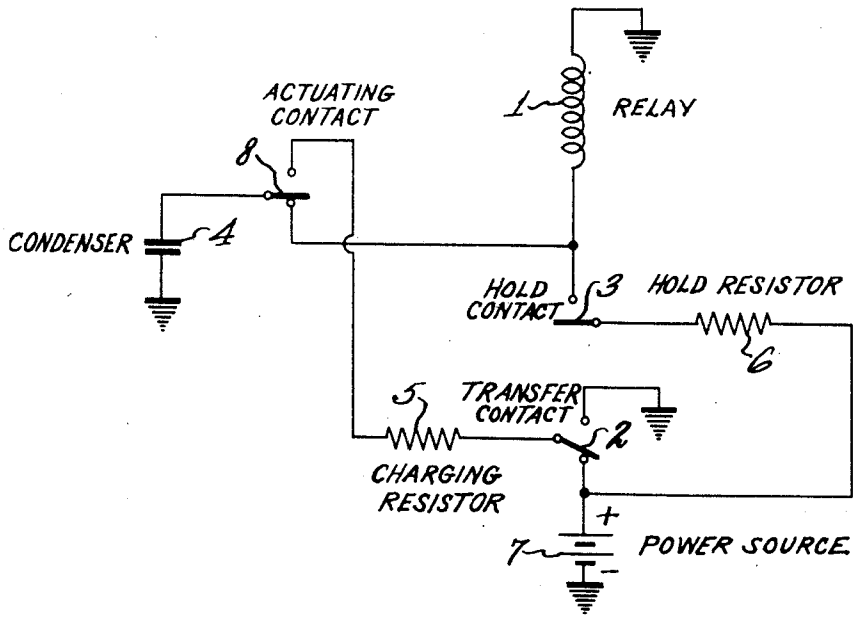
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BISTABLE CIRCUIT

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INVENTOR.
JACK BRECKMAN
BY Morrish Lahtin
ATTORNEY

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BISTABLE CIRCUIT

Jack Breckman, Westmont, N. J., assignor to Radio Corporation of America, a corporation of Delaware

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This invention relates to so-called "flip-flop" circuits which have two conditions of stability and which can be caused to shift abruptly from either condition to the other in response to an input signal.

The principal object of the invention is to provide a simple and efficient circuit of the above type which accomplishes certain desired operational sequences with a conventional single wound general-purpose relay.

Another object is to provide a single relay flip-flop circuit requiring a minimum of equipment, specifically a relay, a condenser, no more than two resistors, a power source and an actuating contact.

Other more specific objects and advantages will be apparent as the nature of the invention is more fully disclosed.

The invention is described in detail in connection with the accompanying single-sheet drawing which is a circuit diagram of a flip-flop embodying the invention.

The flip-flop circuit shown in the drawing comprises a relay 1, which may be a conventional general purpose, neutral, single wound telephone type relay, having a transfer contact 2 and a holding contact 3. The flip-flop circuit also includes a condenser 4, a charging resistor 5, hold resistor 6, power source 7, and an actuating (or driving) contact member 8, which contact is on some external device such as a push button switch or the like used as the source of input information to the flip-flop.

The condenser 4 must be large enough not only to store sufficient energy to energize the relay 1, but also to have sufficient capacity to release the relay. Although the condenser is shown grounded, its grounded plate may be at any convenient fixed potential.

The hold resistor 6 should be large enough to limit the holding current to its minimum reliable value. The charging resistor 5 should only be large enough to limit the noise radiation to an acceptable value, and to prevent fusing at the make spring of the actuating member 8. In a practical case, the value of a charging resistor needed to do this will not affect the final potential attained by the plate of the condenser connected to the actuating member 8 during the charging phase of the operation sequence, as hereinafter described.

The voltage of power source 7 is chosen with a view toward furnishing sufficient energy to condenser 4 to enable it to energize relay 1, yet optimizing the potential on holding contact 3 to allow the release of relay 1 in an acceptably short time. If, for a given combination of relay, resistors, condenser and power source, the release time of the relay is not sufficiently rapid, it may be speeded up by providing some optimum voltage less than that of ground at the make spring of transfer contact 2. (Note: the transfer contact 2 is illustrated engaging the break spring.)

Assuming that at a given time the relay 1 is deenergized, the actuating member 8 is in its normally closed position, and the switched plate of condenser 4 is at ground potential, which is the condition of the circuit illustrated in the drawing, the operation of the circuit is as follows:

The actuating member 8 is actuated to close its normally open upper contact, thus connecting power source 7 to condenser 4 through transfer contact 2, the charging resistor 5, and the upper contact of actuating member 8, thereby charging the condenser 4.

The actuating member 8 now moves back to its normal position, opening its upper contact and closing its lower contact. Thereupon, the stored energy in the condenser operates the relay over a circuit extending through the lower contact of actuating member 8 and the winding of relay 1 to ground.

The relay 1 is now held up via its holding circuit which extends from power source 7, through hold resistor 6, holding contact 3, and the winding of relay 1 to ground. The relay is now in steady-state energized position.

The actuating member 8 again moves to close its normally open upper contact. Thereupon, the condenser 4 returns to ground potential over a circuit extending from ground, through condenser 4, upper contact of actuating member 8, the charging resistor 5, and transfer contact 2 to ground.

The actuating member 8 now moves back to the normal closed position shown in the drawing. Thereupon, the winding of relay 1 is by-passed to ground through condenser 4 and the lower contact of actuating member 8. The holding current through the winding of relay 1 (via hold resistor 6 and holding contact 3 from the power source 7) is forced below a sustaining value, thereby releasing the relay. The holding circuit therefore breaks at contact 3. The relay is now in steady-state released position.

The position of the relay may be read by monitoring any of several voltages within the circuit, for example at the make spring of holding contact 3, the lever spring of said holding contact, the lever spring of transfer contact 2, or the lower contact of actuating member 8. Or, if desired, another contact (not shown) on the relay may be used for this purpose.

It will be evident from the above that the invention provides an economical, simple, and reliable electro-mechanical flip-flop for use in arithmetic units, counters, information stores, pulse dividers, etc., wherever use of a relay flip-flop is indicated.

What is claimed is:

1. A flip-flop circuit of the class described, adapted to be controlled by switch means comprising a movable actuating contact selectively engageable with either a first or a second actuating contact, said flip-flop circuit being adapted to be energized from a direct current source connected to first and second power terminals, and comprising, in combination: a relay having a single winding for operating and releasing said relay in accordance with current flow therethrough, said winding being connected to said second power terminal and to said second actuating contact; a pair of normally open holding contacts which are closed when said relay is operated, one of said holding contacts being connected to said second actuating contact along with said winding and the other of said holding contacts being connected to said first power terminal; and a set of three transfer contacts comprising a movable transfer contact connected to said first actuating contact and which engages a first transfer contact when said relay is operated and a second transfer contact when said relay is released, said first transfer contact being connected to said second power terminal and said second transfer contact being connected to said first power terminal; a holding resistor serially included in said connection of said other holding contact to said first power terminal; a capacitor connected from said movable actuating contact to said second power terminal; and a cir-

cuit connecting said movable transfer contact to said first actuating contact, whereby, on successive motions of said movable actuating contact from said first actuating contact into engagement with said second actuating contact, said relay changes successively between released and operated conditions.

2. A flip-flop circuit according to claim 1, further comprising a current limiting resistor serially included in said circuit from said movable transfer contact to said first actuating contact.

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