United States Patent [19]

Sommer

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[54] **METHOD AND ARRANGEMENT FOR THE MODIFIED RECORDATION OF SIGN CONFIGURATIONS**

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[73] Assignee: **Dr.-Ing. Rudolf Hell**

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[52] **U.S. Cl.** ..... **340/324 A**, 340/212

[51] **Int. Cl.** **G08b 5/36**

[58] **Field of Search** ..... 340/324 A

[56] **References Cited**

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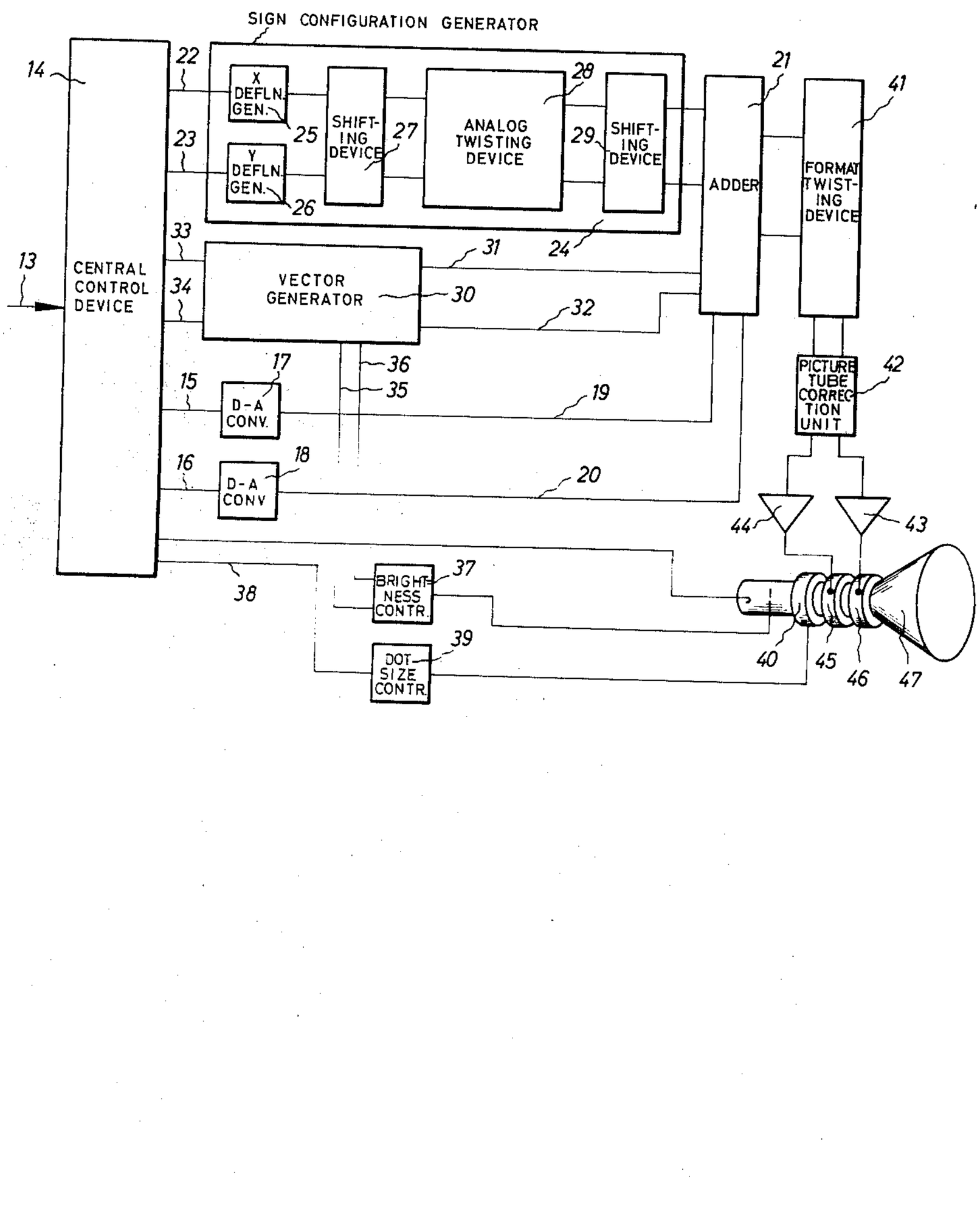
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Primary Examiner—David L. Trafton
Attorney—Carlton Hill et al.

[57] **ABSTRACT**

Recordation of letters and/or picture signs with the help of an electron beam on a picture screen of an electron-beam tube, whereby the sign configurations are recorded with any selected tilt and/or offset depending on command data, by a recordation deflection which is controlled by previously established recordation data of the signs and which proceeds from a basic deflection.

