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DIGIT DISPLAY INDICATOR
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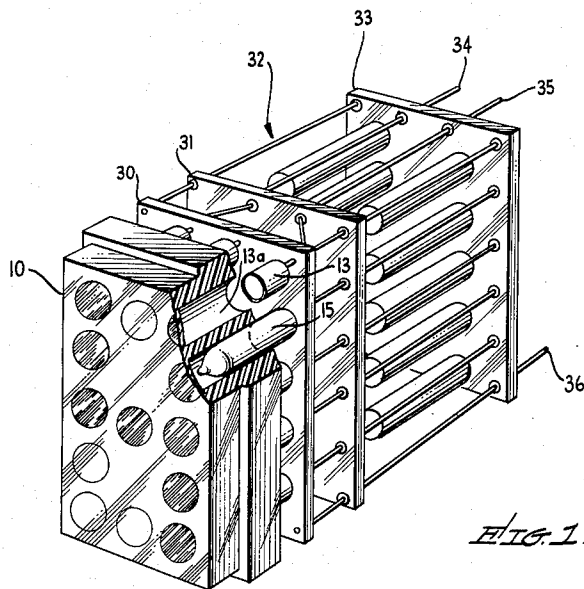


FIG. 1.

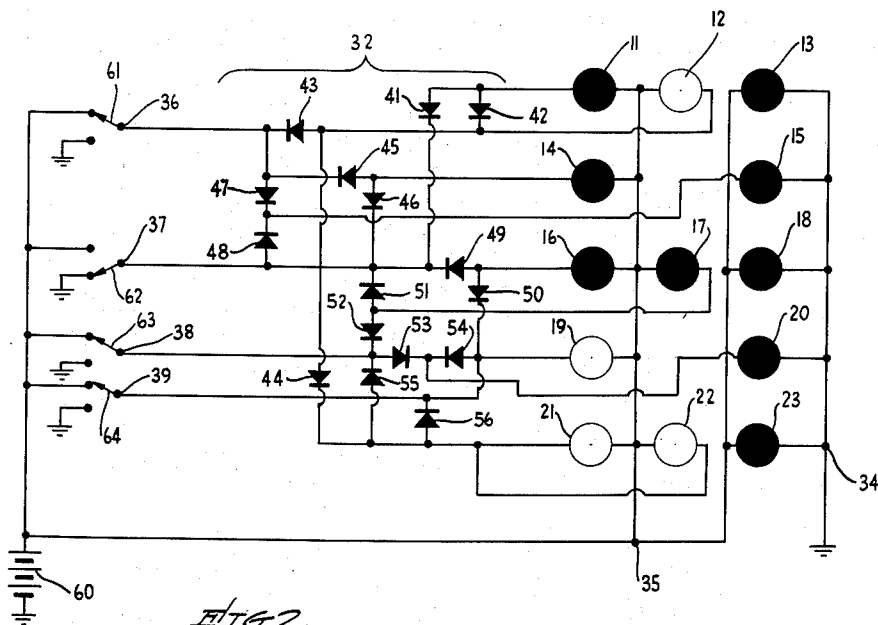


FIG. 2.

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DIGIT DISPLAY INDICATOR

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The present invention relates to digit display indicators and more particularly to a simple and compact arrangement for displaying any of the numerals zero through nine at a remote location.

Remote indicators for displaying different numerals are usually bulky and complex and require the use of a large number of control wires and switches. For example, electrical scoreboards used at athletic contests may have eighteen or more electric incandescent lamps for each digit to be displayed. The lamps are arranged in a pattern so that by illuminating different combinations of lamps, different numerals may be displayed. The different combinations of lamps are illuminated by means of ten or more switches or relay contacts connected to the remote indicator by ten or more control wires.

An arrangement which is used in electronic equipment for the display of numerals utilizes ten glass plates stacked one behind the other, each having a different numeral engraved thereon. Each plate may be illuminated from the edge, and only the numeral on the illuminated plate may be seen from the front of the indicator. However, such devices are too bulky for use in miniaturized electronic equipment. In addition, each lamp must be large in order to provide sufficient illumination for the large area described by each numeral, and a large number of switches and control wires are necessary.

