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VARIABLE CHARACTER DISPLAY INDICATOR

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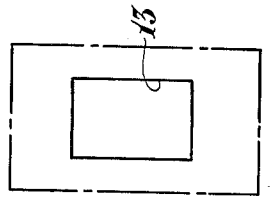

Fig. 1C.

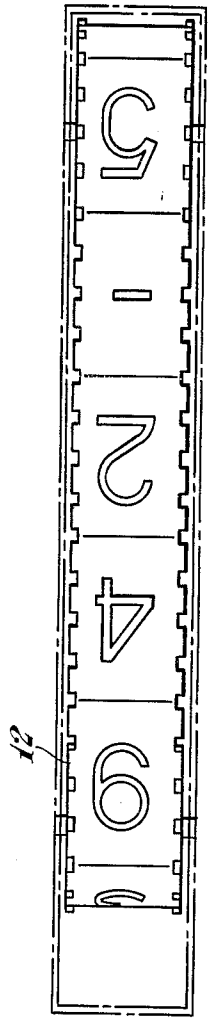

Fig. 1B.

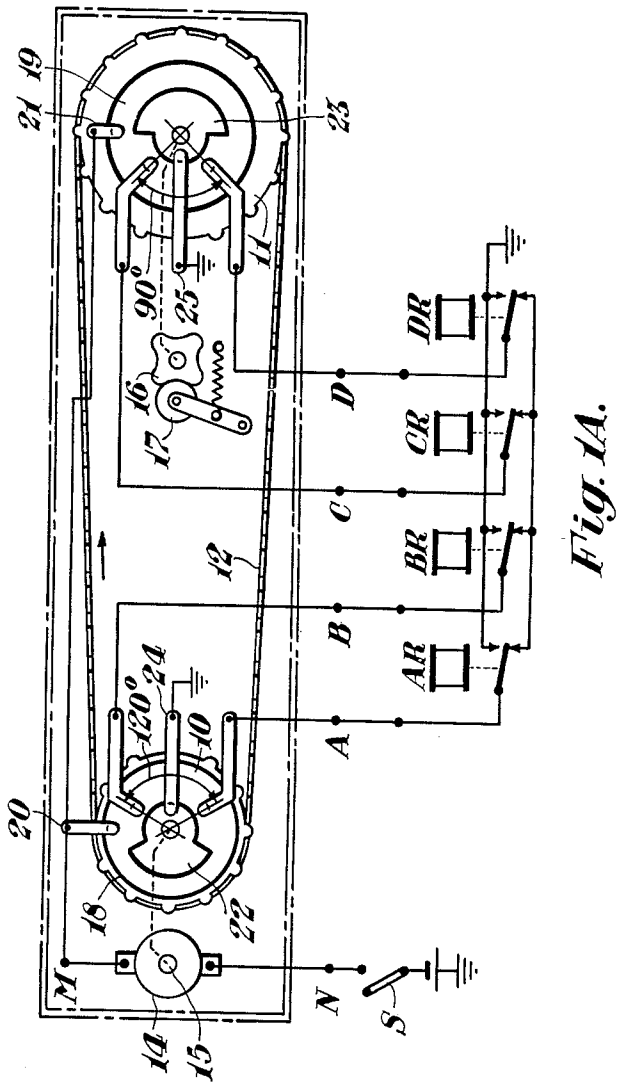

Fig. 1A.

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VARIABLE CHARACTER DISPLAY INDICATOR

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9 Claims. (Cl. 340—316)

This invention relates to a remotely controlled display indicator. More particularly, the invention comprises an indicator mechanism of simple and novel construction which is particularly adapted for use in a display panel containing large numbers of indicators arranged in closely spaced rows and columns, and which are controllable by binary code signals employing a relatively small number of control wires.

The indicator of my invention is particularly adapted for use in aircraft control systems for registering the identification and the course of aircraft, or other data relating thereto, or for the display of weather data or other information received from distant points and supplied to the indicator system of our invention in the form of teletype code signals.

One object of my invention is to provide an indicator mechanism which is quiet and rapid in operation and which occupies a minimum amount of panel space, and to this end, in a preferred form of the invention, the symbols are arranged in spaces on the face of a belt mounted on two sprocket wheels of slightly different size, one in the rear of the other, with their axes parallel to the panel. Upon closing a circuit for a suitable motor device, the wheels are caused to rotate to a position where a selected symbol is displayed in a window in the face of the panel. The surface of the wheels upon which the belt travels is made equal to different integral numbers of belt spaces and the total number of belt spaces eqauls the product of the numbers of spaces on the two wheels. These numbers are so chosen that the wheels have a characteristic relative position for each different belt position.

