(54) Title: METHOD AND SYSTEM OF REPRESENTING INFORMATION DATA
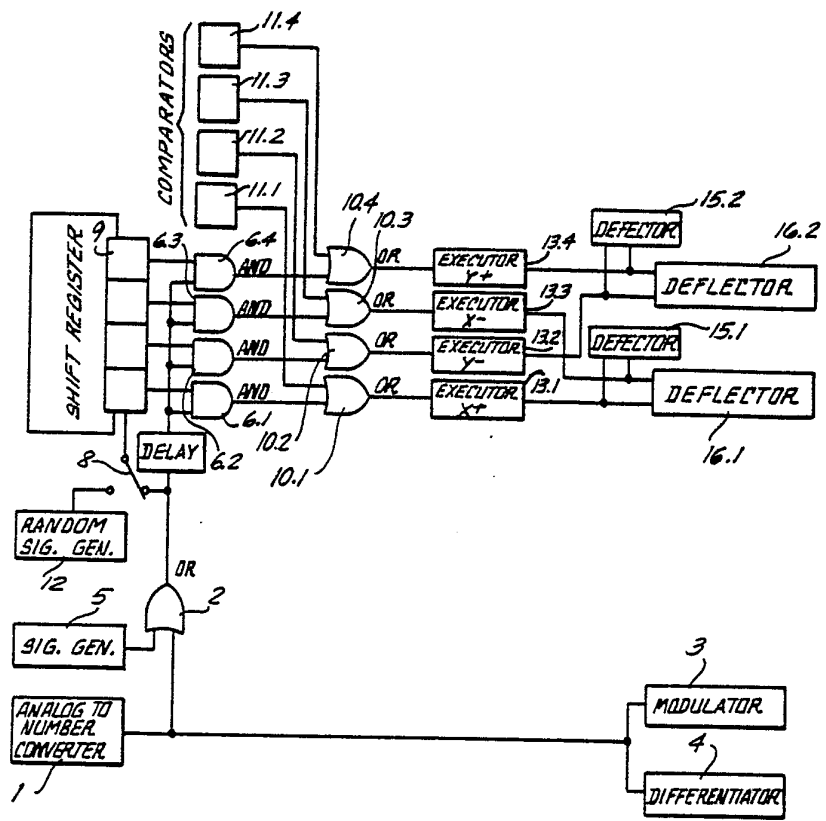
(57) Abstract

A method of and a system for scanning a picture more densely in more detailed regions in order to provide more useful detail in a given amount of picture data. The picture is scanned by a movable interrogating element which is moved by deflection circuits (15.1 and 15.2) in response to signals produced from the picture data by a signal generator (5).

METHOD AND SYSTEM OF REPRESENTING INFORMATION
DATA

## TECHNICAL FIELD .

The present invention relates to a method of and a sys-
tem for representing information data, particularly those
involving scanning of information data.

Methods  and systems of the above-mentioned type are
widely known, for example in television, radiolocation, roe-
ntgenography, radioisotope analysis , storage tubes of com-
puter memory. Scanning of the respective information data
is here performed for  respective use.

## BACKGROUND ART

In transmitting and receiving systems , it is known
to use a two-dimensional or raster scanning. This scanning
has some defects, especially in orthogonal coordinate system,
such as follows:  Scanning along one of the coordinate axis,
particularly along the Y-axis is interrupted so that the
data, for example the image in television systems is trans-
mitted in separate lines with fixed ordinates. There is no
functional dependence between the tightness of scanning li-
nes, the area of a pictured element, and the quantity of
information in the transmitted image. This leads to the
limitation of resolving power of the television systems.
Transmission and reproduction of the image of the objects
in separate lines with fixed ordinates and with synchroni-
zation in time leads to flickering of parts of the image

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of transmitted object. It is necessary to interrupt the beam

after finishing of each line and to return the beam to its

initial position by means of special units. For improving

the quality of image  each frame is divided in two semi-

frames, and because of complicated equipment the frames are

not divided into a greater number of frame fragments.


DISCLOSURE OF THE INVENTION


In accordance  with the present invention, a method

is provided in which scanning of information data is perfor-

med by interrogating the information data with a movable

interrogating element, forming a flow of impulses correspon-

ding to the data which have been interrogated, and moving

the interrogating element successively in directions selected

in response to commands formed by the impulses from more

than two directions with an equal probability, and the mo-

vement of the interrogating element is then used for spe-

cial purposes.

The invention also provides a system which has a

scanning device for scanning the information data and inc-

luding means for interrogating the information data formed

as an interrogating element, means forming a flow of  impul-

ses corresponding to the information data which have been

interrogated by the interrogating element, means forming

commands in response to the impulses for moving the in-

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terrogating element successively in directions selected
from a plurality of directions in random behavior with
equal probability, and means, for receiving the commands
and moving the interrogating element in correspondence
with the commands; and a device for using the movement of
the interrogating element , for specific purposes.

