June 4, 1957 C. O. BARNHART 2,794,969

ELECTRO-MECHANICAL DECODER

Filed Aug. 8, 1955 2 Sheets-Sheet 1

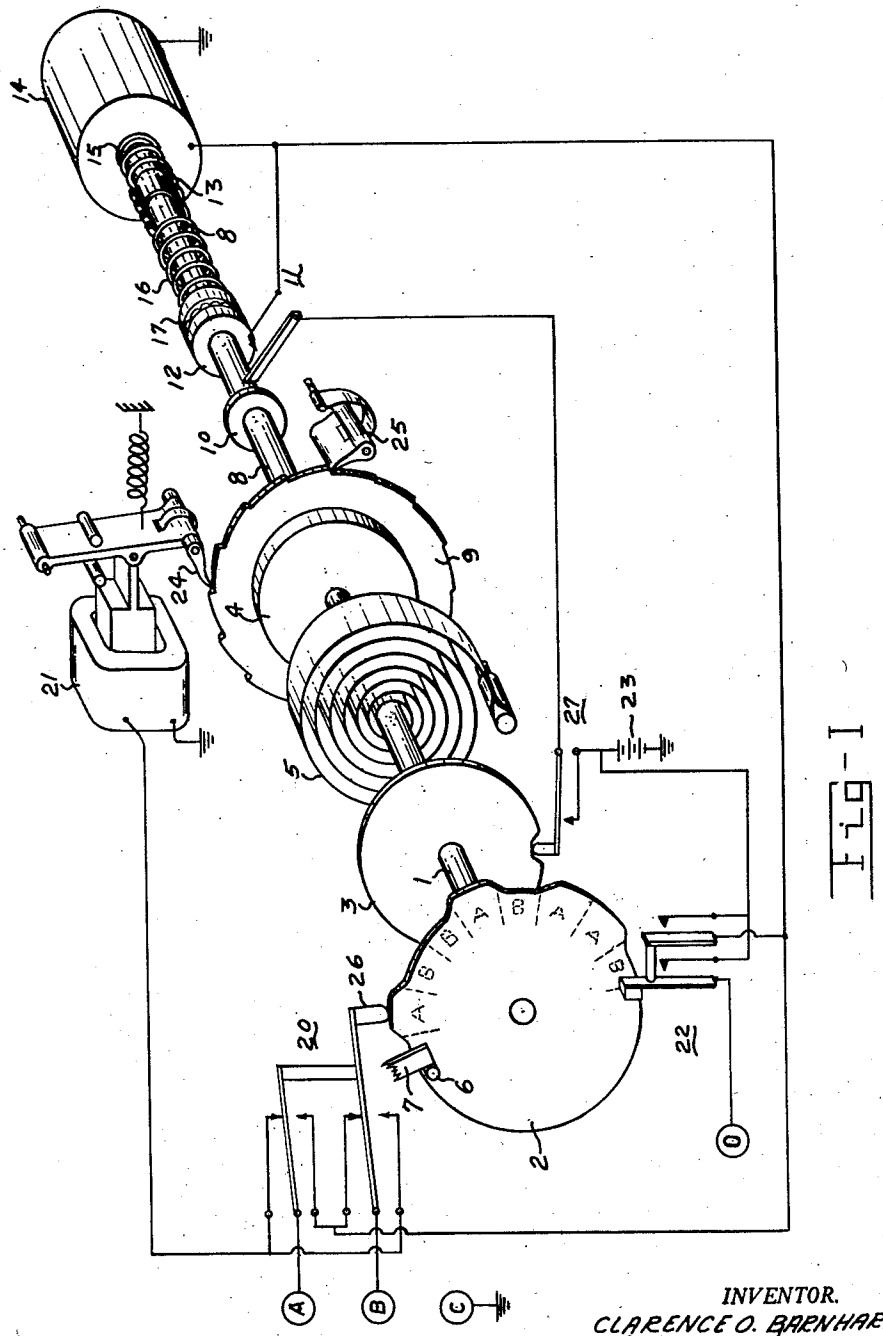


Fig - 1

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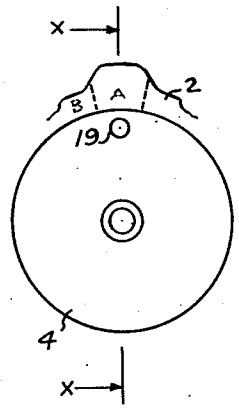