In aircraft electronic equipment, for example, it is desirable to have compact, simple and reliable digit display indicators that can be controlled by means of a minimum number of switches and control wires.

Accordingly, it is an object of the present invention to provide a digit display having only four control terminals.

Another object of the invention is the provision of a remote indicator that occupies a small volume.

Yet another object of the present invention is the provision of a numerical indicator having simplified circuitry.

A further object of the invention is to provide a digit display that requires little illumination per unit area.

In accordance with these and other objects, a feature of the invention is the arrangement of thirteen subminiature incandescent lamps and sixteen switching diodes in a volume less than one cubic inch. Another feature of the invention is the arrangement of the incandescent lamps in a figure-eight pattern so that by illuminating different combinations of lamps, the numerals zero through nine are described. Another feature of the invention is the interconnection of the lamps and diodes such that the ten different combinations of lamps may be illuminated by the application of a source of potential in different polarity combinations to only four control terminals.

The following specification and the accompanying drawing describe and illustrate an exemplification of the present invention. Consideration of the specification and the drawing will lead to an understanding of the invention, including the novel features and objects thereof. Like reference characters are used to designate like parts throughout the figures of the drawing.

FIG. 1 is a perspective view partly broken away of a digit display indicator constructed in accordance with the invention; and

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FIG. 2 is a circuit diagram of the embodiment of the digit display indicator of FIG. 1.

As may be seen in FIGS. 1 and 2, a group of thirteen incandescent lamps 11-23 are arranged in a figure-eight configuration so that by selectively illuminating various ones of the lamps 11-23 the digits zero through nine may be displayed. The lamps 11-23 are arranged in a three-by-five array, that is, in three vertical rows each having five lamp positions. The middle row has only three lamps 12, 17, and 22, these being disposed in the central and two end positions.

As may be best seen in FIG. 1, an indicator block 10 is provided with thirteen cylindrical lamp cells or chambers 11a-23a arranged in the aforementioned figure-eight pattern. The indicator block 10 is cast of a clear epoxy resin with a red filler added to form a red, translucent block, and the cylindrical inside wall of each of the chambers 11a-23a is painted with an opaque material, such as silver paint. Light is thus prevented from passing between adjacent ones of the chambers 11a-23a, but inasmuch as the bottoms of the chambers 11a-23a are not painted, light in any of the chambers 11a-23a is transmitted to the front of the indicator block 10. Thus, each of the lamps 11-23 need only illuminate a small circular area in the front wall of the indicator block 10 and, therefore, extremely small incandescent lamps 11-23 may be used. The so-called "grain-of-wheat" lamps have been found to be satisfactory.

The lamps 11-23 are located in their respective chambers 11a-23a in the indicator block 10 and their leads are soldered to first and second printed circuit boards 30 and 31. A diode switching circuit 32 is soldered between the second printed circuit board 31 and a third printed circuit board 33. Two leads extend through the third printed circuit board 33 to form first and second power terminals 34 and 35, and four additional leads also extend through the third printed circuit board 33 to form control terminals 36-39. The complete digit display indicator occupies a volume of less than one cubic inch and extends behind a mounting panel to a depth of only one inch or less.

Referring now more specifically to FIG. 2, each of the five lamps 13, 15, 18, 20 and 23 in the right vertical row has one lead connected to the first power terminal 34, while one lead of the remainder of the lamps 11, 12, 14, 16, 17, 19, 21 and 22 is connected to the second power terminal 35. The three lamps 13, 18 and 23 in the center and end positions in the right vertical row have their remaining lead connected to the second power terminal 35. Thus, when power is applied to the power terminals 34 and 35, these three lamps 13, 18 and 23 will be illuminated. The remaining or control leads of the remainder of the lamps 11, 12, 14-17, and 19-22 are connected to the four control terminals 36-39 by means of the diode switching circuit 32.