The using step and means may include moving
a reproducing element in synchronism with the movement of
the interrogating element.

For television systems this means that an elec-
tron beam in a transmitting device moves and interrogates
the information, the information which has been interroga-
ted is converted into a flow of impulses which form commands
for changing the movement of the electron beam in directions
selected from more than two directions with equal probabili-
ty, for example along rectilinear paths. This takes place
in a television tube of the transmitting device. On the
other hand, in a television tube of a receiving device a
reproducing electron beam moves in synchronism with the
movement of the interrogating electron beam of the trans-
mitting device and reproduces the information.

For radiolocation systems, roentgenographic
systems, radioisotope scanning systems, storage tubes of
computer memories, the moving elements are respectively
electron beams, sensors of X-ray intensity, counters of
radiation, and electron beams.

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The novel features of the present invention
are set forth in particular in the appended claims. The
invention itself, however will be best understood from the
following description of preferred embodiments which is
accompanied by the following drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a view showing a transmitting-receiving
system in accordance with the present invention; and
FIGS. 2 and 3 are views showing two different pat-
terns of movement of a moving interrogating-reproducing
element in accordance with the present invention.·

BEST MODE FOR CARRYING OUT THE INVENTION

A television system in accordance with the pre-
sent invention is shown in FIG. 1. It has analog-to-
number convertor identified with reference numeral 1. The
convertor 1 converts an analog value of videosignal rece-
ived for example from iconoscope into a flow of impul-
ses. The output of the convertor 1 is connected with a
first input of a logic gate OR identified with referen-
ce numeral 2. It is also connected with a modulating
unit 3 of a picture tube (kinescope ) of a receiving de-
vice, and with a differentiating unit 4 of the receiving

device  , for the purposes which will be explained herein-
below .

An output of a random signal generator 5 which sup-
plies a flow of impulses randomly distributed in time, is
connected with a second input of the logic gate OR. An out-
put of the logic gate  OR is connected with first inputs
of  n logic elements AND  6.1, 6.2, 6.3, 6.4 through a delay
unit 7.  For scanning in orthogonal coordinate system with
n=4  there are four  such  AND gates. The output of the
gate OR  is connected to the first inputs of all four ga-
tes AND.

Reference numeral 9 identifies a circular channel
allocation device (shift register). The output of the lo-
gic gate OR  is also connectable with the channel allocation
unit 9 which has, respectively, n=4 channels. An output of
each channel of the channel allocation unit 9 is connected
with a second input of the respective logic  AND gate 6.1,
6.2, 6.3, 6.4. An output of each logic gate AND is connected
with an output of a respective one of n=4 logic gates OR
10.1, 10.2,10.3, 10.4.  A second input of each logic gate
OR 10.1, 10.2, 10.3, 10.4 is connected with an output of a
respective one of n=4 comparator units 11.1, 11.2, 11.3, 11.4
with an indicator of a threshold value.

By means of a switch 8, a driver input of the
circular channel allocation  unit 9 can be connected either

with the first logic gate OR or with a second random sig-
nal generator 12 which supplies a flow of impulses randomly
ly distributed in time. An output of each logic gate 10.1,
10.2, 10.3, 10.4 is connected with an input of a respective
one of n=4 executing units 13.1, 13.2, 13.3, 13.4. The exe-
cuting units are formed for example as normally open cont-
tolled electronic switches. The executing units are connected
with for example two defecting units 15.1 and 15.2. The exe-
cuting units 13.1 and 13.3 are connected with the deflecting
unit 15.1 which deflects the electron beam along the axis of
abscissa. The executing units 13.2 and 13.4 are connected
with the deflecting unit 15.2 which deflects the electron
beam along the axis of ordinate. In the given example of the
television system , electron beam deflection is for example
electrostatic deflection, magnetic deflection etc. Each
of the executing units serves for turning the deflecting
unit for deflecting the electron beam to one fixed direc-
tion $X^+$ , $X^-$ , $Y^+$ , $Y^-$ , in orthogonal coordinate system,
in the transmitting device A and in the receiving device B.
For this purpose the deflecting units 15.1 and 15.2 are
connected respectively with the deflecting units 16.1 and
16.2 of the receiving device B. Or the executing unit are
connected to the latter.