Fig-2a

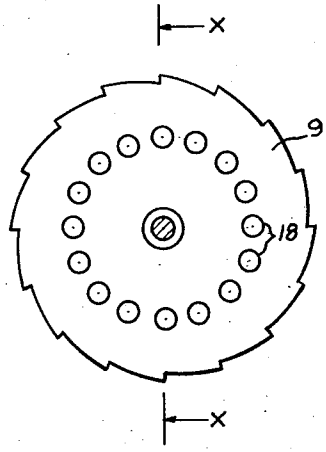


Fig-2b

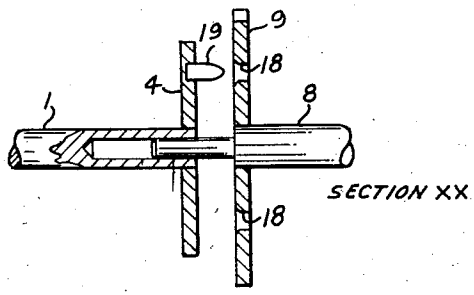


Fig-2c

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ELECTRO-MECHANICAL DECODER

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Application August 8, 1955, Serial No. 527,185

2 Claims. (Cl. 340—164)

(Granted under Title 35, U. S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the United States Government for governmental purposes without payment to me of any royalty thereon.

The decoder described herein operates in response to the occurrence of a predetermined serial electrical binary code in two circuits to perform a desired function such as closing an electric circuit. The code consists of a series of energizations of the two circuits, each energization being of one or the other but not both circuits. The duration of an energization and the interval between successive energizations are immaterial.

Briefly, the decoder comprises a shaft, ratchet means for rotating the shaft a step at a time and a code wheel carried by the shaft. Cooperating with the code wheel and actuated thereby is a switch which is capable of connecting each of the two circuits to either the ratchet means for advancing the shaft or a resetting means for returning the shaft to its zero or start position. The switch is further designed so that if one of the circuits is connected to the ratchet means the other is connected to the resetting means, and vice versa. If the two circuits are energized in the sequence prescribed by the code wheel the shaft continues to advance until the last step, corresponding to the last element of the code, causes a switch to be actuated which closes an output circuit and also actuates the resetting means, returning the decoder to its start position. If, on the other hand, the energization does not follow the prescribed sequence, at the first departure therefrom the resetting means is actuated returning the decoder to its start position.

A more detailed description of the invention will be given in connection with a specific embodiment thereof shown in the accompanying drawings in which:

Fig. 1 is a schematic diagram of the decoder, and

Figs. 2*a–b–c* show details of the clutch used in the decoder.

Referring to Fig. 1, the decoder has a shaft **1** which carries a code wheel **2**, a cam **3** and a clutch disc **4**. The code wheel is shown in its start position toward which it is biased at all times by reset spring **5**, the pin **6** resting against stop **7** in this position. A second shaft **8**, piloted in the end of shaft **1**, carries ratchet wheel **9**, a collar **10** for actuating switch **11**, a thrust collar **12** and a stop collar **13**. Shaft **8** enters reset solenoid **14** through guide **15**. Ratchet wheel **9** is constantly urged toward clutch disc **4** by spring **16** acting through thrust bearing **17** and thrust collar **12**. Solenoid **14** operates when energized to move shaft **8** to the right against the action of spring **16** until collar **13** strikes guide **15**.

The clutching arrangement existing between disc **4** and ratchet wheel **9** is shown in Figs. 2*a–b–c*. Wheel **9** has a plurality of openings **18** at the same radius as pin **19** in disc **4**. These openings are equal in number to and in angular alignment with the ratchet faces. When solenoid **14** is deenergized, as shown in Fig. 1, ratchet wheel **9** is held against disc **4** by spring **16** and shafts **1** and **8**

are locked together by pin **19** which engages one of the openings in the ratchet wheel. When solenoid **14** is energized, ratchet wheel **9** is moved sufficiently far to the right to disengage pin **19** as shown in Fig. 2*c*. Whenever the clutch is disengaged, shaft **1** and code wheel **2** return to the start position under the influence of spring **5**.