9 Claims, 9 Drawing Figures



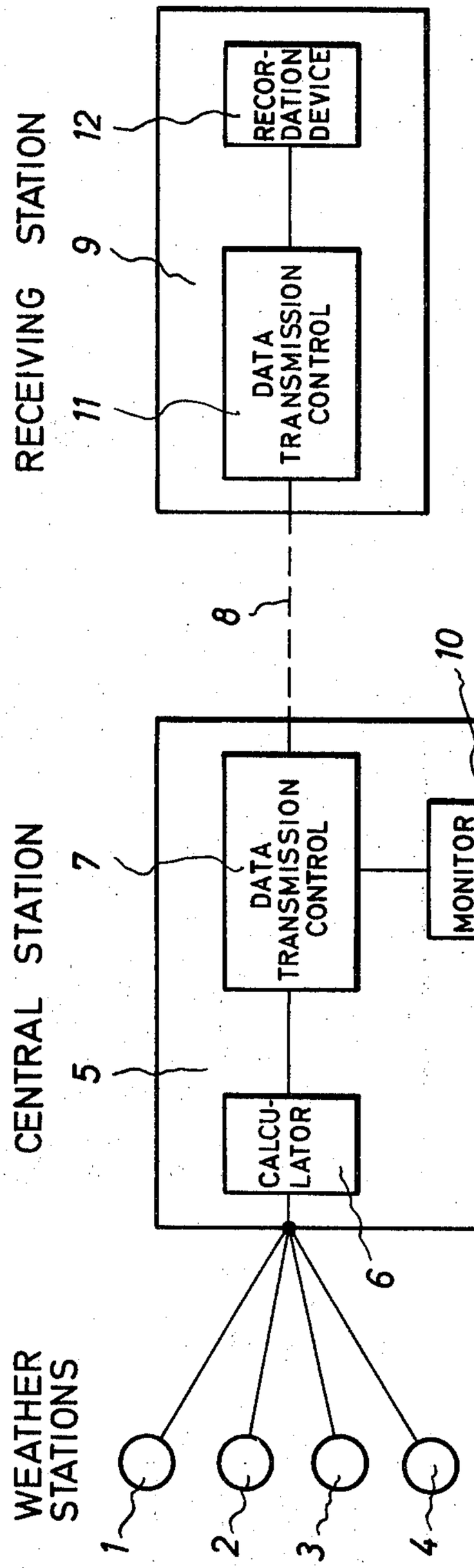


Fig. 1

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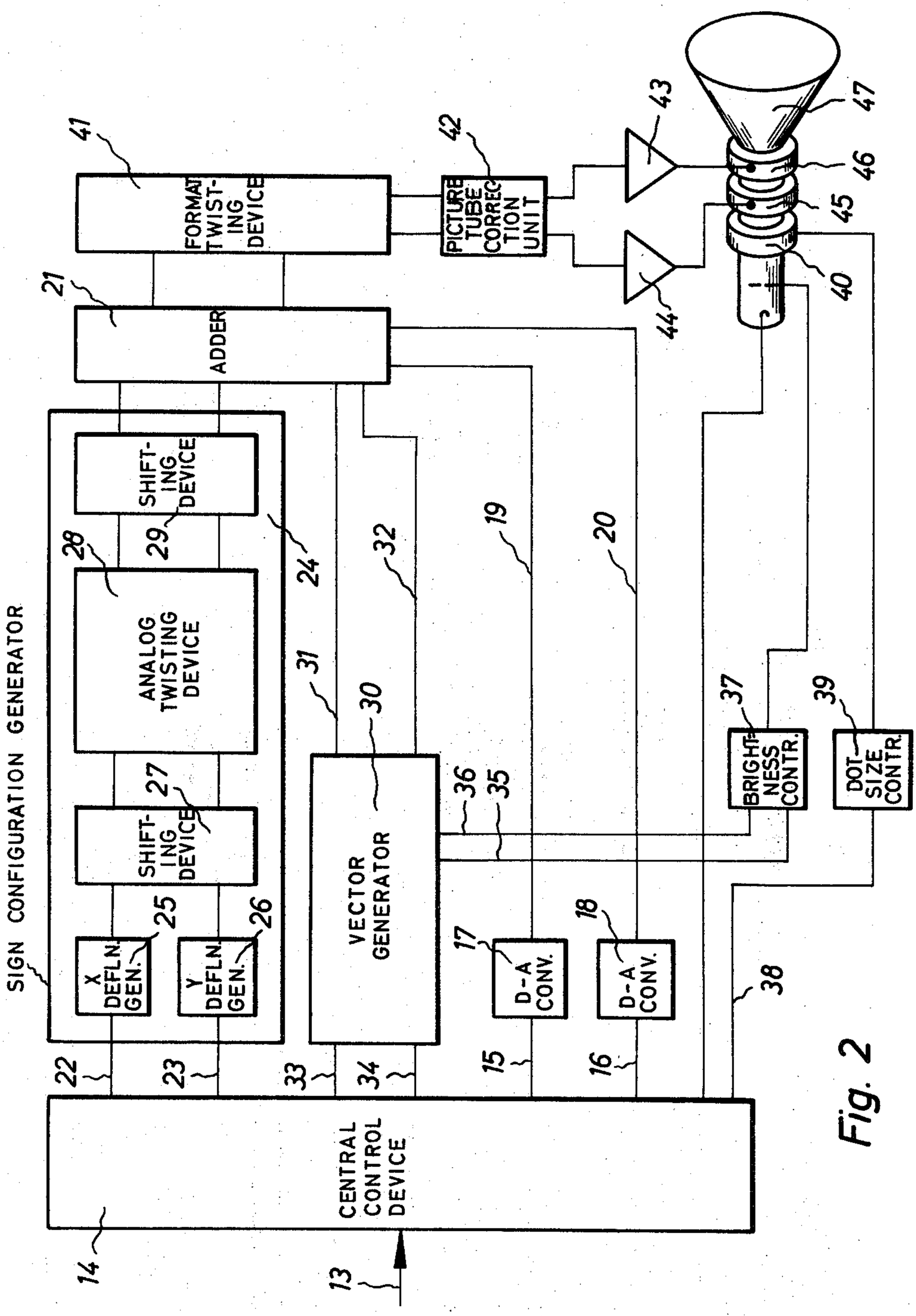


Fig. 2

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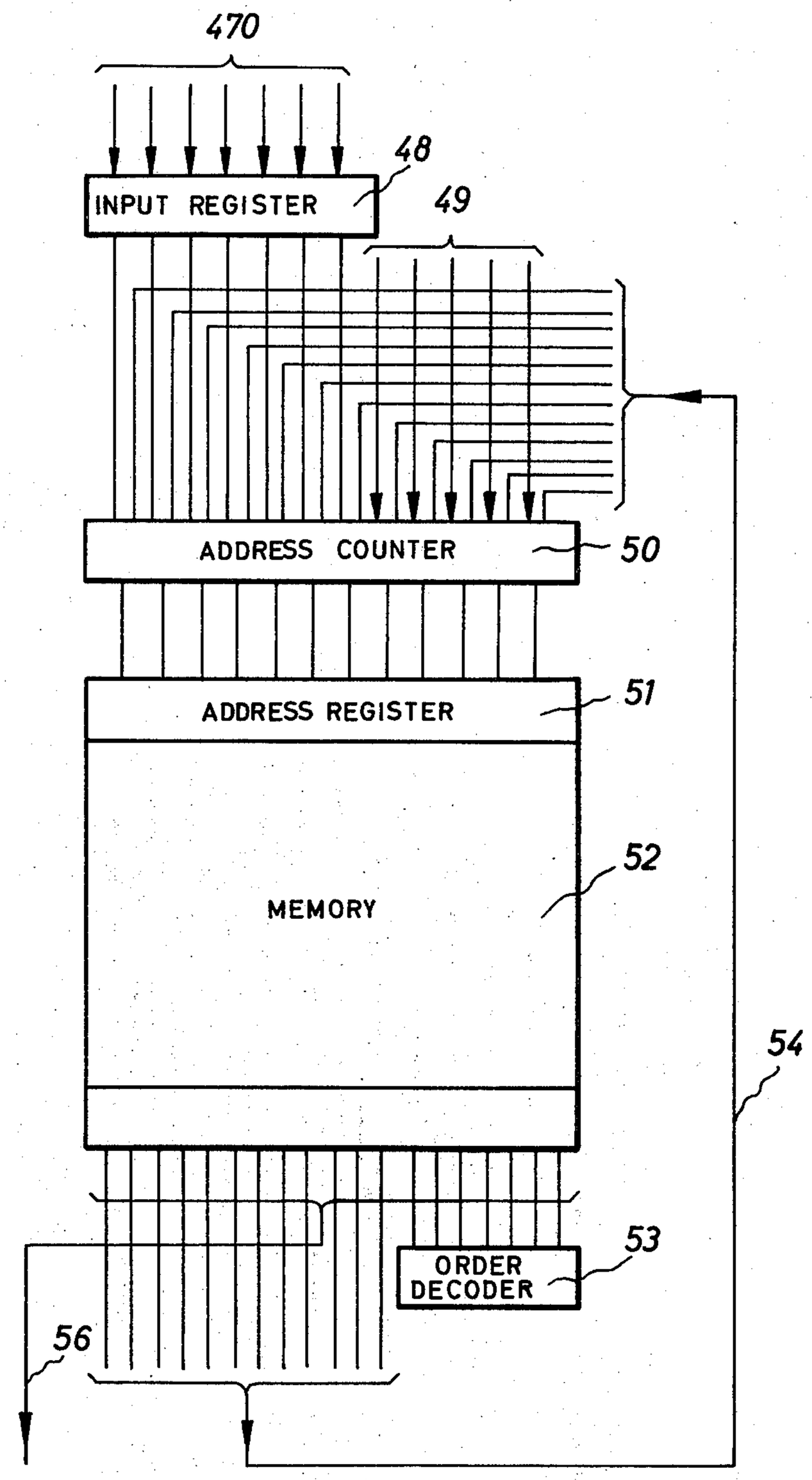


