# United States Patent

**Cohen**

[15] **3,696,390**

[45] **Oct. 3, 1972**


[54] **DIGITAL MAGNETIC WHEEL LOGIC CONTROL NETWORK**


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[22] Filed: **Oct. 19, 1970**

[21] Appl. No.: **81,986**

[52] **U.S. Cl.** .....**340/324 R,** 340/325, 340/378 R, 340/379

[51] **Int. Cl.** .....**G08b 5/24**

[58] **Field of Search** .....340/324 R, 325, 378 R, 379, 340/334, 166 EL, 343, 344, 336



[56] **References Cited**

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| | | | |
|---|---|---|---|
| 3,218,625 | 11/1965 | Knotowicz | 340/325 X |
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| 3,548,403 | 12/1970 | Johnson | 340/324 R |
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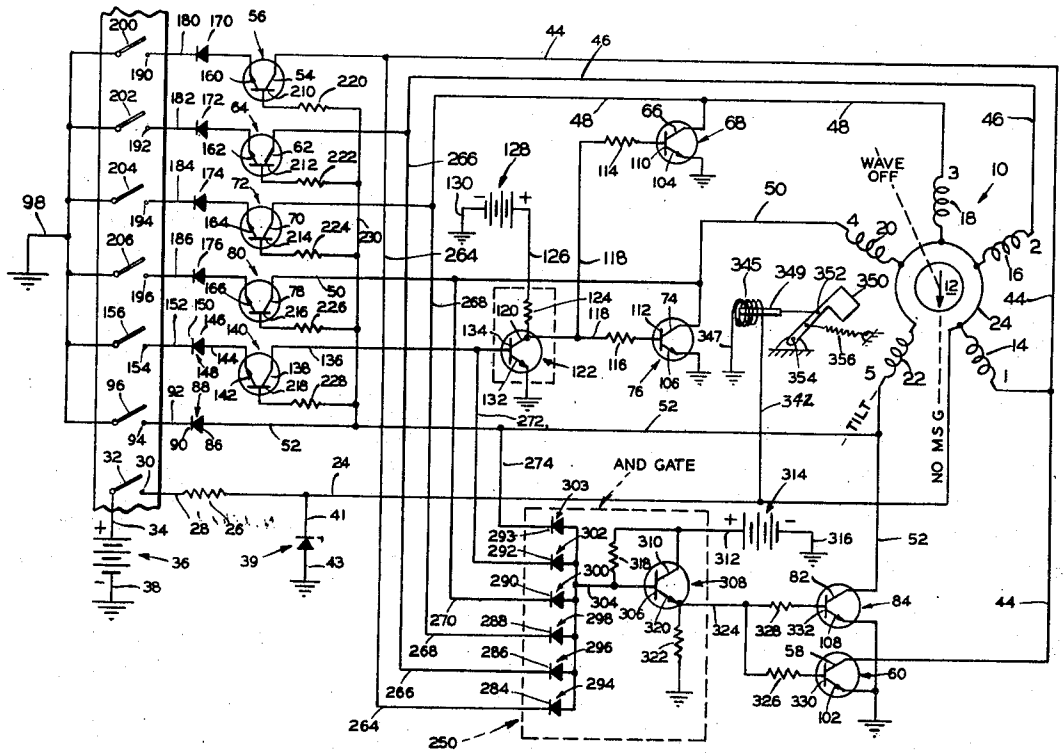
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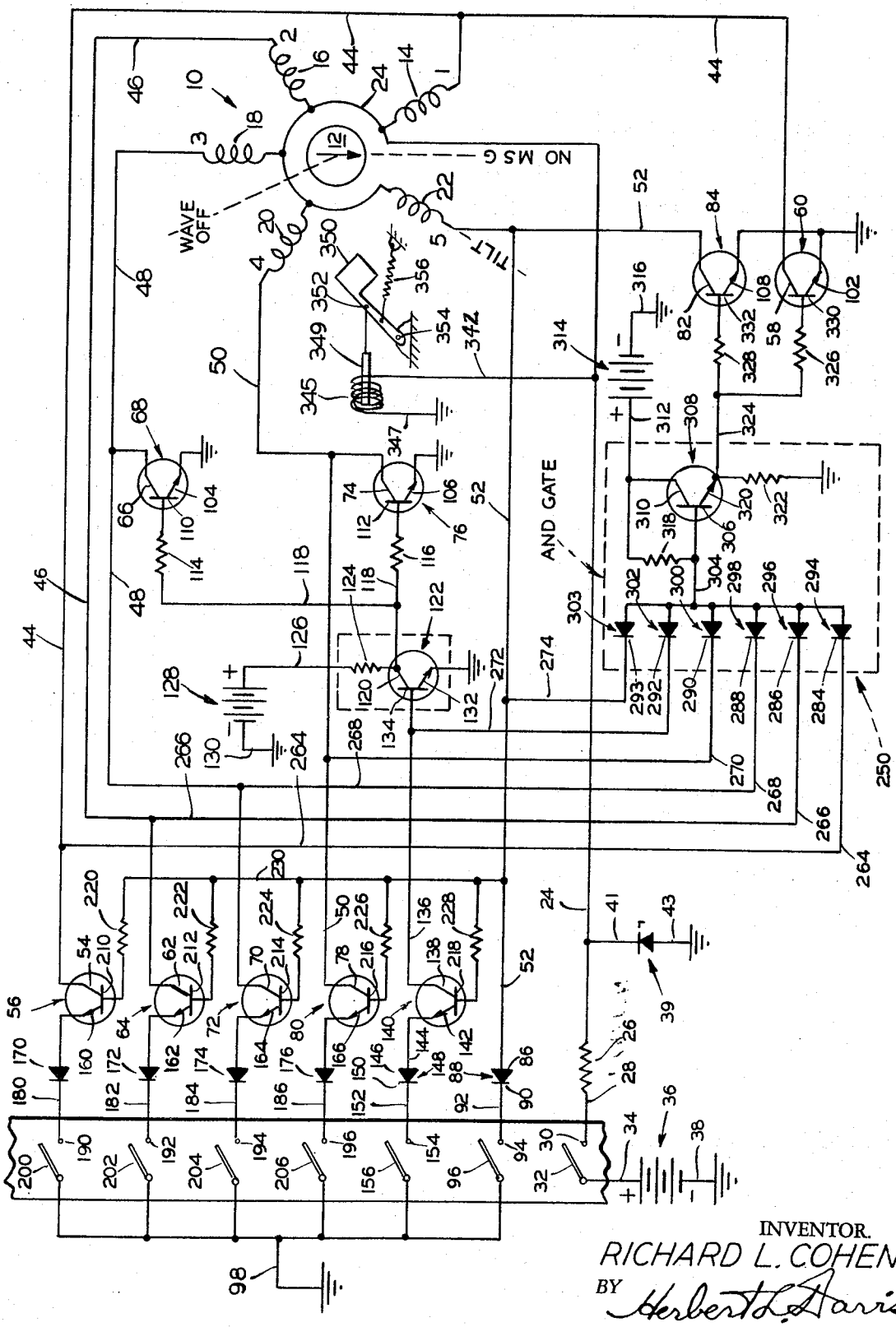