The code wheel **2** is in the form of a two-level cam which actuates switch **20**. The two input circuits to the decoder are connected to terminals A and B of this switch, C being the common terminal. When switch **20** is in its upper position terminal A is connected to step solenoid **21** and terminal B is connected to reset solenoid **14**. In the lower position of switch **20** the conditions are reversed so that terminal A is connected to the reset solenoid and terminal B to the step solenoid. The two cam levels are distributed about the circumference of the wheel **2** in accordance with the prescribed code which, in the specific example shown, is ABBABAAB, the letters referring to the terminal that is energized. The angular extent of the cam surface devoted to each code element is indicated on the code wheel in Fig. 1 and is equal to the angular spacing between the ratchet faces of ratchet wheel **9**. If the code wheel **2** is rotated counterclockwise beyond the last code element (B), pin **6** actuates switch **22** which applies voltage from source **23** to output terminal O and also to reset solenoid **14**.

A step-by-step counterclockwise rotation of shaft **1** and code wheel **2** is achieved through step solenoid **21** which actuates pawl **24**. Pawl **25** prevents reverse rotation of shaft **1** under the influence of spring **5** when the clutch **4—9** is engaged. The alignment of the various parts is such that in the rest position of ratchet wheel **9** the follower **26** of switch **20** rests in the center of a code element cam surface, as shown in Fig. 1. One energization of step solenoid **21** causes code wheel **2** to advance in a counterclockwise direction by an amount equal to the distance between the centers of adjacent code element cam surfaces.

As already indicated, energizations of reset solenoid **14** disengages clutch **4—9** and allows code wheel **2** to be returned to its start position by spring **5**. In order to insure that solenoid **14** remains energized and clutch **4—9** disengaged until code wheel **2** has had time to return to its start position a reset interlock circuit comprising switches **11** and **27** is provided. Switch **11** is actuated by collar **10** on shaft **8** and is closed whenever clutch **4—9** is disengaged. Switch **27** is actuated by cam **3** and is closed at all times except when wheel **2** is in the start position. Therefore, if clutch **4—9** is disengaged by solenoid **14** while code wheel **2** is in other than its start position a circuit is completed from source **23** through switches **27** and **11** which supplies current to the solenoid until wheel **2** has returned to its start position and switch **27** has opened.

Considering the operation of the decoder, if terminals A and B are energized in the sequence prescribed by the code wheel, which in the case illustrated in ABBABAAB, the code wheel is advanced one step in the counterclockwise direction (Fig. 1) for each energization. For example, with code wheel **2** in its start position terminal A is connected to step solenoid **21** so that energization of this terminal causes code wheel **2** to advance to its second position. In the second position terminal B is connected to solenoid **21** and energization of this terminal causes wheel **2** to advance to its third position. The code wheel continues to advance in this manner if the terminals continue to be energized in accordance with the code prescribed by the code wheel. When the code wheel has finally reached the last code element position, in the illustrated case a B position, the final energization of the B terminal advances the code wheel one more step causing

pin **6** (Fig. 1) to actuate switch **22** and apply voltage to an output terminal O. Actuation of switch **22** also applies voltage to reset solenoid **14** causing the code wheel to return to its start position.

If terminals A and B are not energized in the sequence prescribed by the code wheel, the decoder is reset to its start position at the first departure from the prescribed sequence. This will be clear from Fig. 1 where it is apparent that if for any position of the code wheel other than its start position the terminal opposite to that specified by the code wheel in that position is energized, this energization will be applied to reset solenoid **14** rather than to step solenoid **21** and will result in return of code wheel **2** to its start position.

I claim:

1. In combination with a pair of electric circuits that may be energized one circuit at a time in any sequential order, apparatus for determining if said circuits are energized *n* times in a predetermined order, said apparatus comprising: a code wheel having said predetermined order stored along its circumference in the form of a two-level cam extending over *n* adjacent equal sectors of said wheel, the cam in any sector having one of two levels, the upper level corresponding to one of said circuits and the lower level corresponding to the other of said circuits; means defining a start position for said code wheel; spring means constantly biasing said code wheel toward said start position; a ratchet wheel having ratchet faces with an angular separation equal to the angle of said sectors; normally engaged clutch means between said ratchet wheel and said code wheel; electrically operated pawl means for rotating said ratchet wheel and said code wheel through said normally engaged clutch in the direction opposed to said spring means; electrically operated means for disengaging said clutch; and switching means actuated by said cam and operating in the upper level of said cam to connect said one circuit to said pawl means and said other circuit to said clutch disengaging means and operating in the lower level of said cam to interchange said connections.

2. Apparatus as claimed in claim 1, in which there are provided a switch associated with said code wheel and closed except in the start position of said code wheel and a switch associated with said clutch and closed when said clutch is disengaged, and in which means are provided for energizing said clutch disengaging means through said switches in series.

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