May 28, 1968 E. A. WESTPHAL 3,385,943

ELECTRIC SIGNAL CODE GENERATOR

Filed May 2, 1967 2 Sheets-Sheet 1

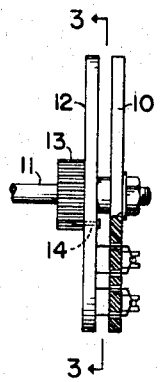

FIG. 1

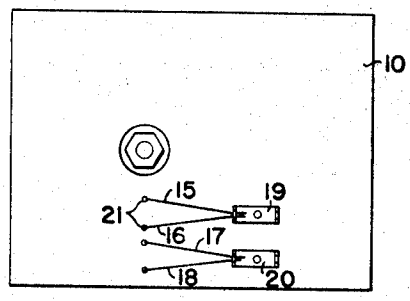

FIG. 2

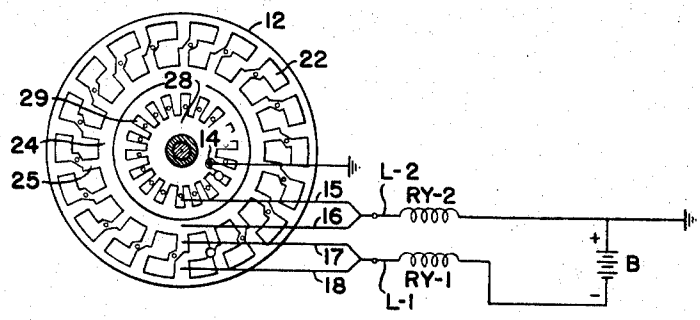

FIG. 3

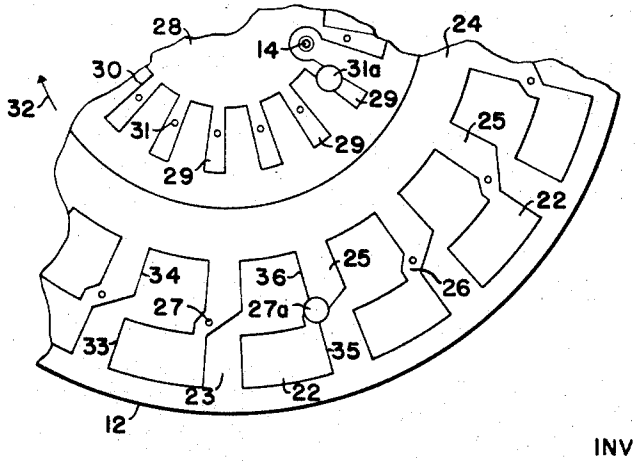

FIG. 4

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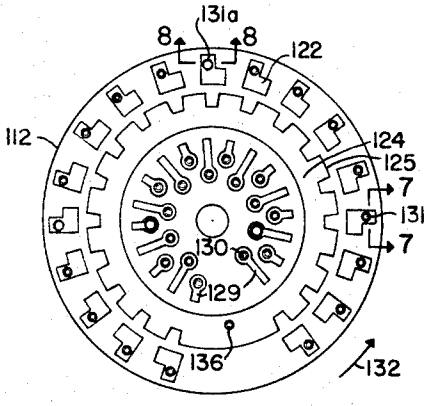

FIG. 5

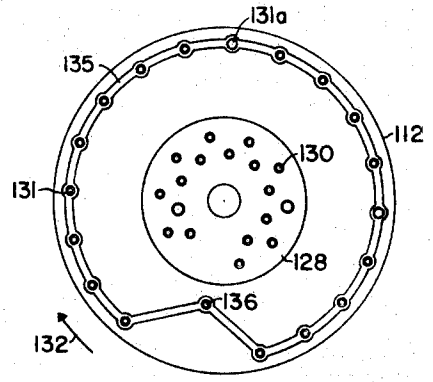

FIG. 6

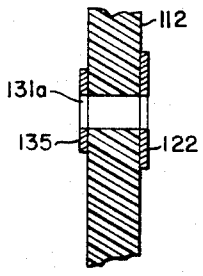

FIG. 8

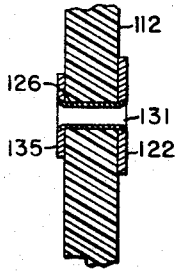

FIG. 7

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ELECTRIC SIGNAL CODE GENERATOR

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ABSTRACT OF THE DISCLOSURE

An electrical signal code generator wherein an electrical circuit is interrupted according to a desired pattern includes a wheel carrying two mutually insulated contacts, at least one of which is a ring of separated contacts wiped by a brush, each of which is connected to a second contact element on the wheel by severable electrical connectors which can be selectively severed, as by drilling, to break the connection and form a desired code. The second contact element can be continuous or interrupted and can be wiped by a second brush or have external electrical contact through the wheel axle. Several pairs of such contacts can be provided to adapt the wheel to an alarm system, e.g., suitable for use in a McCulloh loop.