A feature of my invention comprises means for positioning the belt by supplying energy to one or more of a group of control wires in different binary code combinations, and then closing a contact in the motor circuit. The control wires are connected individually to different circuit controllers, some of which are actuated by one wheel and the remainder by the other. Each circuit controller is arranged so that it either closes or opens a branch of the motor circuit in each wheel position. The circuit controllers cooperate in such a manner that the motor circuit is opened only when the belt is in a position to display the symbol identified by the code signal supplied to the control wires.

In accordance with another feature of the invention, each circuit controller is arranged to supply energy to its control wire when it occupies the position where its connection to the motor circuit is open, so that when the indictator is at rest, the control wires are energized selectively in a code pattern which identifies the position to which the indicator has been operated.

One form of indicator mechanism embodying my invention will now be described in connection with the accompanying drawings, in which

Fig. 1A comprises a side view of one form of display indicator embodying my invention, having four control wires and twelve display positions.

Figs. 1B and 1C show a top view and front view of the indicator of Fig. 1A.

Referring to the accompanying drawings, it will be seen that in the form shown, the indicator comprises a rectangular housing containing a movable member consisting of two sprocket wheels **10** and **11** connected by a belt or ribbon **12**, the edges of which are notched to engage sprocket teeth on the wheels. As shown more particularly in Fig. 1B, the belt is marked by transverse lines which define twelve symbol spaces of equal length. When the belt is rotated, the symbols are brought one at a time into a display position in a window **13**, shown in Fig. 1C, in the face of the indicator housing. The circumference of wheel **10** is made equal to three belt spaces and that of wheel **11** is made equal to four belt spaces, so that as the belt is rotated through its twelve positions, each of the three positions of one wheel comes into alignment once with each of the four positions of the other wheel.

The wheels and belt may be rotated from one position to another by any suitable form of motive power controllable by an electric circuit. The motor circuit as shown, for example, includes a motor **14** which alternatively may be a clutch magnet by which the rear wheel may be coupled to a rotating shaft **15** which may serve as a prime mover for a group of indicators. The front wheel carries a suitable positioning device which may comprise a cam **16** and a spring pressed roller **17**, shown separately for clearness, for maintaining a selected belt space in alignment with the window **13** when the motor circuit is open.

Each wheel carries two circuit controllers which may be of any suitable type. They consist of cams, for example, which actuate transfer contacts of the relay type, but preferably they are combined, as shown, in the form of a wafer switch or disc commutator having inner and outer collector rings, with the outer ring, at least, insulated from the inner ring and from the wheel upon which the rings are mounted. The outer rings, 18 and **19**, are connected by brushes **20** and **21** to terminal M of motor **14**, the other terminal N of which is connected through a normally open circuit controller, such as the switch S, to the negative or common return terminal of a source of energy. The inner rings, **22** and **23**, are connected by brushes **24** and **25** to the positive or supply terminal of the source.

As shown, the positive supply terminal is grounded, but it is to be understood that where a connection to ground is mentioned herein it refers to a connection to the supply terminal of the local source of energy and not necessarily to a connection to earth.

The commutator on wheel **10** has two distributor brushes spaced 120° apart connected to two control wires A and B, and the commutator on wheel **11** has two similar brushes spaced 90° apart connected to two other control wires C and D. Designating the position in which the indicator is shown in Fig. 1A as position 1, and assuming clockwise rotation, as the movable member passes through the twelve positions, the distributor brushes connect wires A, B, C and D alternately to the outer and inner rings in the order listed in the following chart:

Position	ABCD	Symbol	Position	ABCD	Symbol
1	0000	—	7	0011	3
2	0101	5	8	0110	6
3	1011	—	9	1000	8
4	0010	2	10	0001	1
5	0100	4	11	0111	7
6	1001	9	12	1010	0

In the chart, under A, B, C or D, the value "0" indicates a connection to the corresponding outer ring, and the value "1" indicates a connection to the inner ring. Since

the circuit for the outer ring is normally open and the inner ring is grounded, the values "0" and "1" designate the deenergized or open condition, and the energized or grounded condition, respectively, of the control wires A, B, C and D, and correspond respectively to the marking and spacing characters of the elements of four-unit binary code signals for selecting different symbols for display by the indicator.

The indicator may be operated to any one of its twelve positions by connecting its four control wires A, B, C and D to a suitable set of circuit controllers arranged to form one of the four-unit binary code signals listed in the chart, and then closing a contact in the motor circuit, such as the switch S.

