

Nov. 25, 1958

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2,862,201

DECODER FOR AUTOMATIC PHOTORECTIFICATION SYSTEM

Filed March 30, 1954

2 Sheets-Sheet 1

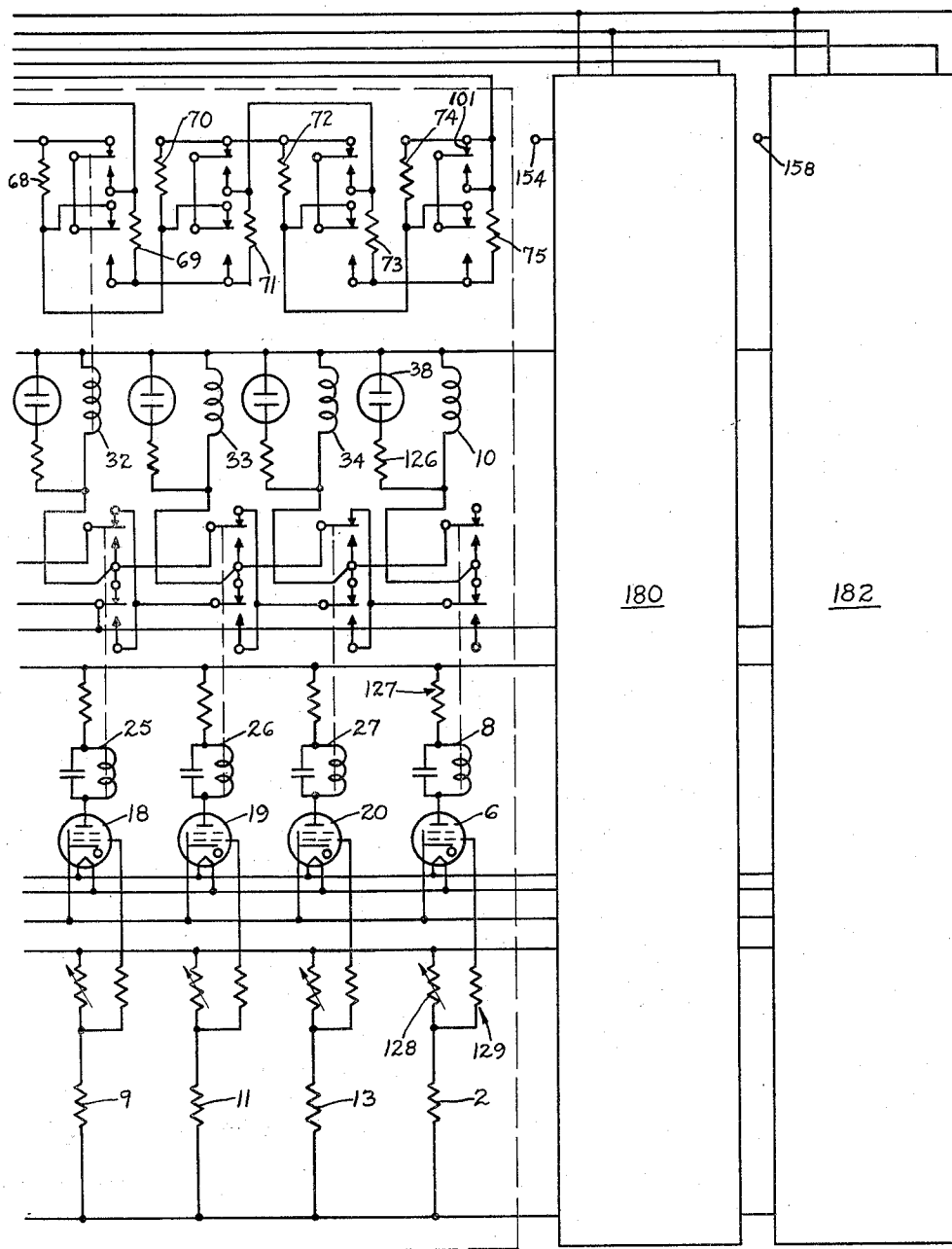


Fig. 1b

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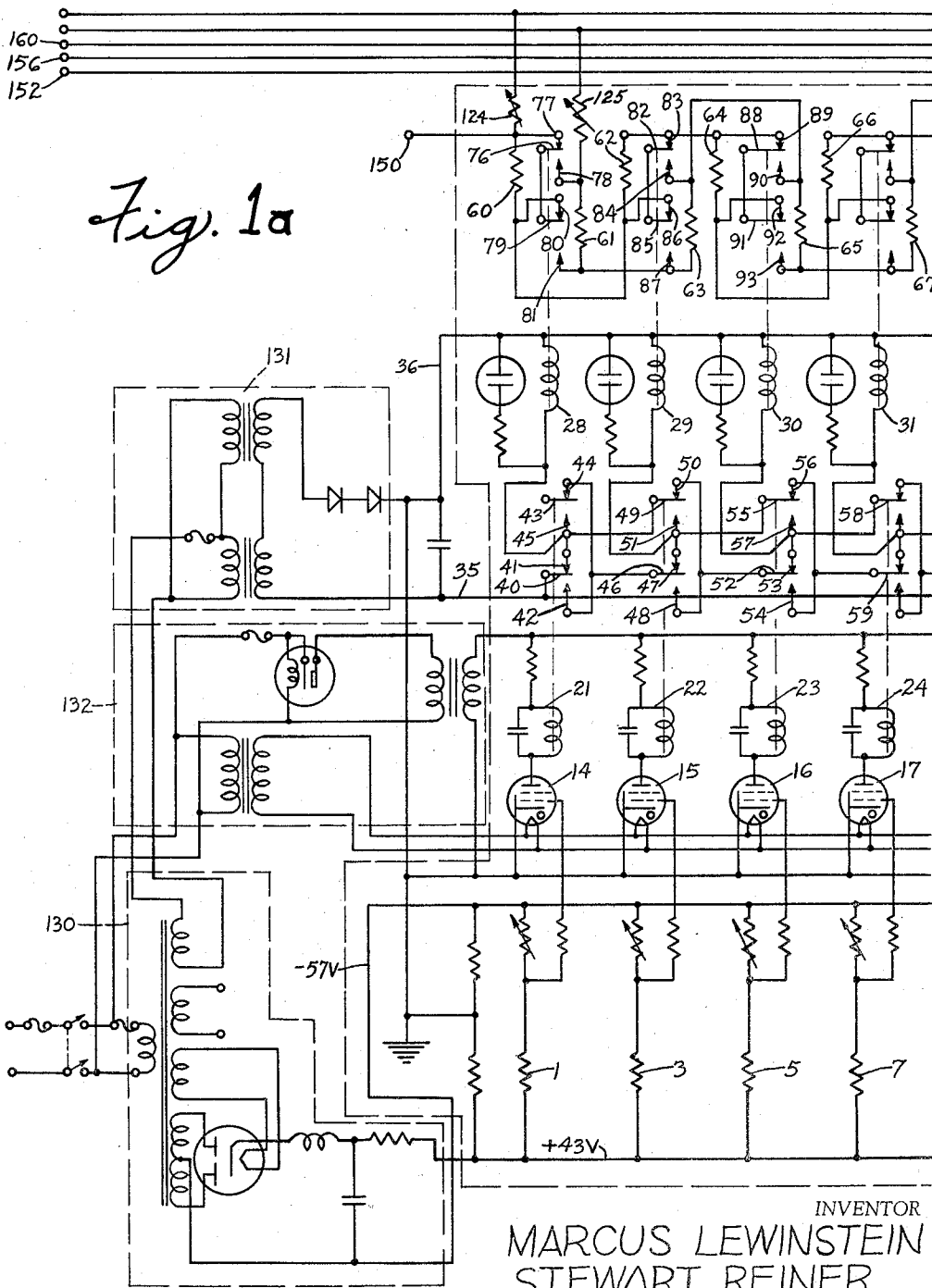
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2 Sheets-Sheet 2



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DECODER FOR AUTOMATIC PHOTORECTIFICATION SYSTEM

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Application March 30, 1954, Serial No. 419,939

5 Claims. (Cl. 340—347)

The present invention relates in general to a method of decoding, and more specifically to automatically decoding coded information into a voltage or an angular displacement of a shaft.

This invention will read and decode coded information that is contained on a marginal portion of a frame of photographic film. The information that is to be recorded is divided into a number of units, the limits of each unit being dependent upon the degree of accuracy that is required. Each unit is then assigned a number. The assigned number is then converted to a pattern in accordance with the Bell Telephone Laboratory Gray Code. This code is then recorded on the photographic film in the form of light and dark spots. Each area represents a digit of the code.