                              OPERATION

        The transmitting-receiving system of television in
accordance with the present invention operates in the fol-

lowing manner:

For operation in a mode of consecutive running, the
switch 8 connects the gate OR 2 with the circular allocation
unit 9. The inpulse flow from the convertor 1 and the impul-
se flow from the random signal generator 5 are united in the
gate OR  2 and a united flow of impulses is supplied into
the unit 9 and also to the first input of the AND gates
6.1-6.4 through the delay unit 7. All impulses are received
into all first inputs of the AND gates, and the impulses are
received in the respective sequence through the unit 9 into
the second inputs of the respective  gates AND. When the
impulses in both inputs of the respective gate AND coincide
with one another, the impulse is supplied into the respec-
tive executing unit 13.1-13.4 of the transmitting device A
(through the respective gate AND, and the executing units
switch the respective  deflecting unit 15.1 , 15.2  to de-
flect the electron beam in the transmitting device A (in
the iconoscope), and also the respective deflecting unit
16.1, 16.2  in the receiving device (in the kinescope) as
shown in FIG. 2. The directions of the electron beam are
changed consecutively parallel to the respective coordi-
nate axes, with an equal probability.  FIG. 2 shows the
movement of the electron  beam in clockwise direction,
wherein 17  is a part of a target of the screen, and 18
is an electron beam.

When the switch 6 connects the random signal ge-
nerator 12 with the circular allocation unit 9, the sys-

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tem operates in accordance with a mode of random running.
The channel allocation unit is selected so that an average
statistic frequency of the impulses at its output is sig-
nificantly greater than that of the impulses received from
the gate OR 2. The impulses of the united flow after the
gate OR 2 are supplied to the first inputs of the respective
gates AND 6.1-6.4. Impulses from the random signal generator
are also supplied to the circular allocation unit 9, and
from the latter are supplied to the second input of the AND
gates 6.1-6.4. From the AND gates the impulses are suppli-
ed to the respective executing units 13.1-13.4 in a random
behavior with the equal probability p= 0.25. When the
random generator 12 is connected with the channel allocation
unit 9, instead of the same flow of impulses from the con-
vertor 1, the channel allocation unit receives a different
flow of impulses, which results in random coincidence of the
impulses in the AND gates 6.1-6.4 and random actuation of
the executing units 13.1-13.4 which receive the impulses
which are randomly distributed in time. Therefore, the elec-
tron beam changes its direction (under the action of the
deflecting units 15.1,15.2 and 16.1,16.2) parallel to the
respective axes, and not consecutively always in clockwise
or counterclockwise direction, but instead in any random
behavior as shown in FIG. 3.

Each second input of the OR gates 10.1-10.4 is
connected with the output of the respective units of com-
parison of threshold value 11.1- 11.4. Each of these units

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forms an impulse when one of the coordinates of scanning reaches a threshold value for the respective unit, For example, if for abscissa of the scanning element the condition $x \leq x_1$ is satisfied, wherein $y=x_1$ is a straight line corresponding to the border of the scanned rectangular field, an impulse is formed in the unit 11.1. Then the impulse is transmitted from the output of the latter through the second input of the gate OR 10.1 to the input of the executing unit 13.1 which forms a command for changing the direction of scanning from $X^-$ to opposite direction $X^+$. The scanning (moving) element is "reflected" at a right angle from the left border of the scanned field.

When however for abscissa of the scanning element the condition $x \geq x_2$ is satisfied, wherein $x_1 < x_2$ and $y = x_2$ is a straight line corresponding to the right border of the scanned field, then an impulse is formed in the threshold unit 11.3. From the output of the latter the impulse is transmitted through the second input of the gate OR 10.3 to the input of the executing unit 13.3 which forms a command for changing the direction of scanning from $X^+$ to the direction $X^-$. The scanning (moving) element is "reflected" from the right border of the scanned field with a straight line $y=x_2$ . Similar actions are performed for the threshold units 11.2 and 11.4, wherein $y < y_2$ $(x=y_1)$ and $x= y_2$ are equations of straight lines corresponding to the lower and upper borders of the scanned rectangular field. The above mentioned function distribution of the threshold units 11.1-11.4 and gates 10.1-10.4 as well as the executing units 13.1 -13.4

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corresponds the  scanning in clockwise direction.

It is to be understood that the electron beam
can also move in counterclockwise direction. It is also to
be understood that the generator 5 can be omitted in some
cases. In these cases the united flow is composed of only
a main flow of impulses  which for example for the television
is a flow of impulses of the videosignal.

When the method is performed and the system is
designed in accordance with the present invention, the scan-
ning is performed hot  by subdividing of an image into indi-
vidual separate lines, half-frames and frames, but by means
of continuous scanning  parallel to both coordinate axes. The
density of lines of scanning and the area of an element of a
frame changes as a function  of a relative density of  dis-
tribution of information  in the frame. The reason for this
is that the value of a signal (videosignal in television) is
a function of the value of brightness of elements of the
image which is transmitted, and also of their derivative ,
as will be explaned hereinbelow.