Fig. 3

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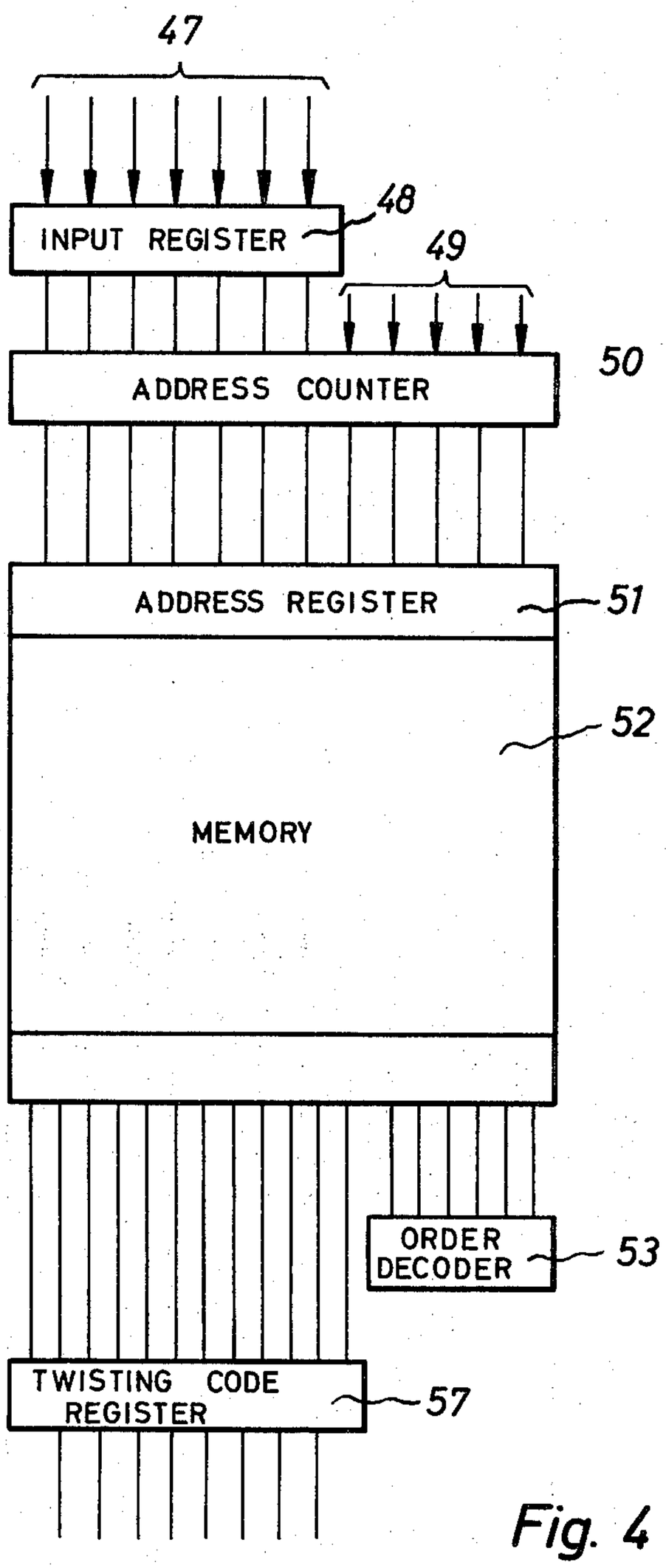


Fig. 4

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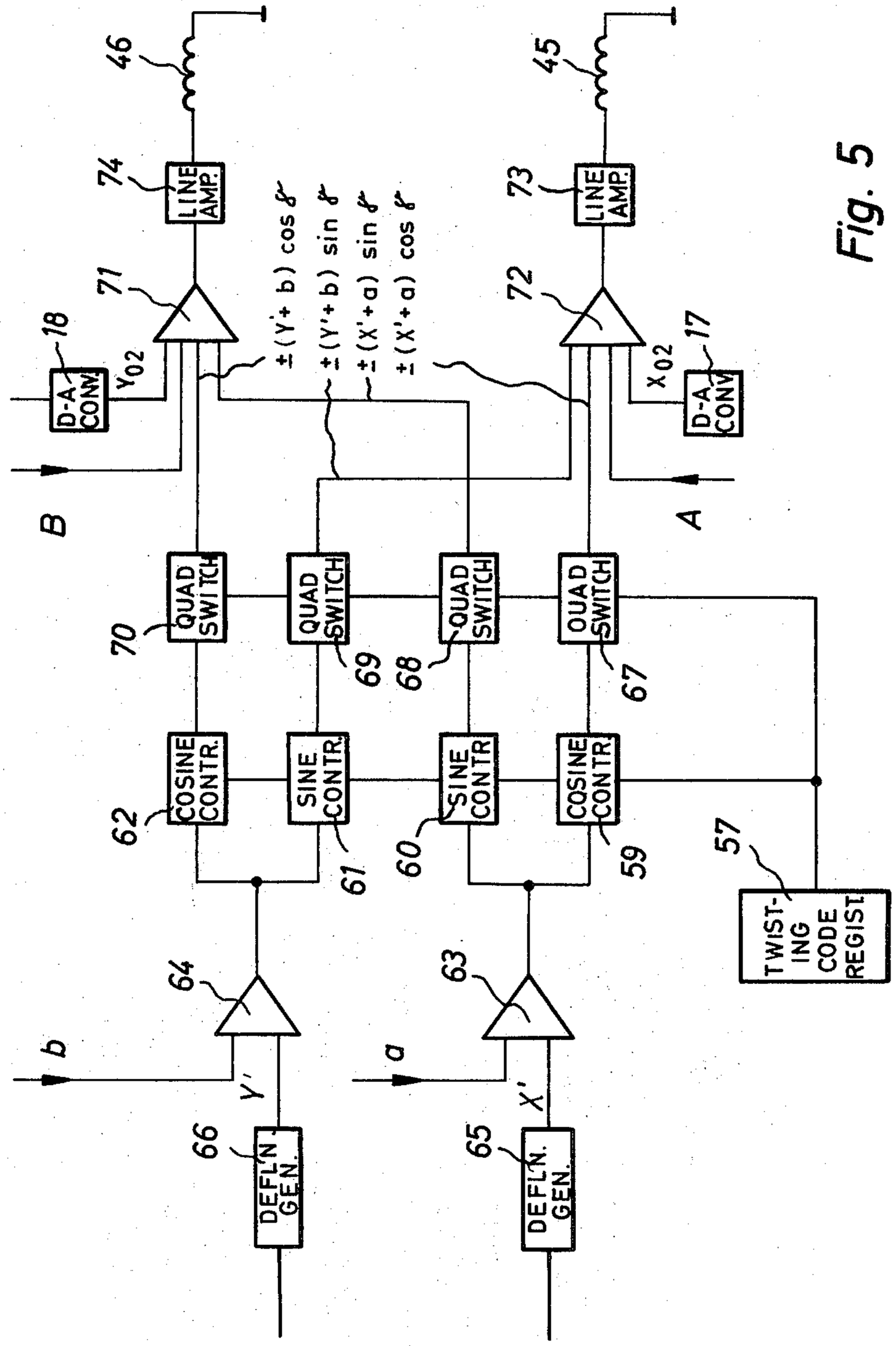