The invention relates to an electrical signal code generator which can make and/or break an electrical circuit in accordance with a desired pattern to generate a code in one or in a plurality of circuits. More particularly, it relates to a generator of the type having a wheel which is rotatable relatively to one or more brushes which wipe electrical contacts on the wheel, wherein the wheel can be easily altered to generate any of a large number of codes.

The invention is applicable, for example, to alarm systems in which a plurality of remote subscribers' premises to be protected from burglary, fire, or the like are connected by electrical circuits, such as telephone lines or radio channels, to a central office whereat the signals are received and recorded in the vent of an unauthorized entry or a fire at the subscriber's premises. In a special application, each of the subscribers' lines is connected to the central office by what is known as a McCulloh loop circuit. This circuit, being well known, will not be described herein in detail; it includes, at the central office, an electrical storage battery, the positive side of which is grounded and which is connected at both sides through coils of relays to the line, these relays being connected to recognize either the opening or the grounding of the circuit. Several subscribers' lines are connected to a common central office receiver and recorder, for example, connected in series, and the identity of the subscriber emitting a signal is recognized by the particular code. In this system, each code generator at a subscriber's premises has a circuit switch which is normally closed so that opening or grounding of the circuit at any subscriber will be manifested at the central office.

In the code generators used heretofore, each mechanism included a pair of spring arms controlling switchpoints, of which one was normally closed and the other, leading to ground, was normally open, these switches being actuated by a cam wheel having a series of notches arranged according to a predetermined pattern. In the event of any unauthorized opening of a circuit at the subscriber's premises, a relay at those premises becomes de-energized, which thereby energizes a motor drive to operate the notched wheel, causing the switches to send coded pulses over the telephone line to the central office registers.

A drawback of the known code generating switch mechanism has been the need to provide a large number of different cams for actuating the switches or the difficulty in cutting a cam wheel having properly spaced notches for each installation. It is evident that when several subscribers are connected in series each must have a different code.

A further drawback has been that the cam mechanism does not always produce pulses of uniform duration or occurring at precisely predetermined intervals. Thus, a slight misalignment of the drive shaft of the notched wheel or a slight deformation of the spring fingers which cooperate with these notches leads to nonuniform operation. This has required the spring arms to be carefully adjusted at each installation, which is a time-consuming operation. Moreover, such mechanisms are subject to rapid wear and frequent servicing is necessary.

According to the present invention, these drawbacks are avoided by providing a code generator having a wheel in which any desired code can be readily set up by merely severing connections between electrical contacts on the wheel. The dimensions of these contacts can be carefully controlled during manufacture, leading to improved uniformity of pulses. Moreover, such a device does not need any adjustment and, by providing the contacts with suitable wear-resistant surfaces, a long service life is assured.

In summary, according to the invention, the code generator includes a wheel carrying at least one pair of contacts, of which at least one is a ring of separated contacts wiped by a brush, each of said contacts being connected to a second contact element (which may be continuous or discontinuous) by a severable electrical connector which is adapted to be easily cut, as by drilling, to break the connection between the separated contact and the second contact on the wheel. The second contact element may also be wiped by a brush or, if desired, an electrical circuit thereto can be established through the shaft of the wheel. Several pairs of such contacts can be provided to adapt the wheel to an alarm system suitable for the above-mentioned McMulloh loop. There must, of course, be relative rotation between the wheel and the brushes; however, it is not essential that the wheel rotate, it being also possible to employ a stationary wheel and to rotate the brushes mounted on a suitable pivoted arm.

To facilitate severing the electrical connectors, each is preferably provided with a depression for guiding its severing implement, e.g., each such connector may have a depression for receiving the point of a small drill which is used to cut away the connection.

Advantageously, the wheel is a flat disc and the contacters are applied thereto by any known printed circuit technique. Preferably, all contacts that are wiped by brushes are further plated to make them wear-resistant.

The invention will be further described with reference to the accompanying drawing forming a part of this specification and showing two preferred embodiments, wherein:

FIG. 1 is an elevation of the code-generating device, a part of the base being shown in section;

FIG. 2 is an end view of the device;

FIG. 3 is a section taken on the line 3—3 of FIG. 1, showing the face of the code wheel, parts of the connecting circuit being shown;

FIG. 4 is an enlarged, fragmentary view of a part of the code wheel;

FIG. 5 is a plan of a code wheel according to a modified embodiment;

FIG. 6 is a plan of the reverse side of the wheel shown in FIG. 5; and

FIGS. 7 and 8 are fragmentary sectional views taken on the corresponding section lines of FIG. 5.