Two diodes 41 and 42 have their anodes connected to the control lead of the first or upper lamp 11 in the left vertical row, while the cathode of the first diode 41 is connected to the second control terminal 37 and the cathode of the second diode 42 is connected to the control lead of the first or upper lamp 12 in the middle row. In a similar manner, two diodes 43 and 44 have their anodes joined to the control lead of the first lamp 12 of the middle row. The first diode 43 has its cathode wired to the first control terminal 36, while the second diode 44 has its cathode connected to the control lead of the last or lower lamp 21 of the left row. Two diodes 45 and 46 have their anodes connected to the control lead of the second lamp 14 of the left row, the cathodes of the diodes 45 and 46 being connected to the first and second control terminals 36 and 37, respectively. In like fashion,

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the cathodes of two diodes 47 and 48 are joined to the control lead of the second lamp 15 of the right row. The anodes of the diodes 47 and 48 are connected to the first and second control terminals 36 and 37, respectively.

The control lead of the middle lamp 16 of the left row extends to the anodes of two diodes 49 and 50 which have their cathodes connected to the second and fourth control terminals 37 and 39, respectively. The middle lamp 17 of the middle row has its control lead connected to the anodes of two diodes 51 and 52 whose cathodes are connected to the second and third control terminals 37 and 38, respectively. The control lead of the fourth lamp 19 of the left row is joined directly to the fourth control terminal 39. The control lead of the fourth lamp 20 of the right row is wired to the cathodes of yet two more diodes 53 and 54, and the anodes of the diodes 53 and 54 are connected to the third and fourth control terminals 38 and 39, respectively. The bottom lamp 21 of the left row has its control lead extended to the anodes of two final diodes 55 and 56. The cathode of the first diode 55 is connected to the third control terminal 38 and the cathode of the second diode 56 is connected to the fourth control terminal 39. The control lead of the bottom lamp 22 of the middle row is wired to the control lead of the bottom lamp 21 of the left row.

A battery 60 is applied across the power terminals 34 and 35 causing the top, middle, and bottom lamps 13, 18 and 23 of the right vertical row to be illuminated. By connecting the four control terminals 36—39 to the battery 60 with various polarity combinations, the remainder of the lamps 11, 12, 14—17, and 19—22 may be illuminated in different patterns to form the numerals zero through nine. These connections may be established by any of several means such as toggle switches, relay contacts, or a wafer switch. Four single-pole, double-throw switches 61—64 are provided in the exemplary embodiment illustrated in FIG. 2 for connecting the four control terminals 36—39 to either side of the battery 60.

In the polarity combination shown in FIG. 2, the first control terminal 36 is connected to the positive terminals of the battery 60 by the first switch 61. The second control terminal 37 is connected to ground or the negative terminal of the battery 60 by means of the second switch 62. The third and fourth control terminals 38 and 39 are connected to the positive terminal of the battery 60 by means of the third and fourth switches 63 and 64, respectively.

The first, second, and third lamps 11, 14, and 16 of the left vertical row are illuminated by means of current paths established through the associated diodes 41, 46, and 49 to the second control terminal 37. The fourth lamp 19 of the left row is not illuminated inasmuch as both sides thereof are connected to the positive terminal of the battery 60. The bottom lamps 21 and 22 of the left and middle rows are not illuminated because the cathodes of the associated diodes 55 and 56 are connected to the positive terminal of the battery 60 through control terminals 38 and 39. The upper lamp 12 of the middle row is not illuminated because the cathodes of the associated diodes 43 and 44 are connected to the positive side of the battery 60. The middle lamp 17 of the middle row is illuminated by means of a circuit completed through the associated diode 51 and the second control terminal 37 to the negative side of the battery 60.

The upper lamp 13 of the right row is always illuminated when the battery 60 is connected across the power terminals 34 and 35. The second lamp 15 of the right row is illuminated by means of a path completed through the associated diode 47 and the first control terminal 36 to the positive side of the battery 60. The middle lamp 18 of the right row is always illuminated. The fourth lamp 20 of the right row is illuminated by means of a current path established through the associated diodes 53 and 54 and the third and fourth control terminals 38 and 39 to the positive side of the battery 60. The lower lamp 23

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of the right row is always illuminated. Thus, lamps 11, 13—18, 20 and 23 are illuminated to define the numeral "4," as illustrated in FIGS. 1 and 2.