Fig. 5

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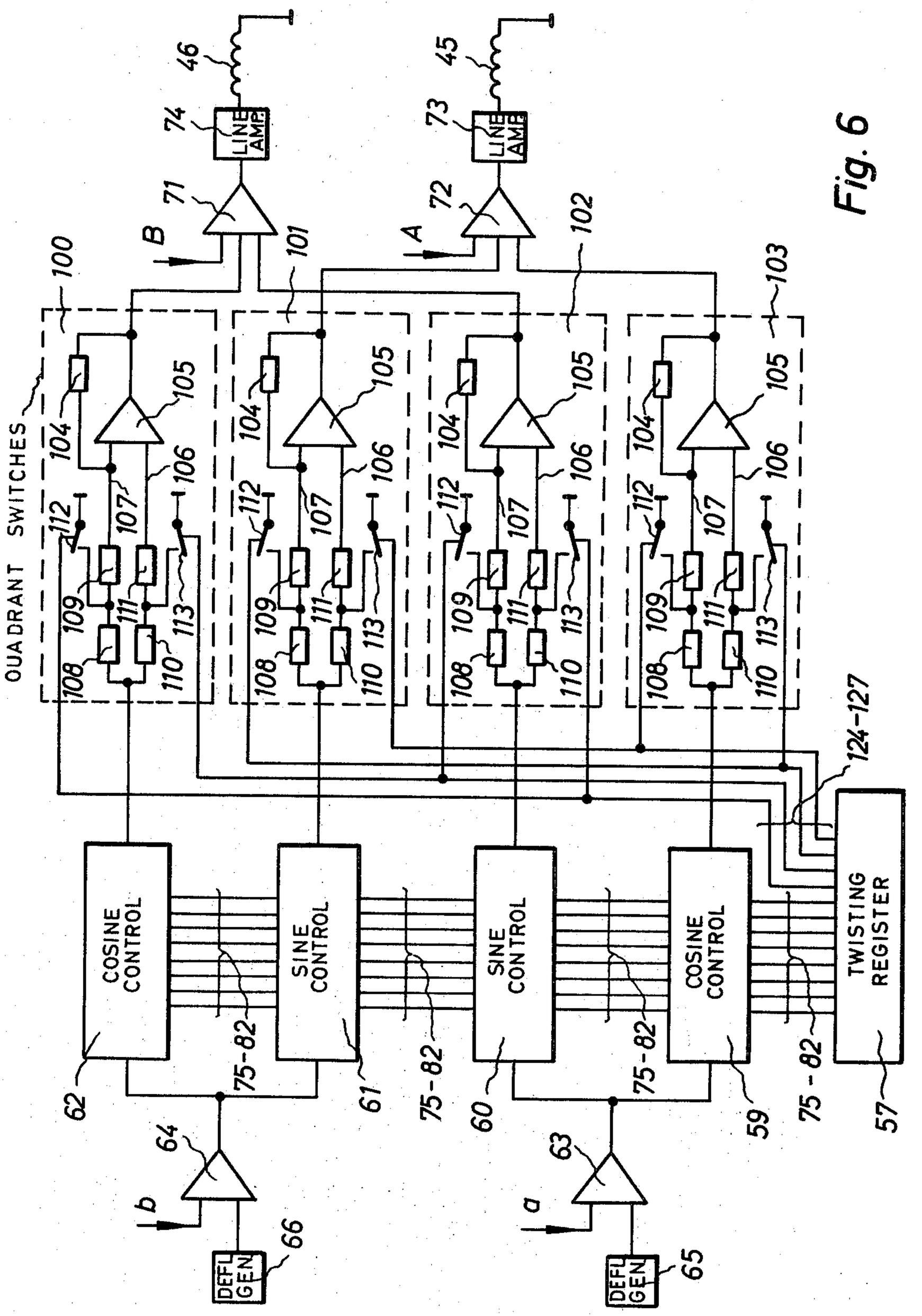


Fig. 6

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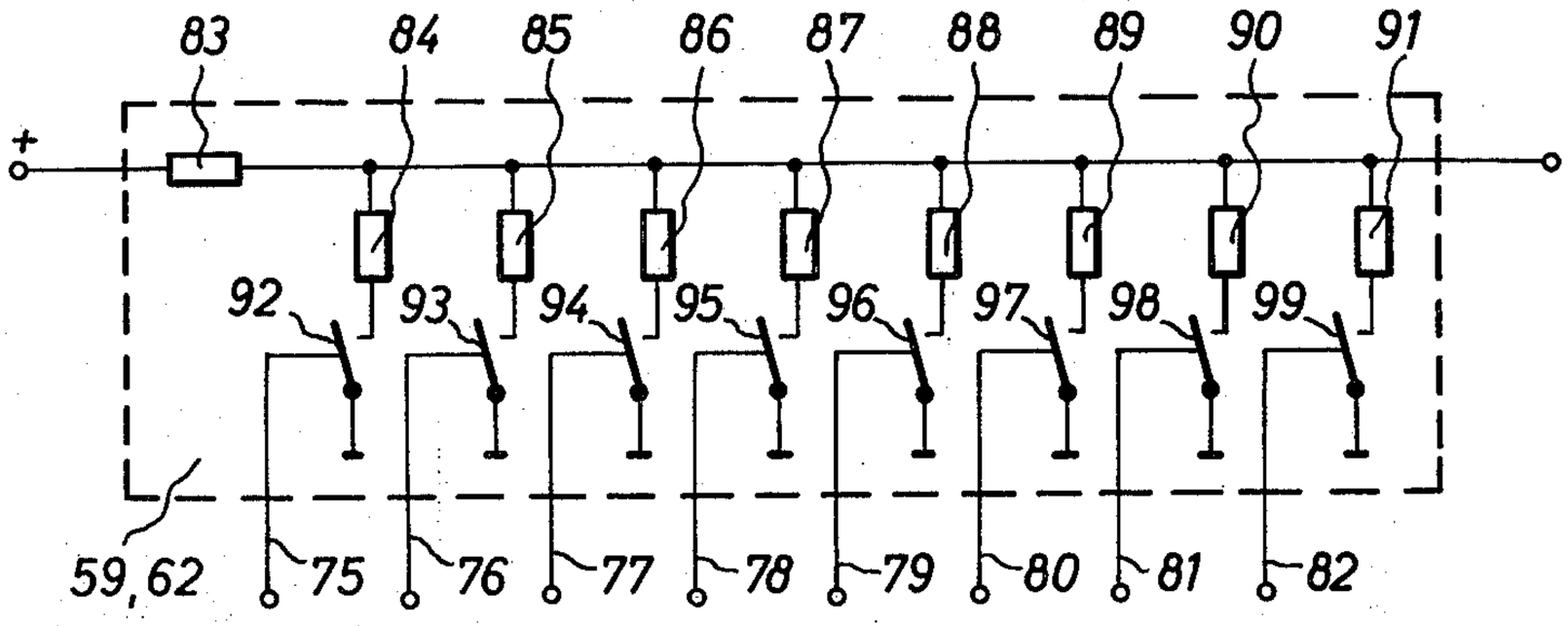