[57] **ABSTRACT**

A digital magnetic wheel logic control network for providing selective visual displays wherein the control network has a plurality of inputs, each of which is associated with a particular indicator display. Selective control of any of the inputs will energize one or more of a plurality of control coils of an electromagnetic indicator display cooperatively arranged in relation to a rotary magnet to angularly position the same and thereby provide for a selected indication and including an intermediary network controlled by one of the selective input controls and so arranged in the control network as to dominate the other of the selective input controls so that upon operation of the one input control the rotary magnet is angularly actuated in the electromagnetic indicator display to a position indicative of a failure in a command condition irrespective of any selective control of the other inputs. Further intermediary networks are located between the plurality of inputs and the control coils, each of these other intermediary networks including a plurality of solid-state control elements for selectively controlling energization of different pairs of the control coils to provide selective indications.


**10 Claims, 1 Drawing Figure**






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# DIGITAL MAGNETIC WHEEL LOGIC CONTROL NETWORK

## BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to a logic control network for providing a plurality of discrete messages by selective energization of control windings of an electromagnetic indicator device.

2. Prior Art

The logic control network of the present invention rests in an inventive concept which simplifies the control of the electromagnetic indicator device in requiring far fewer parts than the conventional servoed approach so as to raise the percent of durability and certainty of operation of the electromagnetic indicator device, and effect a condition of greater durability and one which is more sure to produce the desired results in emergency and not only with greater certainty, but with less expense.

Heretofore electromagnetic indicator devices of a type that may be utilized in the digital magnetic wheel logic control network of the present invention have been described and claimed in a U.S. Pat. No. 3,392,382, granted July 9, 1968 and in a U.S. Pat. No. 3,465,334, granted Sept. 2, 1969. Both of said patents have been granted to Leonard C. Pursiano and Arnold H. Cohen and assigned to The Bendix Corporation.