To illuminate any of the numerals zero through nine, the four control terminals 36—39 are connected to the battery 60 with the following polarity combinations:

Numeral	Control terminal			
	36	37	38	39
0	—	+	+	—
1	+	+	+	—
2	+	+	—	—
3	+	+	—	+
4	+	—	+	+
5	—	—	+	+
6	—	+	+	—
7	+	—	+	—
8	+	—	+	+
9	+	—	—	+

Thus, there has been described a compact digit display indicator utilizing a minimum number of indicator lamps, switching diodes and control terminals. Hence, the digit display indicator of the present invention is simple and reliable.

What is claimed is:

1. A digit display arrangement comprising thirteen incandescent lamps arranged in a three-by-five array to form a figure-eight pattern of three vertical rows having five lamp positions each, the middle vertical row having only three lamps disposed in the central and end positions, a source of potential connected across the three lamps in the central and end positions of the right row, the remaining two lamps in the right row having one lead connected to one terminal of the source of potential, the eight lamps in the middle and left rows having one lead connected to the other terminal of the source of potential, a diode switching circuit connected to the remaining ten lamp leads and having four control terminals, and means for connecting the source of potential to the four control terminals in different polarity combinations to illuminate the lamps in different combinations describing the numerals zero through nine.

2. A remote indicator comprising an indicator block having thirteen chambers, the sides of the chambers being opaque and the front of the chambers being translucent, the chambers being arranged in a three-by-five array describing a figure eight of three vertical rows of five positions each, the middle vertical row having only three chambers in the central and end positions, an electric incandescent lamp having two leads and being disposed in each of the thirteen chambers in the indicator block, first and second power terminals individually connected to the two leads of the three lamps in the central and end chambers of the right row, the remaining two lamps in the right row having one lead connected to the first power terminal, the eight lamps in the middle and left rows having one lead connected to the second power terminal, four control terminals, a pair of diodes connected with a first polarity from the remaining lead of the upper lamp in the left row to the remaining lead of the first lamp in the middle row and to the second control terminal, respectively, a pair of diodes connected with the first polarity from the remaining lead of the upper lamp in the middle row to the first control terminal and to the remaining lead of the lower lamp in the left row, respectively, a pair of diodes connected with the first polarity from the remaining lead of the second lamp in the left row to the first and second control terminals, respectively, a pair of diodes connected with a second polarity from the remaining lead of the second lamp in the right row to the first and second control terminals, respectively, a pair of diodes connected with the first polarity from the remaining lead of the third lamp in the left row to the second and fourth control terminals, respectively, a pair of diodes connected with the first polarity from the remaining lead of the middle

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lamp in the middle row to the second and third control terminals, respectively, a pair of diodes connected with the second polarity from the remaining lead of the fourth lamp in the right row to the third and fourth control terminals, respectively, and a pair of diodes connected with the first polarity from the remaining lead of the lower lamp in the left row to the third and fourth control terminals, respectively, the remaining lead of the fourth lamp in the left row being connected to the fourth control terminal, the remaining lead of the lower lamp in the middle row being connected to the remaining lead of the lower lamp in the left row.

3. A digit display indicator comprising an indicator block having a plurality of chambers, the sides of the chambers being opaque and the front of the chambers being translucent, the chambers being arranged in an array, an electric incandescent lamp having two leads and being

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disposed in each of the chambers in the indicator block, first and second power terminals individually connected to the two leads of a portion of the lamps, the remaining lamps having one lead connected to one of the power terminals, and a solid state switching circuit having four control terminals and being connected to the remaining leads of the remainder of the lamps, the switching circuit being arranged to cause the numerals zero through nine to be described by the illumination of the lamps in different patterns in response to the application of a source of potential to the control terminals in different polarity combinations.

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