Fig. 7

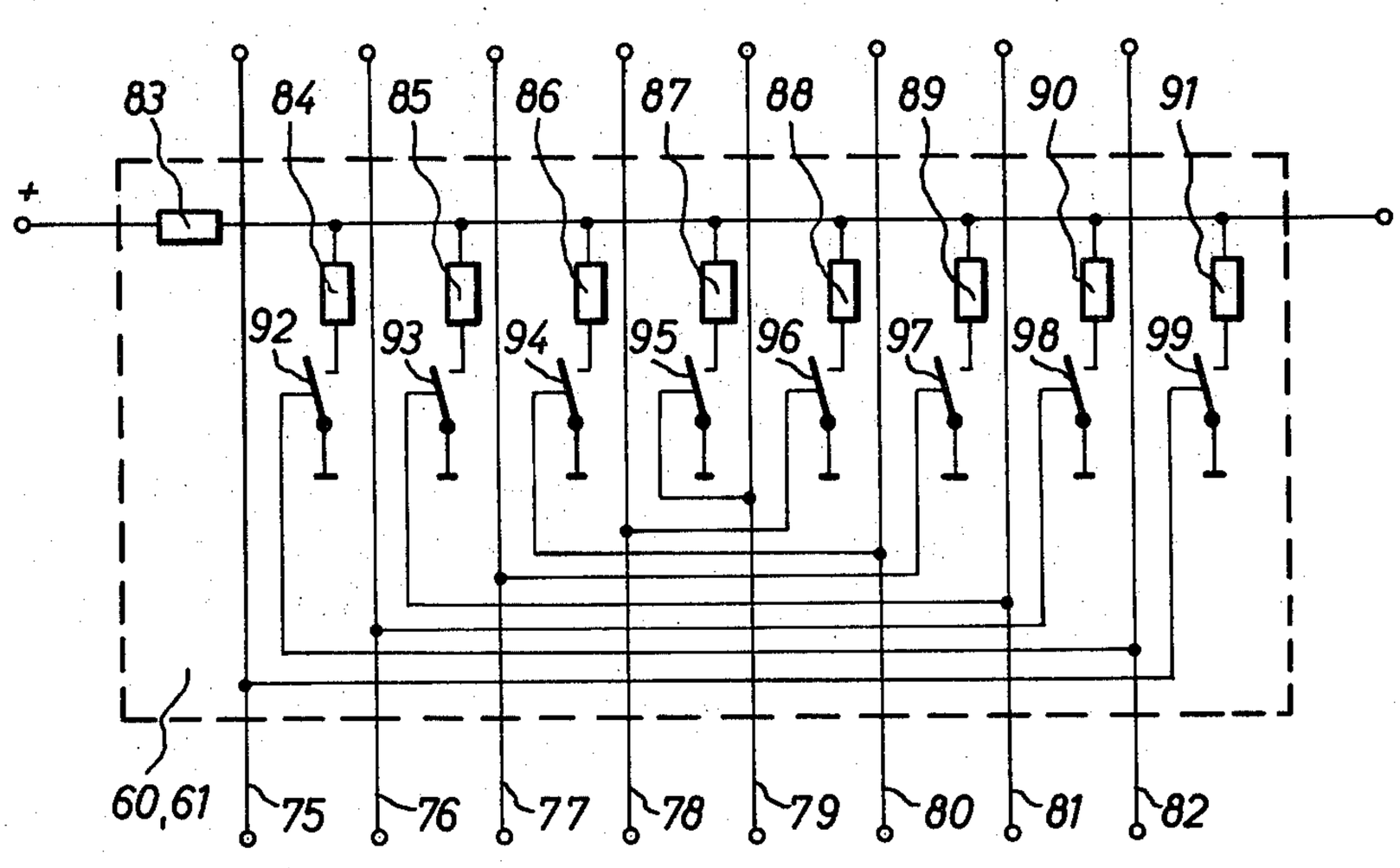


Fig. 8

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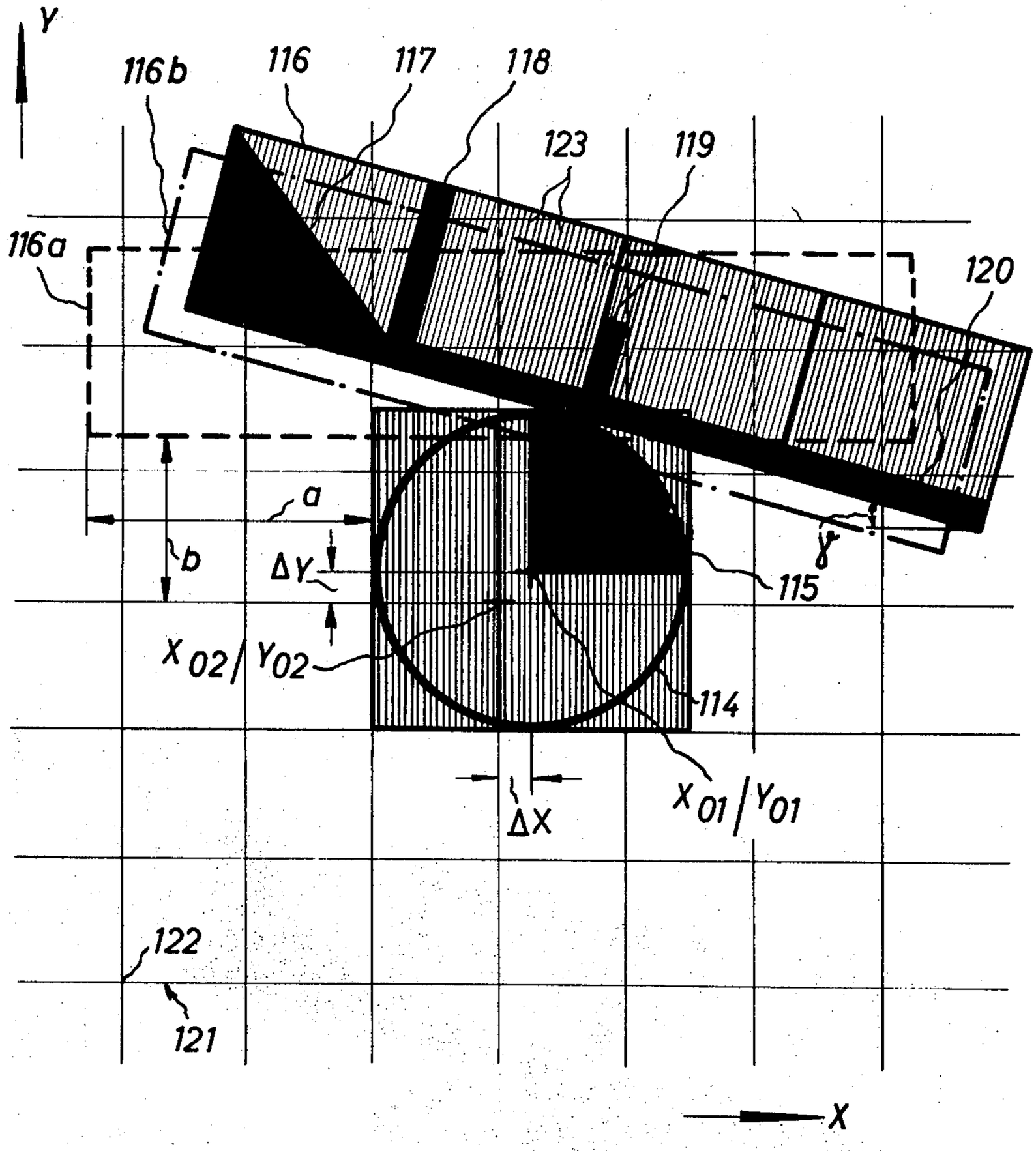


Fig. 9

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METHOD AND ARRANGEMENT FOR THE MODIFIED RECORDATION OF SIGN CONFIGURATIONS

BACKGROUND OF THE INVENTION

It is prior art for recording letters or picture signs, for instance when transmitting weather maps to several receivers, to scan the signs and curves which are to be illustrated at a central transmitting place, to transmit the data which is obtained in this way via a transmission or radio link and to record the data again at the receiving place. Hereby, the entire information, which is obtained when scanning, is transformed, and a large bandwidth is required, on the one hand, and on the other hand, only a relatively slow transmission is possible.

For this reason, simplifications have already been made for the transmission of graphic symbols such as letters or of curves: not the exact sign is transmitted but, according to the so-called incremental method, lines of the characters and curves are approximated by small, fixed, given deflection steps, so-called incremental steps. Usually, eight deflection steps are applied, namely in the direction of the axes and angle bisectors of cartesian coordinates, whereby the deflection values have an equal length for X and Y directions. If furthermore deflection steps of half length are allowed, 24 deflection steps are obtained. Thus a better approximation of the signs-to- be-transmitted can be obtained, but, for instance for a curve of equal length, more information must be transmitted.

Another possibility of approximating the signs-to-be-transmitted is to approximate curvatures by means of polygon paths and to respectively transmit the coordinates of the individual bending points of the approximated curve, whereby, on the recording side, the electron beam connects these points again to become a closed curvature.

These methods, however, have the disadvantage that complicated characters or curvatures can only be approximated very badly and that very much information must be transmitted in the case of very sharp curvatures.

Furthermore, only line drawings consisting of line paths which continue one after another can be transmitted and recorded. The recordation of areal signs is possible by means of cross hatching, but then again very much information must be transmitted.