Moreover in a U.S. Pat. No. 3,218,625 granted Nov. 16, 1965 to Aloysius E. Knotowicz there is disclosed a plural indication rotatable display system wherein one or more selectively energizable inputs controls the particular indication to be displayed. In FIG. 11 of the last mentioned patent, there is shown a solid state control system for an indication system wherein the base inputs of transistors are selectively energized to control the indication to be displayed.

However, the prior art of record does not suggest (1) the specific circuitry of the present invention in which an AND gate is so arranged in an intermediary network that upon no message being selected, all inputs to the AND gate will be floating so that the output from the AND gate will saturate a pair of auxiliary control transistors to selectively effect energization of a pair of control coils of a rotary electromagnetic indicator device to position an indicator wheel of the indicator display with a rotary magnet midway between these two control coils.

The prior art of record further fails to suggest a feature (2) of the present invention which resides in another intermediary network controlled by operation of one of the selective input controls and so arranged upon operation of the one selective input control as to render the other of the input controls ineffective to control the electromagnetic indicator while the operation of the one input control effects an angular actuation of the rotary magnet to a position indicating a command condition failure irrespective of any selective operation of the other input controls.

A further novel feature (3) of the present invention, resides in the provision of another intermediary network controlling another pair of transistors so as to selectively effect energization of another pair of said control coils of the electromagnetic indicator device to position the rotary magnet of the indicator wheel to an indicator position midway between the last mentioned other pair of control coils.



Further upon normal operating voltage being supplied to the control network a solenoid is effective to raise an indicator flag or device, while upon a failure in such operating voltage the solenoid is effectively deenergized whereupon a spring biases the solenoid in an opposite sense to drop a flag or suitable indicator device in front of the indicator wheel in a manner somewhat similar to that described in a U.S. Pat. No. 3,184,731, granted May 18, 1965 to Milton Brown and assigned to The Bendix Corporation.

## SUMMARY OF THE INVENTION

In the simplified arrangement of the present invention, the logic control network includes an AND gate so arranged in an intermediary network that upon no message being selected, all inputs to the AND gate will be floating so that the output from the AND gate will effectively control a pair of auxiliary control transistors so as to selectively effect energization of a pair of control coils of a rotary electromagnetic indicator device to position an indicator wheel of the device with a rotary magnet midway between the pair of energized control coils to provide a no message indication.

Thus an object of the invention is to provide in such a logic control network a simplified arrangement in which an intermediary network is effective to cause energization of a suitable pair of control coils of the electromagnetic indicator device to provide a no message indication, upon the control network being in a no message selected condition.

A further object of the invention is to provide in the logic control network another intermediary network controlling in turn another pair of transistors so as to selectively effect energization of another pair of said control coils of the rotary electromagnetic indicator device to position the rotary magnet of the indicator wheel to a selected indicator position midway between the last mentioned other pair of control coils.

A further object of the invention is to provide another intermediary network between a plurality of the input controls and electromagnetic control coils of the electromagnetic display indicator device and so arranged as to render the input controls ineffective upon operation of another input control to effect actuation of a rotary magnet to an angular position indicative of a command failure condition.

A further object of the invention is to provide a digital magnetic wheel logic control network having a plurality of inputs, each of which is associated with a particular indicator display and including means for selective control of any of the inputs to effectively energize one or more of the control coils of the indicator display or an intermediary network (1) for effecting energization of a pair of said control coils and thereby selectively position a rotary magnet of the electromagnetic indicator so as to provide for the selected indication, and including another intermediary network (2) located between the plurality of inputs and the control coils and effective upon none of the inputs being selectively controlled to effect energization of another pair of the control coils of the indicator device so as to effectively position the rotary magnet of the device intermediate to the last mentioned other pair of control coils to provide a no message condition indication, and a further overriding intermediary network (3) operable by one of the input controls to render the other input

controls ineffective simultaneously with the actuation of the rotary magnet in the electromagnetic indicator to a position indicative of a command failure condition.

These and other objects and features of the invention are pointed out in the following description in terms of the embodiment thereof which is shown in the accompanying drawing. It is to be understood however that the drawing is for the purpose of illustration only and is not a definition of the limits of the invention, reference being had to the appended claims for this purpose.

