

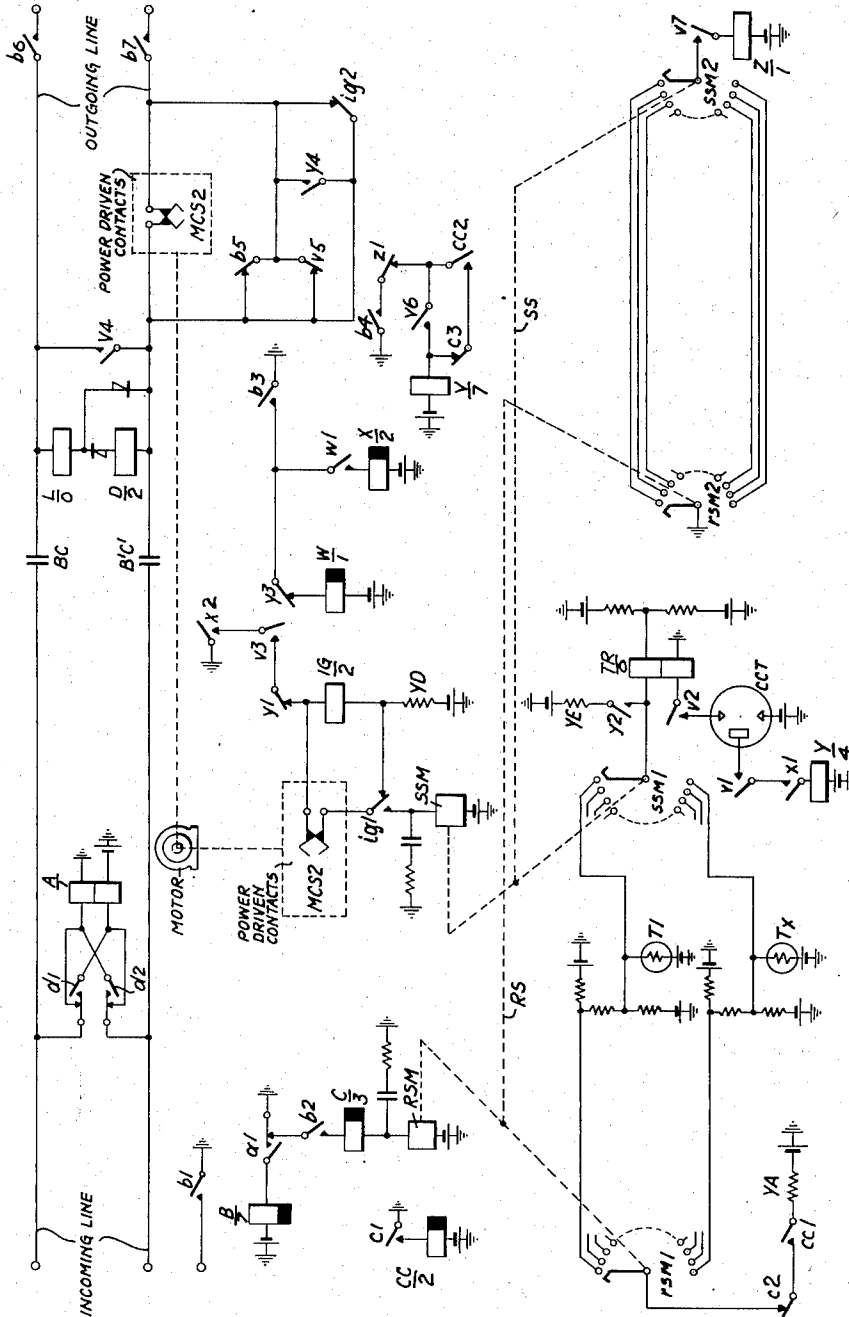
Nov. 27, 1951

F. H. BRAY ET AL

2,576,098

STORAGE OF ELECTRICAL IMPULSES

Filed Nov. 9, 1946



INVENTORS
FREDERICK H. BRAY
DESMOND S. RIDLER
BY
Robert Harding Jr.
ATTORNEY

UNITED STATES PATENT OFFICE

2,576,098

STORAGE OF ELECTRICAL IMPULSES

Frederick Harry Bray and Desmond Sydney
Ridler, London, England, assignors to Inter-
national Standard Electric Corporation, New
York, N. Y.

Application November 9, 1946, Serial No. 709,027
In Great Britain September 27, 1945

Section 1, Public Law 690, August 8, 1946
Patent expires September 27, 1965

7 Claims. (Cl. 179-16)

1

This invention relates to electrical recording of information.

The object of the invention is to provide a cheap and reliable means of recording information.

The main feature of the invention consists in recording by means of thermistors. Another feature consists in the use of thermistor trigger circuits, that is thermistor circuits having two stable current values for an applied voltage.

Thermistors have been in use for some years and are characterised by a temperature co-efficient of resistance which may be either positive or negative and which is moreover many times the corresponding co-efficient for a pure metal suitable for a variety of special applications in electric circuits.