Furthermore it is already prior art with electronic composing devices to file graphic symbols, which are to be recorded, in a memory at the recording place in the form of recordation data. During the recordation, i.e. composing, this recordation data is called out by means of command data, i.e., setting instructions from the memory, and controls the recordation on the picture screen of an electron-beam tube from a position which is also given by command data, the so-called basic deflection. This recordation is effected since the electron beam experiences a so-called recordation deflection which is controlled by the recordation data. Thereby, the electron beam is deflected on the picture screen in the X and Y directions and controlled in intensity to trace light and dark elements of the desired pattern.

Such an arrangement, however, would not be sufficient yet for instance for the transmission of weather maps since in such a case, a very large number of different signs is required, and these signs would furthermore have to be stored several times since they are required

in shifted or twisted positions namely in each respective modified form.

If all of these sign configurations were to be stored at the recordation place, a very large memory would be required which would render the device expensive and not profitable. Furthermore the application of the device would be limited since the signs can only be recorded in the form in which the recorded data is stored.

SUMMARY OF THE INVENTION

This invention thus has the task to provide a method for the modified recordation of letters and/or picture signs with the help of an electron beam on a picture screen of an electron-beam tube, whereby, in particular, the wish exists to record a large amount of information with the help of very few signs stored on the receiving side and with a low amount of transmitted information.

This invention obtains this by shifting the signs once or several times, during the recordation, depending on command data and/or twisting them once or several times. Thus it becomes possible to utilize in multiple ways a stored sign, i.e. to illustrate it in many shifted or twisted positions.

Furthermore there arises the possibility to provide new sign configurations with the help of the command data from the stored signs, consisting of compositions, preferably by means of shifting and/or twisting in a suitable manner. These new sign configurations may be further modified by further shiftings or twistings. Thus enormous savings of storage space are obtained, and a faster transmission of the information and a faster recordation of the signs is guaranteed since no picture information but only command data is transmitted.

According to this invention, this single or multiple shifting and/or single and/or multiple twisting is effected by one or several coordinate transformations of the recording deflection. The coordinate transformation or coordinate transformations are effected in an advantageous manner by means of analog influencing of the X and Y components of the recording deflection, namely according to the functions:

$$X = X_o + (X' + a)\cos\phi - (Y' + b)\sin\phi + A$$

$$Y = Y_o + (X' + a)\sin\phi - (Y' + b)\cos\phi + B,$$

whereby X_o and Y_o are the coordinates of a reference point for the basic deflection, a, b, the values of the shifting in X and Y direction, ϕ the twisting angle, X', Y' the instantaneous values of the deflection of the not shifted and twisted sign, A, B a further shifting.

If only one twisting or only one shifting is supposed to be effected, the inapplicable constants a, b, A, B or ϕ become zero. In order to twist the signs, preferably analog function generators are applied which change the X and Y components of the recordation deflection, depending on command data.

In an advantageous manner, the X and Y components of the recordation deflection are loaded with constant voltages in order to shift the sign configurations, and the magnitude of these voltages is given by the command data.

The particularly advantageous further development of the invention consists in giving the command data into an address register of a memory which can be programmed, as primary addresses, that a storage word is respectively among the primary addresses containing an order for recordation of a secondary address under which the recordation data are filed in the memory and

called out for recording. With successive recordation data of one sign configuration, the recordation data are preferably called for recordation by successively incrementing an address counter.

During the recordation, the electron beam is deflected according to a raster during its recordation deflection, corresponding to the raster according to which the sign has been originally scanned. The light-dark scanning of the electron beam during the recordation deflection is effected according to the light and dark values of the recordation data which is obtained during the original scanning of the sign configuration and stored.

Advantageous possibilities for obtaining the recordation data are to scan a sign pattern electro-optically or to screen the sign pattern onto a so-called storage tube and then to scan the same electrically.

In order to execute the method of the above invention, a circuit arrangement is proposed with a memory for the recordation data, an electron-beam tube with horizontal and vertical deflection coils, horizontal and vertical deflection generators for the production of the X and Y components of the recordation deflection, depending on the recordation data which is read out in response to the command data, and function generators which are connected between the deflection coils and the deflection generators and which can be adjusted by the command data.

These function generators are, in an advantageous manner, oppositely coupled operational amplifiers which are designed as adders for the shifting of the sign configurations and sine and cosine generators for the twisting of the sign configurations.

The final sine and/or cosine generators or control members can be adjusted continuously according to one embodiment of the invention, with the help of the command data, but they can also be designed as voltage dividers which allow adjustment in discrete steps.

According to an advantageous further development of the invention, the final sine and/or cosine control members consist of voltage dividers which reconstruct the values for a given quadrant, and from which the values for remaining quadrants of the sine and/or cosine function are obtained by means of quadrant selection switches.

Other objects, features and advantages of the invention will be readily apparent from the following description of a preferred embodiment thereof, taken in conjunction with the accompanying drawings, although variations and modifications may be effected without departing from the spirit and scope of the novel concepts of the disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** shows a principal circuit diagram of a weather-map transmission device;

FIG. **2** shows a schematic illustration of the circuit of a recordation device;

FIG. **3** shows a circuit example for the memory system of the central control device of FIG. **1**;

FIG. **4** shows the memory system of FIG. **3** for the case where a twisting code is transmitted to a twisting code register;

FIG. **5** shows a principal circuit for the execution of the analog twisting of the X and Y deflection of the electron beam;

FIG. **6** shows a circuit arrangement of an analog twisting device with fixed angle values;

FIG. **7** shows a function generator for the cosine values of the twisting angles according to FIG. **6**;

FIG. **8** shows a function generator for the sine values of the twisting angles according to FIG. **6**; and

FIG. **9** shows a sign configuration which is composed of several individual signs.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

In the drawings the same reference characters have been applied to corresponding parts in several views,

With a weather-map transmission device according to FIG. **1**, the weather data which are obtained by the specially-distributed weather stations **1, 2, 3** and **4** are transmitted to a central station **5** in which a calculator **6** evaluates and codes the data. From the central station **5**, the weather data is transmitted to a receiving station **9** via a data-transmission control **7**, and a transmission line or radio link as indicated at **8**.

A monitor-recordation device **10** which corresponds to the recordation device of a receiving station in its construction is in the central station. The receiving station **9** has a data-transmission control **11** from which the recording device **12** itself is controlled.

In FIG. **2**, the principal construction of the recordation device has been illustrated. The command data, which corresponds to the weather data-to- be-further-processed, reaches a central control device **14** via an input line **13**, and this central control device **14** contains a digital calculator, a memory and a control unit for the recordation. From the command data which arrive from the central station, the basic coordinates of a reference point (e.g., X_{o2}, Y_{o2}, FIG. **9**) of the sign-to-be-recorded are obtained and guided to an adder **21** via lines **15** and **16**, digital-analog converters **17** and **18**, and lines **19** and **20**. Furthermore the recordation data of the sign configuration is supplied to the sign configuration generator **24** via lines **22** and **23** in response to command data which identifies the kind of configuration to be generated. The basic configuration is generated by X and Y deflection generators **25** and **26** which are connected to a shifting device **27** in order to enable the sign configuration to be shifted. With the help of the shifting device **27**, an italic recordation of the signs can also be obtained by means of coupling between the X and Y deflection; this is particularly advantageous for the recordation of letters or similar characters. The resultant X and Y deflection signals reach an analog twisting device **28** from the shifting device **27**, and in this twisting device **28**, the twisting of the sign configurations according to an analog function is effected. Then another shifting of the individual sign configurations can be effected with the help of a further shifting device **29** which is of particular importance when signs are composed, as will be explained later with reference to an example of mounting a wind arrow relative to a weather-station circle. The twisted and/or shifted signs now reach the adder **21** to which the basic coordinates of the sign configurations are supplied via the lines **19** and **20**. Furthermore, a vector generator **30** is connected to the adder **21** via lines **31** and **32** and produces the deflection voltages which are required for the recordation in the case that curves are to be recorded and the coordinates of individual points are given by the central station which are to be connected with each

other at the recording side as polygon paths. The vector generator **30** is connected to the control device **14** via lines **33** and **34.** Furthermore the vector generator **30** supplies signals to a brightness control **37** via lines **35** and **36.** Signals reach a dot-size control **39** from the control device **14** via line **38,** the control **39** having its output connected to a focusing coil **40.** The adder **21,** where the individual voltages are composed to become the entire deflection voltage, further transfers the deflection voltages via a format-twisting device **41,** a picture-tube correction unit **42** and amplifiers **43** and **44** to X and Y deflection coils **45** and **46** of a picture tube **47.** If a not-squared picture window is applied during the recordation, a better utilization of the surface of the recordation carrier (such as film material) can be obtained with the help of the format twisting device by adapting the picture format to the recordation format by fixed angular twistings (rotations) such as around 90°.