Referring to FIGS. 1–4, the code generator comprises a base plate **10** having journaled therein a drive shaft **11** which is connected to a suitable electrical motor (not shown) and is secured to a code wheel **12**. A pinion gear **13** may be mounted on the shaft **11** for rotation with the wheel **12**, e.g., by means of a pin **14** which extends through a hole in the wheel. The gear meshes with another gear (not shown) for controlling the operation of the drive motor. The parts **10** and **12** may be made of any suitable, rigid, insulating material, such as plastic or insulating board. The base **10** carries a plurality, e.g., four brushes **15–18**, which are mounted in pairs on soldering lugs **19** and **20** which are fastened by rivets to the base **10**. These brushes may be Phosphor-bronze wires and extend through holes **21** in the base to engage the face of the wheel **12**. These brushes may, for example, have loops at their ends to present convex contact regions and bear against the wheel resiliently with a pressure of about 20 grams. The pin **14** may be grounded to provide a fifth electrical circuit to the wheel face.

The face of the wheel **12** against which the brushes **15–18** bear is provided with suitable contacts which may be applied by the printed-circuit technique, e.g., being formed principally of copper coated with a wear-resistant material, such as nickel, as needed. However, the invention is not limited to this specific construction, and the contacts may be cut from a metallic sheet and applied to the wheel face. Regardless of the technique of manufacture, the contacts provide the following, which will be described in a specific relationship relatively to the distance from the periphery of the wheel, although the sequence can be varied as desired

At the outside is a ring of separated contacts **22**, positioned for engagement by the brush **18** and separated circumferentially by insulated sections **23**. Inside of this ring is a continuous ring **24**, positioned to make continuous contact with the brush **16** and having a plurality of radially outwardly extending contact sections **25** positioned to make intermittent contact with the brush **17**. Each of the contacts **25** is connected by a severable metallic connector **26** to a corresponding separated contact **22**. Thereby all of the several contacts heretofore described are initially interconnected electrically. Each connector **26** has a guide recess, such as a small tapered depression **27**, for guiding the point of a drill. When a drill is placed into a recess **27** and a hole is drilled partly into the wheel **12**, the connector **26** is severed, as indicated at **27***a* in FIG. 4.

The wheel further has a central metallic area **28** which is electrically connected to the pin **14** to establish a ground circuit, and has a plurality of radially outwardly extending contacts **29** positioned for wiping engagement with the brush **15**. Each contact **29** is connected electrically to the part **28** by a severable connection **30**, which is similarly provided with a recess **31**. When a drill is applied to the recess **31**, the contact **29** is severed from the region **28**, as appears at **31***a*.

The shaft **11** rotates to drive the wheel in the direction indicated by the arrow **32**, and each contact **22** has a leading edge **33** which is aligned radially with the trailing edge **34** of a preceding contact **25**. Similarly, each trailing edge **35** of a contact **22** is aligned radially with the leading edge **36** of the corresponding contact **25**. It will be understood that this alignment is appropriate for the embodiment shown, wherein the several brushes **15–18** are situated on a common radial line; further, the contacts **25** may be slightly wider than indicated. The arrangement, in any case, when employed for use in a McCulloh loop circuit, is such that the brush **17** engages the contact **25** not after the brush **18** disengages the corresponding contact **22**, and that the brush **17** breaks contact with the contact **25** not before the brush **18** engages the next contact **22**. Similarly, each contact **29** is aligned with the outer contacts so that the brush **15** engages the contact **29** somewhat before the brush **17** engages the contact **25** and disengages the contact **29** somewhat before the brush **17** leaves the contact **25**.

A portion of the circuit which receives the code is illustrated in FIG. 3, wherein the brushes **17** and **18** are connected to one side L–1 and the brushes **15** and **16** to the other side L–2 of a telephone line leading to the central office. (When several subscribers are connected to a common central office, additional code generators may be connected serially into this telephone circuit.) The central office has relays of which only the windings RY–1 and RY–2 are shown, these relays being further connected to a battery B of which the positive side is gounded.

In operation, the wheel **12** is normally stationary at a home position at which the brush **15** engages an insulated area between the contacts **29**, the brush **17** engages an insulated area between the contacts **25**, and the brush **18** engages one of the contacts **22**; the brush **16** always engages the contact **24**. When the wheel **12** rotates in the direction of the arrow **32**, the brush **15** engages the contacts **29** in succession. Upon engaging those contacts **29** at which a hole **31***a* was formed to sever the connector **30**, the brush **15** remains ungrounded; however, when the brush engages one of the other contacts **29**, it is temporarily grounded, thereby de-energizing the relay winding RY–2. Also, in the cases of the connectors **26** which do not have holes **27***a* drilled out, either the brush **17** or **18** will be electrically connected to a contact **25** or **22**, respectively, whereby the circuit L–1 is connected to the circuit L–2 via the brush **16** and the contact **24**. However, when the brush **18** engages a contact **22** which has its connector **26** severed by a hole **27***a*, the circuit L–1 is disconnected from the circuit L–2, thereby causing both relays RY–1 and RY–2 to become de-energized.