Various different materials are available for the resistance element of a thermistor, these various materials having different properties in other respect; as one example, a resistance comprises a mixture of manganese oxide and nickel oxide, with or without the addition of certain other metallic oxides, the mixture being suitably heat treated.

Thermistors have been employed in two different forms (a) known as a directly heated thermistor and comprising a resistance element of the thermally sensitive resistance material provided with suitable lead-out conductors or terminals, and (b) known as an indirectly heated thermistor comprising the element (a) provided in addition with a heating coil electrically insulated from the element. A directly heated thermistor is primarily intended to be controlled by the current which flows through it and which varies the temperature and also the resistance accordingly. Such a thermistor will also be affected by the temperature of its surroundings and may therefore be used for thermostatic control and like purposes with or without direct heating by the current flowing through it. An indirectly heated thermistor is chiefly designed to be heated by a controlling current which flows through the heating coil and which will usually, but not necessarily, be different from the current which flows through the resistance element, but this type of thermistor may also be subjected to either or both of the types of control applicable to a directly heated thermistor.

More detailed information on the properties of thermistors will be found in an article by G. L. Pearson in the Bell Laboratories' Record, December 1940, page 106.

The simplest form of thermistor trigger circuit

2

comprises a series combination of thermistor and resistance, but where trigger circuits are to be used, those described in our co-pending U. S. application Serial No. 704,841, now abandoned, are preferred as they are much less subject to ambient temperature effects.

The invention will be clearly understood from the following description of a regenerative repeater for selective impulse trains in automatic telephone exchange systems shown in the accompanying drawing.

The circuit comprises impulse-responsive relays, a digit-storage uniselector switch RS having two banks of stationary contacts with co-operating movable wipers, *rsm1* and *rsm2*, together with a stepping magnet RSM to drive same and a digit-sending switch SS having two banks of stationary contacts with co-operating movable wipers, *ssm1* and *ssm2*, together with a stepping magnet SSM to drive same. Thermistor trigger circuits *Tr1* . . . *Trx* are individually connected to contact banks *rsm1* and *ssm1*, and those circuits connected to bank contacts on which *rsm1* stops at the end of the digits received are triggered.

Continuously operating machine impulse springs MCS1, MCS2, control the transmission of digital impulses over the outgoing line subject to the closure of the V and IG relays which are under control of switches SS, RS and the triggered thermistor circuits, as will be explained in more detail below.

Incoming pulses over the incoming line serve alternately to operate the relay A which through the relays B, C serves to operate the stepping magnet RSM to drive the contacts of this switch RS to the position indicated by the received dial signals. These dial signals are D. C. pulses and cannot pass to the outgoing line on the output side of the repeater because of the blocking condensers BC and B'C' shown between the lines. The power driven switch MCS1 is continually operated, producing pulses of the same repetition rate as the incoming dialling pulses. However, until relay IG is operated these contacts are short circuited and therefore the drive magnet SSM is inoperative until the above-mentioned operates. The IG relay will operate for a period dependent upon the received pulsing signal to step the switch SS around. This stepping continues until the movable contact comes to the selected point at which time, through the various circuits as indicated, the IG relay circuit is interrupted at *x2* so that the stepping

will stop. During this period while switch SS is operating, the output loop is completed by closure of contact *v4* and removal of the short circuit connections from driven contact MCS2 at *b5* and *ig2*. This time period will coincide with the time period for operation of magnet SSM so that contact MCS2 will open the loop circuit to transmit the same number of pulses as were received for the dialing. At the termination of this transmission relay Y is operated again short circuiting contacts MCS2 discontinuing the transmission of these dialling pulses.

When the circuit is seized, relay A operates, followed by relay B which busies the repeater at *b1* and at *b2* prepares the impulsing circuit of an impulse-receiving unselector switch RS. Line impulses received on relay A step switch RS to a position corresponding to the first digit received. Slow-release relay C operates in series with magnet RSM, followed by CC. At the end of the impulse train relay C releases and in turn releases relay CC. The trigger circuit e. g. Tx associated with the switch position reached is triggered during the release time of CC by negative battery applied through the resistance YA. Also during the release of CC, relay V energises via *c3* back, *cc2* front, *z1* back; *b4* front, and locks via *v6*.

Succeeding digits similarly step switch RS and cause another thermistor circuit to be triggered.

The triggered circuits are spaced by groups of contacts each equal to a stored digit.

On the operation of relay B when the circuit was seized relay W operated via *y3* back, *b3* front, and relay X operated via *w1* and *b1* front.

When relay V operates at the end of a digit received earth via *x2*, *v3*, *y1* is connected to machine impulse-springs MCS1, and relay IG in parallel.

When the impulse-springs open, relay IG operates, connecting springs MCS1 to magnet SSM. At the same time contacts *ig2* remove a short-circuit from a second pair of machine springs MCS2, contacts *b5*, *v5* being already opened.

The next closure of the machine springs operate magnet SSM, and the next opening of the springs steps switch SS and sends an impulse over the outgoing metallic loop made at *v4*.