A dark spot or area represents a digit and a light spot or area represents the omission of a digit. The code pattern is recorded on the photographic film by placing a number of lamps next to the film. The flow of current to said lamps is controlled by means of a code wheel having a conductive pattern upon its face in the form of the Bell Telephone Laboratory Gray Code. For a complete disclosure of a system and method of recording information, in the form of a discrete code, upon a photographic film, reference is made to the copending application of Stewart Reiner, Serial Number 376,769, filed August 26, 1953.

The information that is on the photographic negative can represent a voltage, a date, a distance, weather conditions, speed and the like. The developed negative is placed between a light source and a series of light sensitive elements. One light sensitive element is required for each light and dark area or digit of the code. The negative and the light sensitive elements are aligned so that each light sensitive element will view only one digit. Therefore, if said element is beneath a dark spot, it will not receive any light and will remain inactive. However, if said element is beneath a light spot it will view light and become activated. Each light sensitive element is connected to and controls a thyatron tube through a variable resistor. Thus, each time said element sees light, the thyatron tube that is connected to said element will fire and conduct current. The plate circuit of each thyatron tube is connected to the coil of a double pole, double throw relay. The contacts of said relays are connected to the coils of a second set of double pole, double throw relays. Across each coil of said second set of relays is a lamp. The contacts of said second set of relays are connected to the output terminals through a plurality of shorted and unshorted resistors.

The first set of relays converts the Bell Telephone Laboratories gray code to the binary code. The second set of relays converts the binary code into a voltage that is directly proportional to the information that is contained on the film. The lamp that is across each coil of the second set of relays indicates a visual pattern of the information on the film in the form of the binary code.

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The contacts of the second set of relays inserts and removes resistors from the output circuit, thus converting the binary code into a voltage that is proportional to said binary code.

5 The output information of this invention may be converted from a voltage to an angular shaft displacement by inserting the output voltage into a servo means.

10 It is an object of the present invention to convert coded information on a photographic film automatically into a voltage that is proportional to said recorded information.

15 It is another object to convert the coded information on a photographic film automatically into an angular shaft rotation that is proportional to said recorded information.

It is an additional object to present, visually, the binary code equivalent of the gray code that is on the film.

20 A further object is to provide a plurality of relays that convert the gray code as it appears on a photographic film, into the binary code, and then convert the binary code into a voltage or an angular shaft displacement that is directly proportional to the coded information.

25 Another object of the present invention is to automatically read and to automatically convert information on a photographic film that is in the form of the gray code, back to its original form.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

30 The entire invention is represented as a single circuit diagram in Fig. 1, and wherein Fig. 1a shows a schematic diagram of the power supply and a portion of a channel and

35 Fig. 1b is a block and schematic diagram illustrating the remainder of the channel and two additional channels.

40 Figs. 1a and 1b constitutes the circuit diagram of the present invention showing the connections between the light sensitive cells, the thyatron tubes, the relays and the like.

Referring to the form of the invention that is illustrated in Figs. 1a and 1b Cetron lead sulfide cells 1, 2, 3, 5, 7, 9, 11 and 13 are utilized as the light sensitive elements. Said cells are arranged so that the flat surfaces of said cells scan the code pattern of light and dark spots on the photographic film. Said cells have photo conductive characteristics that results in a decrease of the electrical resistance of the cells when said cells are illuminated. The electrical resistance of the Cetron cells is approximately 245,000 ohms. A variable resistor 128 is connected between the control grid of the thyatron tube 6 and ground and a Cetron cell 2 is connected in series with said parallel combination of vacuum tube 6 and variable resistor 128. The coil of a double pole-double throw relay 8 is connected in series with the plate of the thyatron tube. Thus, each time that the tube conducts current, said relay will operate. The contacts of said relay are connected to the contacts of similar relays 21 through 27; and are also connected to complete the circuit of a second double pole-double throw relay. The contacts of said second relay are connected to resistors that are shorted or unshorted, depending upon the pattern on the film, to determine the output voltage.

For each digit, one Cetron cell; one variable resistor; one thyatron tube; two double pole-double throw relays and a set of output resistors are required. The present invention was designed to read three channels. Each channel consists of eight digits. The equipment that is required to read each digit is similar consisting of eight

Cetron cells, eight variable resistors, eight vacuum tubes, sixteen double pole-double throw relays and the necessary components that are shown on the drawings are required for each channel.