In order to enable the operating circuits for the indicator of Fig. 1A to be more readily traced, the control wires A, B, C and D are shown connected to the contacts of a bank of four control relays AR, BR, CR and DR. It is to be understood that these relays may be set up to represent the different binary code signals listed in the chart, by any suitable means, not shown.

It is to be noted that when the relay contacts are picked up they ground the control wires A, B, C and D like brushes 24 and 25, and that when they are released, the contacts are connected together like brushes 20 and 21. The relay contacts therefore are functionally equivalent to the circuit controllers actuated by the indicator wheels, and it follows that the indicator may also be operated by connecting its control wires to the corresponding control wires of another similar indicator instead of to the contacts of relays. In other words, when the switch in the motor circuit is closed, the indicator is conditioned to serve as a receiver, and when this switch is left open, the indicator is conditioned to serve as a transmitter of binary code signals.

The indicator circuits function in the following manner:

Assuming first that the indicator is in one of its positions 2 to 12, but that the relays are deenergized, as shown, so as to supply the blank signal 0000 for position 1 to the indicator. Since the value "0" appears in each of the signals listed in the chart, it is evident that as the wheels rotate, there will be a connection over at least one control wire from an outer ring connected to the motor terminal M, to the back contacts of the relays. Since the value "1" appears in each of the signals for positions 2 to 12 indicating a connection to an inner ring, it will be evident that the back contacts of the relays will be connected to ground over at least one control wire which is grounded at the indicator end, in each position except position 1. On closing switch S, the motor circuit is completed through the source of energy to ground, causing the moving member to be operated from one position to another until position 1 is reached.

Assuming next that one of the control relays becomes energized, relay BR, for example, so that the relay positions correspond to the signal 0100 for position 5; wire B is grounded at the relay end, over a front contact of relay BR. This grounds the motor terminal M in each of the indicator positions except 2, 5, 8 and 11. In these positions, terminal M is connected over wire A to the back contacts of the relays, which are grounded at brush 25 over wire C in positions 8 and 11 and over wire D in positions 2 and 11, as indicated in the chart. Consequently, if the motor circuit is closed at switch S, it will open to stop the indicator when the movable member arrives at position 5.

If any two of the control relays are energized, the operations are similar. If, for example, relays BR and DR are energized, corresponding to signal 0101, the grounding of wires B and D at the relay end grounds the motor terminal M in each position except 2 and 11. In position 11 terminal M is connected over wire A and the back contacts of the relays to wire C which is grounded at the indicator end. Consequently the movable member will stop only in position 2.

If three control relays are energized, there will be three control wires grounded at the relay end, B, C and D, for example, corresponding to signal 0111, and the motor terminal M is grounded by one or more of these three wires in all positions except position 11.

From the foregoing it will be clear that when one or more of the control relays is energized, the movable member of the indicator is operated through certain positions by energy supplied over the control wires at the point of control, and through other positions by energy supplied to the control wires at the indicator end. When all but one of the control wires are grounded at the point of control, this is of itself sufficient to move the indicator to the required position.

It will be seen that when the indicator stops in a selected position, each control wire which is grounded at the point of control is also grounded at the indicator end, and if the relay contacts are then disconnected from the control wires the indicator terminals remain grounded or ungrounded in accordance with the code signal by which the indicator was operated. The indicator position is thus indicated electrically by the signal which its circuit controllers supply to the control wires, as well as by the visual display of a symbol.

From the foregoing description of the embodiment of my invention herein illustrated, it will appear that the underlying principle of my invention is the provision of a control or signal wire for each element of a multi-element code signal, and the distribution of the individual signal wires to individual brushes cooperating with two wafer switches or disc commutators. Each of the disc commutators is mounted on a sprocket wheel, a perforated belt carried by the two wheels providing a positive driving connection between the two. Each of the disc commutators must have a different number of commutating sectors, and the diameters of the supporting sprocket wheels must be proportioned to the number of sectors. The circumferences of the two sprocket wheels may thus be divided into a number of spaces, each equal in length to a unit arc of the commutator sectors. The circumferences of the sprocket wheels are thus divided into a different number of spaces of equal length. The total number of belt spaces is made equal to the product of the number of spaces provided on the two sprocket wheels.

In the embodiment of my invention herein described, the commutator disc 18 is divided into three sectors of 120° each, while the commutator disc 19 is divided into four sectors of 90° each. The inner ring 22 of disc 18 extends 120° of arc while the inner ring 23 of disc 19 extends 180° of arc. This particular combination provides the three-unit and four-unit wheels 10 and 11, respectively; the belt 12 driven by the wheels being divided into twelve spaces.