Impulsing continues until wiper *ssm1* reaches a triggered thermistor circuit. The increase in potential due to the conducting thermistor causes current to flow in the primary winding of relay TR which is used as a transformer. The E. M. F. induced in the secondary fires a biased cold cathode tube CCT, and the anode relay Y energises via *z1* and *v1* front. Any suitable electronic tube may be used.

Contacts *y4* short-circuit springs MCS2 while contacts *y1* open the circuit for SSM and relay IG. Contacts *y3* cause relays W, X to release in turn, providing outgoing interdigital time.

The opening of contacts *z1* releases relay Y, allowing relays W, X to re-operate and initiate the transmission of the next digit.

Battery through a low resistance YE is connected via *y2* front to restore the triggered thermistor circuit to normal condition.

When all the stored digits have been sent in this way, switches SS and RS will be standing on the same trigger circuit position. Relay Z will, therefore, operate via *v1*, *ssm2*, *rsm2*. Contacts *z1* release relay V, opening the outgoing impulsing circuits removing the outgoing short circuit, and inserting the supervisory relays L and D. Thus, stored information denoted by a thermistor circuit whose resistance has been altered

can be utilized to affect the outgoing digital impulses.

From this point, the regenerator functions in the conventional manner.

What is claimed is:

1. An electrical signal recording and repeating circuit comprising an incoming signal line, and outgoing signal line, a plurality of thermistors, a plurality of individual circuit means respectively coupled to each of said thermistors, said means adapted to maintain said thermistors normally at a predetermined temperature and at a given resistance value, common circuit means including a source of thermistor triggering potential for selectively altering the temperature and resistance value of selected of said thermistors, means coupled to said incoming line and responsive to signals received thereover for selectively connecting said common circuit means to a selected one of said thermistors thereby to trigger said thermistor, signal transmitting means coupled to said outgoing line for transmitting outgoing signals thereover, switch means having a movable contact and a plurality of stationary contacts respectively coupled to an associated one of said thermistors, said movable contact adapted to be moved over said stationary contacts by said signal transmitting means, a normally inoperative control circuit coupled with said movable contact for controlling operation of said signal transmitting means, and means responsive to switch connection of said movable contact with the stationary contact coupled with said selected thermistor for operating said control circuit and for restoring said selected thermistor to said predetermined temperature and given resistance value.

2. An electrical circuit as claimed in claim 1, wherein said individual circuit means comprises a voltage divider network for normally maintaining a predetermined potential across said thermistor, and said common circuit means comprises a counter-potential means for altering said first named potential in a predetermined manner.

3. An electrical circuit as claimed in claim 1, wherein the means to operate said control circuit comprises a non-contact making relay.

4. An electrical circuit as claimed in claim 3, wherein said means further comprises a gaseous discharge tube.

5. An electrical signal recording and repeating circuit comprising an incoming signal line, an outgoing signal line, a plurality of thermistors, a plurality of individual circuit means respectively coupled to each of said thermistors, said means adapted to maintain said thermistors normally at a predetermined temperature and at a given resistance value, common circuit means including a source of thermistor triggering potential for altering the temperature and resistance value of selected of said thermistors; a first switch means having a plurality of stationary contacts, a movable contact and means to step said movable contact over said stationary contacts; means coupling said stepping means to said incoming line, said stepping means adapted to step said movable contact to a selected stationary contact in response to signals received over said incoming line; a second switch means having a plurality of stationary contacts, a movable contact and means to step said movable contact over said stationary contacts; each of said thermistors respectively connected to corresponding stationary contacts of both said switch means, power driven switch means connected to said outgoing line for transmitting signals thereover, relay means coupled

5

between said power driven switch means and the stepping means of said second switch means, said relay means adapted to control stepping of said second switch means by said power driven switch means, said relay means under control of the means coupling the stepping means of said first switch means to said incoming line, means coupled to the movable contact of said second switch means to render ineffective the stepping of the stepping means of said second switch by said power driven switch means, said last named means adapted to become operative when the movable contact of said second switch means becomes connected with a stationary contact of said second switch which is associated with a thermistor whose resistance has been altered by said common circuit means, and additional means for restoring a triggered thermistor to said predetermined temperature and given resistance value, said additional means under control of said means to render ineffective said second switch stepping means.

6. An electrical circuit as claimed in claim 5 wherein additional means are provided to re-set said output circuit upon the completion of a train of impulses.

6

7. An electrical circuit as claimed in claim 6, wherein said additional means comprises additional sets of interconnected stationary contacts and a pair of additional movable contacts adapted to cooperate therewith, said additional movable contacts operating in step with the first mentioned and second mentioned movable contacts, a relay means to energize said relay when said additional movable contacts of said switches are on corresponding contacts.

FREDERICK HARRY BRAY.
DESMOND SYDNEY RIDLER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,131,589	Halligan	Sept. 27, 1938
2,179,826	May	Nov. 14, 1939
2,196,173	Black	Apr. 9, 1940
2,236,499	Cesareo	Apr. 1, 1941
2,248,212	Albert	July 8, 1941
2,414,488	Shanck	Jan. 21, 1947