## DESCRIPTION OF THE DRAWING

The drawing is a schematic wiring diagram of a digital magnetic wheel logic control network embodying the present invention and including a plurality of input controls and intermediary networks for controlling the angular position of a magnetic indicator wheel upon a selected operation of one of said input controls or one of said intermediary networks.

## DESCRIPTION OF A PREFERRED EMBODIMENT

In the aforenoted U.S. Pat. No. 3,465,334 and No. 3,392,382 there is disclosed an electromagnetic indicator device of a type having a magnetic or permanent magnet rotor angularly positioned by peripheral electromagnets and in the control system of which indicator device there may be provided a digital magnetic wheel logic control network embodying the present invention.

Referring to the drawing such an electromagnetic indicator device has been designated generally by the numeral **10** and may include a magnetic rotor **12** selectively angularly positioned by peripheral control electromagnetic windings or coils **14, 16, 18, 20** and **22** respectively.

Each of the control coils or windings **14, 16, 18, 20** and **22** have one end thereof connected by a common conductor **24** through a resistor **26** and a conductor **28** to a switch contact element **30** controlled by a switch arm **32** which is in turn connected through a conductor **34** to a positive terminal of a source of electrical energy or battery **36** having an opposite negative terminal connected through a conductor **38** to ground.

A Zener diode **39** has an anode element connected to ground through a conductor **43** and a cathode element connected to a conductor **41** leading to the input conductor **24**. The Zener diode **39** is of a type having a unique reverse current breakdown characteristic which effects reduction in the back direction upon voltages exceeding a predetermined value being applied to the input conductor **24** so as to maintain the voltage on the input line **24** at a predetermined voltage value.

The voltage maintained on the input conductor **24** at said predetermined value by the operation of the Zener diode **39** is applied at one end of each of the control windings **14, 16, 18, 20** and **22**, while opposite other ends of each of the control windings **14, 16, 18, 20** and **22** are connected, respectively, through conductors **44, 46, 48, 50** and **52** to selectively operable means for controlling the energization or flow of current through the control windings **14, 16, 18, 20** and **22**.

Thus the conductor **44** leads from the control winding **14** to a collector element **54** of an NPN type transistor **56** and also to a collector element **58** of another NPN type transistor **60**. Further the conductor **46** leads from the control winding **16** to a collector element **62** of an NPN type transistor **64**, while the conductor **48** leads from the control winding **18** to a collector element **66** of an NPN type transistor **68** and also to a collector element **70** of another NPN type transistor **72**. Moreover the conductor **50** leads from the control winding **20** to a collector element **74** of an NPN type transistor **76** and in addition to a collector element **78** of another NPN type transistor **80**. Furthermore the conductor **52** leads from the control winding **22** to the collector element **82** of an NPN type transistor **84** and also from the control winding **22** to an anode element **86** of a diode **88** having a cathode element **90** connected by a conductor **92** to a switch contact **94** controlled by switch arm **96** connected by a conductor **98** to ground. Each of the transistors **60, 68, 84** and **76** include emitter elements **102, 104, 106** and **108**, respectively, connected to ground.

Further each of the transistors **68** and **76** have base elements **110** and **112**, respectively, connected through resistors **114** and **116** to a conductor **118** leading to a collector element **120** of an NPN type transistor **122**. Also connected to the collector element **120** is a resistor **124** leading through a conductor **126** to a positive terminal of a source of electrical energy or battery **128** having a negative terminal connected to ground through a conductor **130**. The transistor **122** also has a emitter element **132** connected to ground and a base element **134** connected through a conductor **136** to a collector element **138** of an NPN type transistor **140** having an emitter element **142** connected to a conductor **144** leading to an anode element **146** of a diode **148** having a cathode element **150** connected through a conductor **152** to a switch contact **154** controlled by a switch arm **156** which is in turn connected to ground through the conductor **98**.

Each of the transistors **56, 64, 72** and **80**, respectively, have emitter elements **160, 162, 164** and **166** connected to anode elements of diodes **170, 172, 174** and **176** respectively. The diodes **170, 172, 174** and **176** have cathode elements connected through, respective, conductors **180, 182, 184** and **186** to switch contacts **190, 192, 194** and **196** controlled by, respective, switch arms **200, 202, 204** and **206** connected to ground through the conductor **98**.

Furthermore each of transistors **56, 64, 72, 80** and **140** have base elements **210, 212, 214, 216** and **218**, respectively, connected through resistor elements **220, 222, 224, 226** and **228** to a common conductor **230** leading in turn to the conductor **52**.