A limitation is necessarily placed upon the number of selectable belt spaces by the particular type of binary code signals used. The theoretical limit of the number of selectable belt spaces in a binary code system is 2^n where n is the number of signal wires. In a four-unit binary code system the greatest number of belt spaces capable of being selected would be sixteen. In the four-unit binary code system herein described, the theoretical maximum number of selectable belt spaces is not attained but is limited to (2^n-1) fifteen belt spaces. This limitation upon the system described herein will be apparent upon reference to the drawings herein and considering the belt to be in position 1 with all four brushes of the signal wires engaging the outer rings of the commutator discs. The four controlling relays being down, the ground connection of the front contacts of these relays is not connected to the outer ring of either of the commutator discs. This position is therefore not selectable. In a copending application for Letters Patent of the United States bearing Serial No. 268,022, filed on even date herewith by Lloyd V.

Lewis and myself, for Display Indicator and Control System, a similar indicator and system is provided wherein the number of theoretical selectable belt spaces 2^n is attained by changes in the circuit connections of the motor and the controlling relays.

The differential pulley arrangement herein described for a belt having twelve selectable spaces can very readily be expanded to provide any desirable number of selectable spaces on the controlled belt, as long as the circumferences of the sprocket wheels are divided into spaces of equal length and the numbers of spaces on each wheel are different integral numbers, the number of belt spaces equaling the product of the numbers of spaces on the two wheels. The commutator discs are divided into unit arcs subtended by the circumferential divisions of the supporting sprocket wheels to provide the necessary commutating surfaces. Thus in the case of a six-unit binary code system in which the limit of selectable belt spaces for the system described herein is sixty-four less one, a fifty-six space belt may be provided. The circumferences of the supporting sprocket wheels for the fifty-six space belt would be divided into seven and eight spaces, respectively. The unit arcs for the commutator sectors carried by the sprocket wheels of such an indicator would be 51⅞° and 45°, respectively. Examples of indicators and control systems for six-unit binary code systems including improved control circuits are disclosed in the aforesaid copending application filed by Lloyd V. Lewis and myself.

It is therefore apparent that any combination of sprocket wheels may be used as long as the wheels are provided with a different number of commutator sectors and the circumferences of the wheels proportioned to the number of sectors. The number of belt spaces should be equal to the least common multiple of the numbers of sectors of the sprocket wheels. For example, a six-unit wheel and an eight-unit wheel may be used, but such a differential pulley arrangement would provide twenty-four selectable belt spaces, not forty-eight selectable spaces.

Although I have herein shown and described only one form of indicator mechanism embodying my invention, it is understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. A display indicator having a member movable through selectable positions for the display of symbols, with means for moving said member to said positions, comprising two wheels of different size, and a motor for rotating said wheels through different angular positions, said wheels being of such size that the product of the numbers of positions which said wheels may assume equals the number of selectable positions of said member and the wheels have a characteristic relative position for each such position, an operating circuit for said motor, circuit controllers on said wheels for opening or closing said circuit as said wheels assume different relative positions, and control means for supplying energy to said circuit.

2. A display indicator having a movable member comprising a belt with symbols on its surface for display one at a time in a window in the face of the indicator, with means for moving said belt to different selectable positions for the display of different symbols comprising two wheels of different size, and a motor for rotating said wheels to different positions corresponding to the different belt positions, said wheels being of such size that the product of the numbers of positions which the wheels may assume equals the total number of belt positions and the wheels have a characteristic relative position for each belt position, a plurality of circuit controllers including one set on each wheel for selectively opening or closing a circuit for said motor in each position in a manner characteristic of such position, and control means for selectively connecting a source of energy to said circuit controllers.

3. A display indicator having a movable member with symbols on its surface for display one at a time in a window in the face of the indicator, with means for moving said member to different selectable positions for the display of different symbols, comprising two wheels of different size and a motor for rotating said wheels to different positions corresponding to the different selectable positions of said member, the wheels being of such size that the product of the numbers of positions which the wheels may assume equals the total number of selectable positions and the wheels have a characteristic relative position for each such position, and means for selectively supplying energy to a circuit for said motor in accordance with the relative position of said two wheels.

4. A display indicator having a movable member comprising a belt with symbols on its surface for display one at a time in a window in the face of the indicator, with means for moving said belt to different selectable positions for the display of different symbols comprising two wheels of such size that the producet of the numbers of positions which the wheels may assume equals the total number of belt positions and the wheels have a characteristic relative position for each belt position, a motor for rotating said wheels to different positions corresponding to the different belt positions, a plurality of circuit controllers some of which are actuated by one wheel and the remainder by the other wheel, each arranged to open or close a branch of a circuit for said motor in each wheel position, said circuit controllers collectively having a distinctive combination of positions for each different belt position, and remote control means for selectively connecting a source of energy to one or more of said circuit controllers.