Since the contacts of each of the first mentioned relays are connected in a similar manner, the connection of the contacts of the first three relays 21, 22 and 23 only will be described. When the relay contacts are in their normally deactivated position, the normally open contact 45 that cooperates with the pole 43 is connected to the normally closed contact 41 that cooperates with the other pole 40; and the remaining contacts 44 and 42 of relay 21 are connected together. The contacts of the other relays are connected in the same manner. The upper pole 43 of relay 21 is left open because said relay 21 is the first in line. The lower pole 40 is connected to one side 35 of the line. The contacts 45 and 41 are connected to the coil of the first relay 28 of the second series of double pole-double throw relays. Said contacts 45 and 41 are also electrically connected to the upper pole 49 of relay 22. The remaining contacts 44 and 42 of relay 21 are connected to the lower pole 46 of the relay 22.

The contacts 51 and 47 of the relay 22, are connected to the coil 29 and to the upper pole 55 of the relay 23. The contacts 50 and 48 are connected to the lower pole 52 of the relay 23. The contacts 56 and 54 of the relay 23 are connected to the lower pole 59 of the relay 24 and the contacts 57 and 53 of the relay 23 are connected to the upper pole 58 of the relay 24. The connections of the remaining contacts of the other relays are similar to the connections of the relays described and they are illustrated in Fig. 1.

The contacts of the second set of double pole-double throw relays determines the voltage output of the channel. The resistors 60, 62, 64, 66, 68, 70, 72 and 74 are connected in series and are shorted by the contacts of the relays 28 through 34 and 10 respectively when said relays are in their deactivated position. The resistors 61, 63, 65, 67, 69, 71, 73 and 75 are connected in series and are shorted by the contacts of the relays 28 through 34 and 10 respectively when said relays are in their activated position. The said resistors are arranged in pairs so that each relay will unshort the shorted resistor and short the unshorted resistor when said relay is activated.

The most advantageous resistive values of the output resistors have been found to be as follows:

	Ohms
60 and 61 -----	819,456
62 and 63 -----	409,728
64 and 65 -----	204,864
66 and 67 -----	102,432
68 and 69 -----	51,216
70 and 71 -----	25,608
72 and 73 -----	12,804
74 and 75 -----	6,402

Referring specifically to the double pole-double throw relays 28, 29 and 30; the poles 76 and 79; 82 and 85; 88 and 91 are shorted together. Resistors 60, 62 and 64 are connected across the contacts 77 and 80; 83 and 86, and 89 and 92 respectively. The resistors 61, 63 and 65 are connected across the contacts 78 and 81; 84 and 87, and 90 and 93 respectively. Contacts 80 and 86, 83 and 89, 81 and 87, and 84 and 90 are connected together. The contacts of the relays 31, 32, 33, 34 and 10 are connected in a similar manner.

One side of the input of seventy volts R. M. S. is connected to the contact 77 through a variable scaling resistor 124. The other side of the line is connected to the contact 78 through a variable scaling resistor 125. The output terminals 150 and 152 are connected to the contacts 77 and 101 of the relays 28 and 10 respectively.

The preferred values of the resistors 126, 127, 128 and 129 are 25,000 ohms, 150 ohms, 600,000 ohms, and

1,500,000 ohms, respectively. The vacuum tubes are the 2D21 type and the double pole-double throw relays are preferably of the type generally known in trade circles as the Potter and Brumfield Relay Number LM-11-DPDT.

The resistive network that cooperates with the second set of relays operates as a voltage divider. The double set of resistors provides an arrangement whereby the input power supply operates into a constant impedance load regardless of the relay positions.

The decoder can be expanded or contracted to read and convert a code containing more or fewer digits. The present invention can be expanded to read more than one item of intelligence by utilizing a plurality of decoding units.

The transformers 130, 131, 132 and the necessary associated equipment are required to supply the proper values of voltage to enable the present invention to operate properly. The design of the power supply is of common knowledge to those that are experienced in the art and, as such, will not be described in detail.