It is evident that by selectively severing the connections **26** and **30** a large variety of codes or patterns of signals can be provided in the same code wheel, and that this is easily done by the mere use of a rotary drill.

The invention may be otherwise embodied, and the severable connectors may take other forms. For example, in the embodiment shown in FIGS. 5 through 8, the code wheel **112** has an outer ring of separated contacts **122**, a circumferentially continuous contact ring **124** having radially outwardly projecting contacts **125**, and an inner ring of circumferentially separated contacts **129**, all fixed to one face thereof and formed as previously described. Reference numbers in this embodiment denoting parts which correspond to those of the first embodiment are increased by one hundred, and the wheel **112** is designed to cooperate with four brushes similarly aligned along a common radial line. The reverse side of the wheel **112** carries a continuous metallic conducting ring **135**. Each of the contacts **122** is electrically connected to the ring **135** by a tubular connector **126** having flared outer ends which provide tapered recesses **131**. The connectors **126** can be selectively removed by drilling completely or partly through the wheel so as to sever the electrical connection between the parts **122** and **135**. When the wheel is drilled entirely through, the connector **126** is removed, leaving a hole **131***a*, as appears in FIG. 8. The ring **135** is connected to the continuous contact **124** by a similar tubular connector **136**. The contacts **129** are electrically connected to a metallic, conductive area **128** on the reverse side of the wheel by tubular connectors **130**, which are constructed exactly as previously described for the connectors **126**. These can be selectively drilled out to sever the connections **130** and separate the contacts **129** from the conductive area **128**. It will be understood that the area **128** is suitably connected to an external circuit, e.g., is grounded as described for the area **28** in the first embodiment.

The wheel **112** has the various contacts placed in coordinated positions in accordance with the desired function, e.g., as described for the first embodiment, and is rotated in the direction indicated by the arrow **132**. It is evident that the operation is the same, and that any desired code can be generated in accordance with the numbers and locations of the connectors **125** and **130** which are severed.

Although severable electrical conductors were described in connection with the preferred embodiment, it is evident that the opposite may be used. Thus, the code wheel of either embodiment may be initially manufactured with the connections absent, and these can be added in setting up the desired code, as by applying a drop of solder to bridge the unconnected contacts in the first embodiment or by inserting the tubular connectors **130** as necessary.

I claim:

1. An electrical signal code-generating system which comprises: first and second brushes, a code wheel rotable relative to said brushes, first and second mutually insulated contact rings on said wheel situated to make electrical contact respectively with the first and second brushes, at least the first ring being discontinuous to form a series of contacts separated by insulated sections, and electrically conductive means interconnecting said contacts to said second ring, said conductive means being the only electrical connections between said rings and being selectively severable to thereby establish a desired code of sequential circuit interruptions between said brushes upon relative rotation of said wheel and brushes, said separated contacts having the trailing edges thereof spaced from the leading edges of the respectively next contacts by insulated sections greater in length than the contact length of said first brush, said wheel including a third electrically conductive ring of contacts, said ring being electrically connected to said second ring, and a third brush positioned for electrical contact with said third ring, the contacts of said third ring having leading edges positioned in coordinated relation to the separated contact, whereby rotation of said wheel relative to said brushes causes a predetermined series of circuit interruptions to thereby establish a signal pattern.

2. The apparatus set forth in claim **1**, wherein the leading edge of each contact of said third ring is situated in relation to the positions of said first and third brushes and of said separated contact so that the contact of the third ring makes contact with the third brush not after the first brush breaks contact with the separated contact and breaks contact with the third brush not before the first brush makes contact with the next separated contact.

3. The apparatus as set forth in claim **1**, wherein said conductors comprise strips of metal interconnecting each contact of the third ring with corresponding separated contacts.

4. The apparatus as set forth in claim **1**, wherein the contacts of said third ring have radial leading and trailing edges, said edges being aligned radially respectively with the trailing edge of a separated contact and with the leading edge of a succeeding separated contact.

5. The apparatus as set forth in claim **1**, wherein a fourth brush is provided, said wheel having a fourth ring of circumferentially spaced contacts, said fourth ring being positioned for successive electrical contact with said fourth brush, a common electrical circuit, and severable electrical conductors connecting each of said contacts of the fourth ring with said common circuit.

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