## OPERATION OF FIRST INTERMEDIARY NETWORK

From the foregoing it will be seen that the transistor **122** and its cooperating circuitry provides a first intermediary network for controlling the operation of the pair of transistors **68** and **76** and in turn effect upon closure of switch arm **156** energization of the pair of control windings **18** and **20** of the electromagnetic indicator **10** to cause the rotary magnet **12** to be angularly adjusted to a position intermediate the energized control windings **18** and **20** to cause, as shown by the dash lines of the drawing, the electromagnetic indicator device **10** to provide a selected indication, designated as a "Wave-Off" indication.

## SECOND INTERMEDIARY NETWORK

Furthermore an AND gate **250** and its cooperating circuitry provides a second intermediary network for controlling the operation of the pair of transistors **60** and **84** and in turn energization of the pair of control windings **14** and **22**, as hereinafter explained.

In controlling the operation of the AND gate **250**, there lead from the conductors **44, 46, 48, 50, 136** and **52** controlling energization of the respective windings **14, 16, 18, 20** and **22** of the electromagnetic indicator **10**, conductors **264, 266, 268, 270, 272** and **274** which in turn lead to cathode elements **284, 286, 288, 290, 292** and **293**, respectively, of control diodes **294, 296, 298, 300, 302** and **303** for the AND gate **250**. The, respective control diodes have anode elements connected to a common conductor **304** leading to a base element **306** of an NPN type transistor **308** having a collector element **310** connected by conductor **312** to a positive terminal of a source of electrical energy or battery **314** having a negative terminal connected through a conductor **316** to ground. respective,

A biasing resistor **318** is connected across the base element **306** and collector element **310** of the NPN type transistor **308** so as to apply a positive bias to the base element **306**. Further the transistor **308** has an emitter element **320** connected through a resistor **322** to ground and through a conductor **324** and resistors **326** and **328** to the base elements **330** and **332** of the respective NPN type transistors **60** and **84**.

## OPERATION OF SECOND INTERMEDIARY NETWORK

Thus upon the control switch arm **32** being positioned so as to close contact **30** to apply an operating voltage to the input conductor **24** of the control network with the message input selector switches **96, 156, 206, 204, 202** and **200** all being in an open circuit position, as shown by the drawing, or in a no message transmitting condition, a resulting positive bias is applied through conductors **264, 266, 268, 270, 272** and **274** to the several cathode elements of the control diodes **294, 296, 298, 300, 302** and **303**.

In the last mentioned operating condition, the control diodes **294, 296, 298, 300, 302** and **303** are so back biased that the positive bias applied to the base element **306** from the battery **314** through the biasing resistor **318** is effectively maintained to render the NPN type transistor **308** conductive of electrical energy which is in turn applied through the emitter follower resistor **322**.

A resultant voltage drop across the emitter follower resistor **322** will in turn apply through the conductor **324** and resistors **326** and **328** a biasing voltage to both the base element **330** and the base element **332** of the transistors **60** and **84** to render these NPN type transistors in turn conductive to effectively energize both of the control windings **14** and **22**. This will in turn effect a positioning of the rotary magnet **12** to an angular position intermediate the respective control windings **14** and **22** to cause an indication of a no message transmitting condition of the electromagnetic indicator **10**.

However, upon anyone of the selector switch arms **96, 156, 206, 204, 202** or **200** being positioned so as to close the corresponding switch contact controlled thereby, the positive voltage or back bias heretofore applied through the corresponding conductors **264, 266, 268, 270, 272** or **274** will be withdrawn from the cathode element of the corresponding control diode **94, 296, 298, 300, 302** or **303**.

The last mentioned action will then in turn divert through such control diode, from which the back bias has been withdrawn, the positive bias heretofore applied to the base element **306** of the transistor **308**. The thus effected control diode will then render the transistor **308** nonconductive so as to in turn cause a negative output to be applied through the conductor **324** leading from the AND gate **250** to render both transistors **60** and **84** nonconductive. Thereupon the control windings **14** and **22** will no longer be effectively energized through the transistors **60** and **84** so that the rotor magnet **12** will then be positioned in the electromagnetic indicator device **10** to an angular position dependent upon the energization of the control windings **14, 16, 18, 20** and **22** that has been effected by the selectively closed switch arm **96, 156, 206, 204, 202** or **200**, as the case may be.