5. A display indicator having a movable member with symbols on its surface for display one at a time in a window in the face of the indicator, means for moving said member to different selectable positions to display said symbols comprising two wheels of different size and a motor for rotating said wheels, a positioning device adapted to hold said member in the position to which it has been moved by said motor, when the motor is de-energized, position selecting means comprising a circuit including said motor and a plurality of circuit controllers some of which are actuated by one wheel and the remainder by the other wheel, said circuit controllers assuming different relative positions as said member is moved to its different positions, and remote control means for connecting a source of energy to one or more of said circuit controllers in accordance with different code signals each identified with a particular symbol and effective to complete the circuit for said motor in all positions of said movable member except the one where the corresponding symbol is displayed.

6. In combination, an indicator having a member movable by a motor to display symbols corresponding to code signals supplied to said indicator, a normally open circuit for said motor, a set of two position contacts actuated by said member for selectively establishing connections from a set of control wires to said motor circuit, said contacts assuming a distinctive combination of positions in each indicator position corresponding to the code signal for the symbol displayed in such position, the number of selectable positions of said movable member being equal to (2^n-1) where n is the number of control wires, and means including a manually operable contact for completing said motor circuit effective when said control wires are supplied with a code signal which does not correspond with the symbol displayed by said indicator.

7. A display indicator for a multiple-unit code signal system, comprising a belt movable to a plurality of selectable positions, two wheels for advancing said belt, a motor for rotating said wheels to advance said belt, a circuit controller for each of said wheels including a continuous conducting ring and a discontinuous conduct-

ing ring, the conducting rings being divided into different numbers of sectors, the circumferences of the wheels being divided into spaces of equal length and equal in number to the sectors carried by said wheels, said belt having a number of spaces equal in number to the product of the numbers of spaces on the two wheels, a control wire for each unit of the multiple-unit code, said control wires being divided between the two circuit controllers; brushes cooperating with the rings of said circuit controllers and connected to said control wires, and an energizing circuit for said motor including a source of energy, said control wires and said circuit controllers, said brushes engaging the rings of said circuit controllers in accordance with the relative angular position of said rings to energize said control wires in a distinctive pattern corresponding to the code signal to complete the energizing circuit for said motor to advance said belt to a selectable space position determined by the code signal.

8. A display indicator for a multiple-unit code signal system, comprising a belt movable to a plurality of selectable positions, two wheels for advancing said belt, a motor for rotating said wheels to advance said belt, a circuit controller for each of said wheels including a continuous conducting ring and a discontinuous conducting ring, the conducting rings being divided into different numbers of sectors, the circumferences of the wheels being divided into spaces of equal length and equal in number to the sectors carried by said wheels, said belt having a number of spaces equal in number to the product of the numbers of spaces on the two wheels, a control wire for each unit of the multiple-unit code, said control wires being divided between the two circuit controllers; a brush for each of said control wires cooperating with the continuous and discontinuous rings of said circuit controllers, a source of energy having one terminal connected to said discontinuous rings and the other terminal connected through said motor to the continuous rings of said circuit controllers, said control wires being energized in a distinctive pattern corresponding to the code signal to energize said motor to advance said belt to a selectable space position determined by the code signal.

9. A display indicator for a multiple-unit code signal system, comprising a belt movable to a plurality of selectable positions, two wheels for advancing said belt, a motor for rotating said wheels to advance said belt, a circuit controller for each of said wheels including a continuous conducting ring and a discontinuous conducting ring, the conducting rings being divided into different numbers of sectors, the circumferences of the wheels being divided into spaces of equal length and equal in number to the sectors carried by said wheels, said belt having a number of spaces equal in number to the product of the numbers of spaces on the two wheels, a control wire for each unit of the multiple-unit code, said control wires being divided between the two circuit controllers; a brush for each of said control wires cooperating with the continuous and discontinuous rings of said circuit controllers, the brushes for each circuit controller being spaced apart an angle equal to the angle subtended by a sector of the conducting rings of the respective circuit controller; a source of energy having one terminal connected to said discontinuous rings and the other terminal connected through said motor to the continuous rings of said circuit controllers, said control wires being energized in a distinctive pattern corresponding to the code signal to energize said motor to advance said belt to a selectable space position determined by the code signal.

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