In the picture-tube correction unit **42,** correction are effected which are to even out non-linearities of the picture tube.

In FIG. **3,** the address coding within the central control device **14** is given with the help of a memory system which can be programmed. The selection of the signs is effected from the central station via command data such as a seven-bit signal supplied at input **470** leading to an input register **48.** By means of adding five fixed bits from input **49,** the number of the bits is increased to 12 and is fed via address counter **50** into an address register **51** of a memory **52** which can be programmed. Now a stored word is found in the memory **52** under a so-called primary address which, among other things, contains an order key which is recognized in the order-decoding device **53,** and the order key informs whether the symbol is a normal one or a further order such as a twisting order, an advance order or a similar thing. If one is concerned with normal signs the remaining bits will be the secondary address which is guided to the counter **50** via a line **54.** The recordation data of the signs-to-be-recorded are at this secondary address. The further recordation data which belong to the sign configuration are found in the directly adjacent (directly following) storage locations of the memory **52** by means of a further counting (incrementing) of the address counter **50.** This information, i.e., the recordation data, are given out via a line **56.**

In FIG. **4,** a circuit example has been given for the twisting-order coding with the help of the memory **52.** Command data **470** containing a twisting order reaches the address register **51** of the memory **52** via the input register **48.** The twisting code is found directly at the primary address and it is taken over into a twisting-code register **57** from which the control of an analog twisting device is effected.

FIG. **5** shows the circuit of an analog twisting device for the X and Y deflection of the electron beam. Final cosine and sine control members (cos and sin adjusting members) **59** through **62** are controlled from the register **57,** and they are connected to the outlets of two operational amplifiers **63** and **64** which are operated as adders and cause shiftings according to the supplied values a and b in the X′ deflection **65** and in the Y′ deflection **66.**

These shifted deflection signals first pass through the final sine and cosine control members **59** through **62** and then the quadrant selection switches **67** through **70** belonging to them. After this sign-twisting device has been passed, the X and Y deflection signals reach the adders **71** and **72** in which, on one hand, the basic deflection signals X_o, Y_o are suppled via the digital to analog (D-A) converters **17** and **18** and, on the other hand, a further shifting is effected for instance a reverse shifting A, B. From the adders **71** and **72,** the deflection coils **45** and **46** are controlled by the line amplifiers **73** and **74** which may include relevant parts of circuits such as those indicated at **41–44** in FIG. **2.** The network which is shown in FIG. **5** reconstructs the equation of the coordinate transformation with the help of which the shifting and twisting are effected.

FIG. **6** shows a particular embodiment of an analog twisting device with which the values of the angle twistings are given as fixed function values. As in FIG. **5,** the X and Y deflection signals reach final sine and cosine control members **59** through **62** from the deflection-signal generators **65** and **66** via the adders **63** and **64,** and the final control members **59** through **62** are connected with the twisting-code register **57** via continuous control lines **75** through **82.** The desired twisting angles are adjusted in the final sine and cosine control members **59–62** by the twisting-code register **57** via lines **75** through **82.**

In order to have a better overall view, the final sine and cosine control members have been illustrated separately in FIGS. **7** and **8.** FIG. **7** shows a final cosine control member corresponding to the final control members **59** and **62.** A sine control member is shown in FIG. **8** corresponding to the final control members **60** and **61** of FIG. **6.** These final sine and cosine control members consist of an initial resistor **83** forming voltage dividers with the resistors **84** through **91,** which can be connected to ground potential via switches **92** through **99.** The voltage dividers represent analog values of angle functions for given angles which are adjusted via lines **75** through **82** of the twisting-code register **57.** Since $\sin \alpha = \cos (90° - \alpha)$, the sine is obtained from the cosine by effecting the control of the voltage dividers of the final sine control member according to FIG. **8:** the angle sine 10° is illustrated by connecting switch **99** with the control line **65** for the cos of 80°. The other angles are obtained correspondingly.

Since these final sine and cosine adjusting members **59** through **62** are only embodied for angles from 0 through 90°, but twisting angles larger than 90° are also desired, quadrant switches **100** through **103** FIG. **6,** are connected in circuit after the final sine and cosine control members **59** through **62** and are also connected to the twisting-code register **57** via control lines **124** through **127.** Thus the angular functions of twisting angles between 90° and 360° can be obtained by giving the outputs of components **59–62** the corresponding polarities.

The quadrant switches **100** through **103** each consists of an operational amplifier **105** which has a feedback coupling via a resistor **104** with a plus input **106** and a minus input **107.** The minus input **107** adjoining the output of a final sine or cosine control member via resistors **108** and **109,** respectively and the plus input **106** being connected with the resistors **110** and **111.** Switches **112** and **113** are positioned between the resistors **108** and **109,** and **110** and **111,** and these switches are actuated via the control lines **124** through **127.** When the switch **112** is closed, the negative input **107** is closed for a short time, i.e., the positive input **106** is

effective; when the switch **113** is closed, the negative input **107** is effective. The connection of the switches **112** and **113** of the quadrant polarity generators **100** through **103** via the lines **124** through **127** is selected in such a way that the polarities of the sine and cosine functions result which correspond to the transformation equations. Furthermore, the values of sinα and/or cosα = 0 or ± 1 can easily be obtained when both switches **112** and **113** are closed or one is open.

The outputs of the quardrant polarity generators are connected in such a way that the Y deflection appears at the outputs of the polarity generators **100** and **102** and the X deflection at the outputs of the polarity generators **101** and **103.** As in FIG. **5,** adders **71** and **72** are provided with the help of which an additional shifting or reverse shifting of the signs can be effected over the values A and B. The deflection voltages reach the deflection coils **45** and **46** of the recordation tube via the line amplifiers **73** and **74,** from the adders **71** and **72.**

In FIG. **9,** an example for the composition of a sign configuration from several individual signs has been shown. A case is shown which occurs often when weather maps are recorded, namely the recordation of a weather station which is composed of a station circle **114** with cloud covering indicated at **115,** a wind arrow **116** composed of several partial symbols **117, 118, 119** and **120,** and which has an angle of inclination γ indicating the wind direction.