## OPERATION OF THIRD INTERMEDIARY NETWORK

Moreover it will be seen that so long as the switch arm **96** remains in an open circuit position, a positive voltage bias will be applied through the common conductor **230** to the base elements of the NPN type transistors **56, 64, 72, 80** and **140** so as to render the same conductive. These transistors **56, 64, 72, 80** and **140** provide in the control network a third intermediary network for conducting electrical energy for energizing the selected control winding or windings of the electromagnetic indicator device **10** upon the closure of the selected switch arm **156, 206, 204, 202** or **200**, as the case may be.

However upon the switch arm **96** being selectively operated so as to close the switch contact **94**, the positive voltage bias applied through the common conductor **230** of this third intermediary network will be diverted through conductor **52**, diode **88** and the closed switch arm **96** leading through conductor **98** to ground. Thereupon the several transistors **56, 64, 72** and **140** of the third intermediary network will be rendered non-conductive and the several switch arms **200, 202, 204, 206** and **156** ineffective for causing selective energization of the control windings **14, 16, 18** and **20** or the selected simultaneous energization of both control windings **18** and **20** upon the switch arm **156** being positioned to close switch contact **154**.

Thus, the closure of switch contact **94** by the switch arm **96** will override the selective control that would otherwise be effected by the closure of anyone of the other switch arms **200, 202, 204, 206** and **156**. This is a desirable feature of the invention inasmuch as the resultant flow of current through the control winding **22** by the switch arm **96** closing switch contact **94** will effect upon such energization of the control winding **22** an actuation of the rotary magnet **12** to an angular position corresponding to that of the control winding **22** to cause the electromagnetic indicator device **10** to provide a command equipment failure indication, designated as a "TILT" indication on the drawing by the dash lines.

In this connection, the several message transmitting switch arms **156, 206, 204, 202** and **200** may be automatically operated by suitable means responsive to sensed or command conditions so as to act through the control network to cause the angular positioning of the rotary magnet **12** of the electromagnetic indicator device **10** to provide selected indications of such sensed or command conditions.

However upon a failure in such automatic operating means, it is essential that energization of the control winding **22** by the closure of switch **96** by operation of other suitable command or failure sensing equipment should dominate the control network so as to cause the rotary magnet **12** to be angularly positioned in the electromagnetic indicator device **10** to a position indicative of a "TILT" or command equipment failure condition, irrespective of whatever other selected message is being transmitted by the selected closure of one or the other of the aforesaid switch arms **156, 206, 204, 202** and **200**.

## INPUT VOLTAGE FAILURE INDICATOR

Furthermore in order to alert the observer of the indicator **10** to a failure in the operating voltage applied at the input conductor **24**, failure in the source of electrical energy **36** or an open circuit condition of the switch arm **32**, there is provided a suitable failure indicator means operatively connected across the input conductor **24** and ground so as to sense the condition of the operating voltage applied at the input conductor **24**.

The last mentioned indicator means may be connected to input conductor **24** by a conductor **342** which leads to one end of a solenoid winding **345** having an opposite end connected through a conductor **347** to ground. The solenoid winding **345** upon effective energization by the input voltage applied across conductor **24** and ground may serve to actuate an armature **349** into the solenoid winding **345** so as to raise an indicator flag **350**. The flag **350** is pivotally connected at **352** to the armature **349** and is further pivotally mounted at **354** and biased by a suitable spring **356** so as to drop the flag **350** upon ineffective energization by the input voltage so as to indicate a failure of the operating voltage. Another form of the indicator means may include a suitable shield or indicator element which may be biased by a suitable spring means into a position in front of the indicator wheel **12** upon the control winding **345** of the solenoid operatively connected to the indicator element being effectively deenergized, as upon failure of the source **36** of the operating voltage applied at the input conductor **24** or upon the switch arm **32** being positioned out of contacting relation with the switch contact **30**. The structure and operation of the solenoid **345** and the indicator element or shield positioned thereby may be similar to that described in the aforenoted U.S. Pat. No. 3,184,731, granted May 18, 1965 to Milton Brown and assigned to The Bendix Corporation.

Although only one embodiment of the invention has been illustrated and described, various changes in the form and relative arrangements of the parts, which will not appear obvious to those skilled in the art may be made without departing from the scope of the invention. Reference is, therefore, to be had to the appended claims for a definition of the limits of the invention.