In the operation of the present invention, a photographic film containing the coded information is accurately placed between a light source and the Cetron cells so that each Cetron cell views a specific minute area of the film representing a digit of the code. To simplify the explanation of the operation of the present invention, it shall be assumed that the information that is on the film is represented by the number five. The number five is represented, in the Gray Code, by a series of five blank or light spots and then three dark spots, and said code appears on the film in that form. The same number, in the binary code, is represented by five blank or light spots, one dark spot, one blank or light spot and then one dark spot. When the film is in position, Cetron cells 1, 3, 5, 7 and 9 will see light areas and cells 11, 13 and 2 will see dark areas. Light from the light source will pass through the light areas only. Therefore, only the Cetron cells 1, 3, 5, 7 and 9 will see light and, thus fire their respective thyatron tubes 14, 15, 16, 17 and 18. The relays that are in the plate circuits of the tubes that pass current will thus become activated while the other relays remain in their normal inactive position.

By the action of the aforementioned relays, current flows through the coils of relays 33 and 10. The lamps 38 that are in parallel with the coils of relays 33 and 10 will pass current. At this instant through the pattern presented by the lighted lamps 38, a visual indication of the number recorded on the film appears in the form of the binary code. The contacts of the relays 33 and 10 operate, thus removing the short across the resistors 70 and 74 and shorting the resistors 71 and 75 respectively. The voltage that appears across the output is the IR drop across the resistors 70 and 74. The voltage drop across said resistors 70 and 74 is proportional to the number five or five units of voltage.

From the foregoing it will become obvious that the present invention may be modified by substituting photo-electro cells for the Cetron cells. When said substitution is made, a slight modification may have to be made in the circuit design so that the thyatron tube will fire at the proper instant. Said modification is obvious to those that are experienced in the art.

An additional modification is to connect a voltmeter across the output 150 and 152, or 154 and 156, or 158 and 160. The voltmeter is calibrated to read the answer directly. Therefore, if the original recorded information was in terms of feet, the voltmeter will be calibrated to read in feet.

The blocks 180 and 182 represent two additional channels. Obviously the number of channels of information may be increased to any desired number.

An additional modification is to attach a servo means that appears at terminals 150 and 152, 154 and 156, and 158 and 160 to receive the output voltage and thus obtain

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a shaft rotation that is proportional to the recorded information.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A decoder comprising voltage generating means, a voltage divider comprising a first and a second plurality of impedances coupled in series with said means, first switching means to short one of said second plurality of impedances, second switching means to short one of said first plurality of impedances and to open said means to short one of said second plurality of impedances simultaneously, and means for controlling the operation of said first and second switching means.

2. A decoder to convert digital code group signals into discrete voltages comprising a source of potential, a constant impedance voltage divider in series with said potential, said divider comprising a first plurality of series coupled impedances series coupled to a second plurality of series coupled impedances, means to short said second plurality of impedances, and means responsive to the code group signals coupled to said voltage divider circuit to short at least one of said first plurality of impedances and to open the short of at least one of said second plurality of impedances.

3. A decoder comprising a source of potential, a constant impedance voltage divider in series with said potential, said divider comprising a first section including a plurality of impedances and a second section including a plurality of impedances having values bearing a predetermined relation to the values of said first impedances, first switching means to short said first impedances, second switching means coupled to said voltage divider to short selected second impedances and to open said means to short corresponding first impedances simultaneously, and means for controlling the operation of said first and second switching means.

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4. A decoder for digital code group signals comprising a source of potential, a constant impedance voltage divider in series with said potential, said divider comprising a first plurality of impedances series coupled to a second plurality of impedances equivalent in values to the values of said first impedances, means to short out said first impedances, first switching means coupled to each of said first plurality of impedances to short out at least one of said impedances, second switching means coupled to each of said second plurality of impedances to remove the short from at least one of said impedances having a predetermined relation to the shorted out impedance, and means responsive to the digital signals for activating said first and second switching means to convert said code signals to a discrete voltage.

5. A decoder for digital code group signals comprising a source of potential, a constant impedance voltage divider in series with said potential, said divider comprising a first plurality of impedances series coupled to a second plurality of impedances equivalent in values to the values of said first impedances, means to short out said first impedances, first switching means coupled to each of said first plurality of impedances to short out at least one of said impedances, second switching means coupled to each of said second plurality of impedances to remove the short from at least one of said impedances having a predetermined relation to the shorted out impedance, relays responsive to the digital signals to actuate said first and second switching means to convert said code signals to a discrete voltage, an output circuit coupled to said voltage divider, and means coupled to said relays to indicate the digital code group signals.

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