The speed of the wind is given by the partial symbols **117** through **120,** whereby **117** is assigned to represent the value 50 knots, 118 to represent the value 10 knots, **119** to represent the value 5 knots and **120** to represent the value zero knots. Since usually the speed of the wind does not need to be stated more exactly than within 5 knots, the desired wind direction and speed can be illustrated by combining four or more partial symbols. This combination is effected by a succession of the corresponding partial symbols to result in the desired new wind-arrow symbol which then is shifted a certain amount and, then, depending on the wind direction γ, recorded while twisted around the center of the station circle **114.** First of all, the station circle **114** is recorded in a positioning raster **121** as a normal sign without twisting, with the basic coordinates X_o, Y_o being measured from a cross point such as **122** where $X = 0$, $Y = 0$. Then the center of the station circle is selected as a basic reference point with coordinate $X = X_o1$ and $Y = Y_o1$ for the wind arrow **116** which is still to be recorded. Depending on the diameter of the station circle, the center of the station circle can be positioned on a cross point such as $X = X_o2$, $Y = Y_o2$ of the positioning raster **121** or be between the cross points. If the center is not positioned on a cross point, an adjacent cross point (e.g. $X = X_o2$, $Y = Y_o2$) will be selected as the basic reference point for the wind arrow. The deviation of this point from the center of the station circle is to be designated as $\Delta X = A$. $\Delta Y = B$.

Before the deflection signals of the wind arrow now reach the twisting device **28, FIG. 2,** a coordinate transformation is effected at displacements of $X' + a$, $Y' + b$, from the basic reference point (X_o2, Y_o2), whereby a and b determine the position of the untwisted wind arrow (indicated in dash outline at **116***a*) relative to the center of the station circle. Then, a twisting is effected around the selected basic reference point (having coordinates $X = X_o2$, $Y = Y_o2$) at an angle amount γ corresponding to the wind direction which is supposed to be illustrated by the wind arrow. The rotated wind arrow is indicated in dot dash outline at **116***b*. After the rotation, a reverse shifting of the wind arrow is effected at values $\Delta X = A$ and $\Delta Y = B$, so that the wind arrow again is tangent to and is positioned symmetric to the station circle **114,** with respect to its longitudinal extension.

This reverse shifting drops out ($A = 0$, $B = 0$) when the station center is on one of the cross points of the positioning raster **121.**

After all parameters for twisting and shifting are taken into account, the deflection of the electron beam itself can be effected according to a filter raster **123** corresponding to the raster according to which the patterns of the signs and/or partial symbols have been scanned when the recordation data was originally generated.

In the course of the recordation deflection, the electron beam is also controlled to produce light and dark segments corresponding to the bright-dark values of the recordation data.

The term "recordation" is used herein to refer to the display and/or recording of data, and is not intended to require the making of a permanent record, nor to require the making of a visible record since the image on the picture screen of the electron beam tube may be used to expose photographic film which requires subsequent development to render it visible.

The term "sign configuration" is intended to cover graphic symbols such as weather symbols as well as characters and the like, both in a normal disposition and in transposed or composite arrangements as taught by the present invention.

The term "transform" is used herein to refer to translation and/or rotation (twisting) of sign configurations as contemplated by the present invention.

I claim as my invention:

1. The method of recordation of sign configurations on a picture screen of an electron beam tube with the use of an electron beam, wherein the significant points defining the shapes of a series of basic signs are represented by stored digital recordation, X and Y deflection data and wherein the stored digital recordation deflection data for the respective basic signs is available from storage in response to respective recordation data signals, for generating corresponding basic recordation deflection signals, said method comprising

responding to digital recordation data signals with respect to selected sign configurations including certain modified sign configurations to be generated by means of the electron beam tube to generate successively the corresponding basic recordation X and Y deflection signals of the significant points of such signs, and

transforming certain of the basic recordation deflection signals relative to others in response to input command data so as to transpose certain of the basic signs relative to others on said picture screen, thereby to produce modified sign configurations without the need for storage of specific recordation deflection data therefor,

the transformation of the basic signs being effected by at least one coordinate transformation of the recordation deflection signals,

the coordinate transformation or the coordinate transformations being effected by an analog influ-

encing of the X and Y components of the recordation deflection signals.

2. A method according to claim 1, characterized in that the X and Y components of the recordation deflection signals are transformed according to the functions:

$X = X_o + (X' + a) \cos \phi - (Y' + b) \sin \phi + A$

$Y = Y_o + (X' + a) \sin \phi + (Y' + b) \cos \phi + B,$

wherein: X_o and Y_o are the coordinates of the basic deflection, X', Y' the instantaneous values of the deflection signals for the basic signs which are not shifted and twisted, *a*, *b*, the values for effecting a first shifting in the X and Y directions, ϕ the angle of twisting, and A, B the values for effecting a further shifting in the X and Y directions.

3. A method according to claim 1, characterized in that the X and Y components of the recordation deflection signals are supplied to analog function generators in order to twist the basic signs, the parameters of the analog function generators being adjusted in accordance with the input command data.

4. A method according to claim 1, characterized in that constant voltage values are added to the X and Y components of the recordation deflection signals in order to shift the basic signs, the magnitudes of said voltage values being given by the input command data.

5. The method of recordation of sign configurations on a picture screen of an electron beam tube with the use of an electron beam, wherein the significant points defining the shapes of a series of basic signs are represented by stored digital recordation, X and Y deflection data and wherein the stored digital recordation deflection data for the respective basic signs is available from storage in response to respective recordation data signals, for generating corresponding basic recordation deflection signals, said method comprising:

responding to digital recordation data signals with respect to selected sign configurations including certain modified sign configurations to be generated by means of the electron beam tube to generate successively the corresponding basic recordation X and Y deflection signals of the significant points of such signs, and

transforming certain of the basic recordation deflection signals relative to others in response to input command data so as to transpose certain of the basic signs relative to others on said picture screen, thereby to produce modified sign configurations without the need for storage of specific recordation deflection data therefor,

the input data being supplied to an address register of a memory which can be programmed, certain storage words at the primary addresses containing recordation deflection data and certain storage words containing secondary addresses where recordation data are filed.

6. A method according to claim 5, characterized in that, with successive recordation data of one sign configuration or with successive sign configurations, the recordation deflection data are called from a secondary address in response to further counting of an address counter.

7. An apparatus for the recordation of sign configurations including an electron beam tube with an electron beam for the recordation of signs on the picture screen of the tube, and a memory system for storing recordation X and Y deflection data representing the significant points defining the shapes of a series of basic signs for readout as corresponding basic recordation X and Y deflection signals, said apparatus comprising:

function generators for differentially acting on said basic recordation deflection signals and responsive to input command data to transform selectively certain of said basic recordation deflection signals relative to others in accordance with respective different transformation parameters contained in said command data, thereby to produce modified sign configurations on said picture screen without the need for storage of specific recordation deflection data therefor,

and means connected to said function generators and responsive thereto for controlling the scanning of said tube in accordance with said X and Y deflection signals, for successive scanning of said significant points,

the function generators comprising oppositely coupled operational amplifiers.

8. An apparatus for the recordation of sign configurations including an electron beam tube with an electron beam for the recordation of signs on the picture screen of the tube, and a memory system for storing recordation X and Y deflection data representing the significant points defining the shapes of a series of basic signs for readout as corresponding basic recordation X and Y deflection signals, said apparatus comprising:

function generators for differentially acting on said basic recordation deflection signals and responsive to input command data to transform selectively certain of said basic recordation deflection signals relative to others in accordance with respective different transformation parameters contained in said command data, thereby to produce modified sign configurations on said picture screen without the need for storage of specific recordation deflection data therefor,

and means connected to said function generators and responsive thereto for controlling the scanning of said tube in accordance with said X and Y deflection signals, for successive scanning of said significant points,

the function generators for shifting signs comprising adders for receiving translational parameters from the input command data and those for twisting the signs comprise angular control members for receiving angle information from said input command data,

the angular function control members consisting of voltage dividers which are provided with electronic switches which allow the reconstruction of the values or sine and/or cosine functions.

9. An apparatus according to claim 8, characterized in that the voltage dividers are provided for the function values of one quadrant, and that the function values of the remaining quadrants are reconstructed by means of polarity switching.

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