What is claimed is:

1. In an electromagnetic indicator of a type for displaying a plurality of discrete indicia in response to electrical energization, said indicator device being of a type including a magnetic rotor supported for deflection about an axis of rotation thereof to a plurality of discrete angularly spaced positions, a plurality of electromagnetic coils positioned about the axis of rotation of said rotor, and an electrical control network including selectively operable input controls to energize said coils; the improvement comprising in said electrical control network an intermediary control network connected between at least one of the input controls and a plurality of said coils; said intermediary control network including a plurality of control devices, each of said control devices including a control element, and each of said control devices being connected in the intermediary control network in an electrical circuit including means to operate at least a different one of said electromagnetic coils, means to operate the control element of each of said control devices in one selective sense to cause said control devices to be relatively conductive of electrical energy and in another selective sense to cause said control devices to be relatively nonconductive of electrical energy, said control devices being operably connected in the intermediary network to at least one of said input controls so as to render the operation of the control elements of each of said plurality of control devices in said one and other selective senses dependent upon a selective operative and inoperative condition of said at least one input control so that a resultant selective energization of said electromagnetic coils may effect actuation of the magnetic rotor of the electromagnetic indicator to predetermined angular positions dependent upon said at least one input control being selectively in said operative and inoperative condition; the plurality of control devices including first and second control devices, and the means to operate the control element of each of said control devices including a main control device having a control element, a source of biasing voltage connected with said main control device in a main control circuit, means operably connecting said main control circuit to the control elements of said first and second devices for controlling the energization of the different electromagnetic coils, and other means operably connecting the control element of the main control device to said at least one input control so that the actuation of the magnetic rotor of the electromagnetic indicator to said predetermined angular positions may be dependent upon said at least one input control being selectively in said operative and inoperative condition; said electrical control network including another intermediary control network connected between said electromagnetic coils and all of said input controls selectively operable to energize said coils, said other intermediary control network including third and fourth control devices, each of said third and fourth control devices including a control element, each of said third and fourth control devices being connected in said other intermediary control network in a circuit with another different one of said electromagnetic coils, another main control device to operate the control elements of said third and fourth control devices in one selective sense to cause said third and fourth control devices to be relatively conductive of electrical

energy and in another selective sense to cause said third and fourth control devices to be relatively non-conductive of electrical energy, said other main control device including another control element, a plurality of unidirectional current flow control elements for operably connecting the control element of the other main control device to each of said input controls, said unidirectional current flow control elements being responsive upon at least one of said input controls being in an operative condition to cause the other main control device to operate the control element of each of said third and fourth control devices in said other selective sense so as to effect a simultaneous deenergization of said different electromagnetic coils selectively controlled thereby, and said unidirectional current flow control element being responsive upon all of said input controls being in an inoperative condition to cause the other main control device to operate the control element of each of said third and fourth control devices in said one selective sense.

2. The improvement defined by claim 1 including means operatively connecting said at least one input control to all of the control elements of said plurality of control devices, and other means operatively connecting each of the control devices in the intermediary control network between other of said input controls and said means to operate at least a different one of said electromagnetic coils so as to render the selective operation of said electromagnetic coils by said other input controls dependent upon a selective operative and inoperative condition to said at least one input control.

3. The improvement defined by claim 1 in which said other operable connecting means includes a plurality of unidirectional current flow control elements for operably connecting the control element of the main control device to each of said input controls, said unidirectional current flow control elements being responsive upon at least one of said input controls being in an operative condition to cause the main control device to operate the control element of each of said first and second control devices in said other selective sense so as to effect a simultaneous deenergization of said different electromagnetic coils selectively controlled thereby, and said unidirectional current flow control elements being responsive upon all of said input controls being in an inoperative condition to cause the main control device to operate the control element of each of said first and second control devices in said one selective sense so as to effect said simultaneous energization of said different electromagnetic coils selectively controlled thereby.

4. The improvement defined by claim 1 including in said electrical control network another intermediary control network connected between said electromagnetic coils and all of said input controls selectively operable to energize said coils, said other intermediary control network including a plurality of third control devices, each of said third control devices including a control element, the control elements of said third control devices being operable in one sense to cause said third control devices to be relatively conductive of electrical energy and in another selective sense to cause said third control devices to be relatively non-conductive of electrical energy, said plurality of input controls including a main input control, means operatively connecting said main input control to all of the control elements of said plurality of third control devices, and other means operatively connecting each of the third control devices in the other intermediary control network between other of said input controls and the means to operate at least a different one of said electromagnetic coils so as to render the selective operation of said electromagnetic coils by said other input controls dependent upon a selective operative and inoperative condition of said main input control.

5. The improvement defined by claim 4 including in said electrical network a third intermediary control network connected between said electromagnetic coils and all of said input controls selectively operable to energize said coils, said third intermediary control network including fourth and fifth control devices, each of said fourth and fifth control devices including a control element, each of said fourth and fifth control devices being connected in said third intermediary control network in a circuit with another different one of said electromagnetic coils, a third main control device to operate the control elements of said fourth and fifth control devices in one selective sense to cause said fourth and fifth control devices to be relatively conductive of electrical energy and in another selective sense to cause said fourth and fifth control devices to be relatively non-conductive of electrical energy, said third main control device including another control element, a plurality of unidirectional current flow control elements for operably connecting the control element of the third main control device to each of said input controls, said unidirectional current flow control elements being responsive upon at least one of said input controls being in an operative condition to cause the third main control device to operative the control element of each of said fourth and fifth control devices in said other selective sense so as to effect a simultaneous deenergization of said different electromagnetic coils selectively controlled thereby, and said unidirectional current flow control elements being responsive upon all of said input controls being in an inoperative condition to cause the third main control device to operate the control element of each of said fourth and fifth control devices in said one selective sense.

6. In a control network for an electromagnetic display of a type including a plurality of control coils, and the control network including a plurality of control inputs for selectively energizing the control coils associated in cooperative relation with an indicator display means, the control network including an intermediary network controlled by one of the selective input controls, and means responsive to selective operation of said one input control in one sense to dominate the other of the selective input controls so as to render the other input controls ineffective to provide a selective energization of the control coils associated therewith so long as said one input control remains in said operative condition of said one sense and effective to provide selective energization of another of said control coils to cause said display means associated therewith to provide an indication of the operative condition of said one input control in said one sense, and other means responsive to selective operation of said one input control in another sense to effectively

deenergize said other of said control coils and render the other of said input controls effective to provide selective energization of the control coils associated therewith so long as said other of said input controls remains in said operative condition to said other sense.

7. In a control network for an electromagnetic display of a type including a plurality of control coils, and the control network including a plurality of control inputs for selectively energizing the control coils associated in cooperative relation with an indicator display means, the control network including an intermediary network including means operative upon all of said input controls being in an inoperative condition to cause selective energization of said control coils in one sense to thereby cause said display means associated therewith to provide an indication of said inoperative condition of said input controls, and other means responsive upon anyone of said input controls being in an operative condition to present said operative means from causing the selective energization of said control coils in said one sense, whereupon the said control coils may be selectively energized in another sense dependent upon the one input control being in said operative condition; the control network including another intermediary network controlled by one of the selective input controls, and means responsive to selective operation of said one input control in one sense to dominate the other of the selective input controls so as to render the other input controls ineffective to provide a selective energization of the control coils associated therewith so long as said one input control remains in said operative condition of said one sense and effective to provide selective energization of another of said control coils to cause said display means associate therewith to provide an indication of the operative condition of said one input control in said one sense, and other means responsive to selective operation of said one input control in another sense to effectively deenergize said other of said control coils and render the other of said input controls effective to provide selective energization of the control coils associated therewith so long as said other of said input controls remains in said operative condition of said other sense.

8. In a control network for an electromagnetic display of a type including a plurality of control coils, and the control network including a plurality of control inputs for selectively energizing the control coils associated in cooperative relation with an indicator display means, the control network including an intermediary network controlled by said input controls, the intermediary network including means responsive to operation of a first of said input controls operative to effect simultaneous energization of a pair of said control coils, a second of said input controls operative to effect selective energization of one of said control coils of said pair of control coils, and a third of said input controls operative to effect selective energization of the other of said control coils of said pair of control coils, and means responsive to operation of one of said aforementioned input controls for rendering the other of said input controls ineffective to provide the foregoing selective energization of said control coils so long as said one input control remains in an operative condition.

9. In a control network of a type defined by claim 8 in which the control network includes another intermediary network including means operative upon all of said input controls being in an inoperative condition to cause selective energization of said control coils in one sense to thereby cause said display means associated therewith to provide an indication of said inoperative condition of said input controls, and other means responsive upon anyone of said input controls being in an operative condition to prevent said operative means from causing the selective energization of said control coils in said one sense, whereupon the said control coils may be selectively energized in another sense dependent upon the one input control being in said operative condition.

10. In a control network of a type defined by claim 9 in which the operation of said one input control effects a selective energization of said control coils to cause said display means associated therewith to provide an indication of the operative condition of said one input control.

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