With the increase in quantity of transmitted informa-
tion , the density of the lines of scanning is increased
and the area of an element of scanning is decreased (or
sharpness of focusing of electron beam on the screen is
improved ). Coordinates of the lines of scanning and the
frequency of changing of the latter are not fixed and are
random values both in the mode of random running and  in the
mode of consecutive running, since the value of signal
(videosignal in television ) changes during scanning as a
function of random values of transmitted information. This
eliminates flickering of individual parts of image, which

takes place in raster scanning.

The frequency of forming the fragments of the lines between the successive impulses of the videosignal and alternating of these fragments parallel to the coordinate axes determine the density of the fragments of lines as a function of the signal (videosignal). The higher is the value of the signal, the higher is the density of the lines which are parallel to both coordinate axes.

The increase of a part of randomly distributed in time impulses in the united flow increases the number of formed fragments of a frame. Frame fragments with a higher quantity of information are repeated with higher frequency than the frame fragments with a lower quantity of information.

The dependence of the density of the fragments of lines and the number of subdivisions into parts of a frame can be improved if the signals for forming commands of direction switching or the random selection of scanning directions are formed as a function of a derivative of intensity of the brightness of elements of image. Movement of the scanning element (electron beam in television) from one line to the other and from one part of a frame to the other part is performed in the process of uninterrupted scanning of the image without extinguishing and returning of the scanning (moving) element to an initial abscissa or into an initial point, as in the case of the raster scanning.

It is to be understood that the units 3 and 4 are not necessary for the basic idea of the present invention and therefore can be omitted.

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As can be seen from the drawing, the modulating unit 3 in the receiving device B is connected with the output of the convertor 1. It receives the flow of impulses from the convertor 1 and sends the signals to a modulating electrode of the kinescope, so that the intensity of the electron beam and therefore the illumination of the elements of image on the screen change in dependence on the impulse flow.

The differentiating device 4 is also connected with the convertor 1 to receive the impulse flow, and is connected with a focusing electrode of the kinescope so that sharpness of focusing of the electron beam changes as a function of the impulse flow. In particular, when a greater quantity of information is scanned, the sharpness of focusing of the respective element of the image on the screen is increased.

It is to be understood that with different types of patterns of scanning, it is possible to use the inventive method and system in accordance with the present invention for both above described modes. It is also possible to provide not only two -dimensional, but also three- and multi-dimensional scanning.

The invention is not limited to the details shown since various modifications and structural changes are possible without departing in any way from the spirit of the present invention.

What is desired to be protected by Letters Patent is set forth in particular in the appended claims.

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CLAIMS

1. A method of representing information data comprising the steps of

scanning information data, including interrogating information data by a movable interrogating element, forming a flow of impulses corresponding to the data which have been interrogated by said interrogating element, and moving said interrogating element successively in directions selected in response to commands formed by said impulses, from more than two directions with an equal probability.

2. A method as defined in claim 1, wherein said moving step includes moving said interrogating element in directions selected in accordance with a predetermined sequence so that after a previous direction said interrogating element is moved in a predtermined subsequent direction.

3. A method as defined in claim 1, wherein said moving step includes moving said interrogating element in directions selected in accordance with a random pattern.

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4. A method as defined in claim 1, wherein said scanning step includes uniting the flow of impulses corresponding to the data, with a further flow of randomly distributed in time impulses so as to form a united flow of impulses, said moving step including moving the interrogating element in directions selected in response to commands formed by the impulses of the united flow of impulses.

5. A method as defined in claim 1; further comprising the step of providing a reproducing element and moving the latter in synchronism with the movement of said interrogating element.

6. A method as defined in claim 5, wherein said scanning step includes determining a derivative of the flow of impulses; and further comprising the steps of focusing the reproducing element in accordance with the derivative of the flow of impulses.

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7. A method as defined in claim 1; and further
comprising the step of limiting the movement of the inter-
rogating element and including forming a limiting impulse
and supplying the limiting impulse to the interrogating
element so as to limit the movement of the latter.

8. A method as defined in claim 5; and further
comprising the step of varying illumination of an image
reproduced by the reproducing element, in dependence upon
the flow of impulses.

9. A system for representing information data,
comprising

a scanning  device for scanning information
data and including means for interrogating the information
data and formed as a movable interrogating element, means
forming a flow of impulses corresponding to the information
data which have been  interrogated by said interrogating
element, means forming commands in response to the impulses
for moving said interrogating element successively in direc-
tions selected from more than two directions with equal pro-
bability,and means for receiving said commands and moving
said interrogating element in correspondence with the latter.

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10. A system as defined in claim 9,wherein

said command forming means includes means for forming

commands to move said interrogating element in accordance

with a predetermined sequence so that after moving said

interrogating element in a previous direction it moves

in a predetermined subsequent direction.


11. A system as defined  in claim 9, wherein

said command forming means includes means for forming

commands to move said interrogating element in accordance

with a random pattern.


12. A system as defined in claim 9; and further

comprising means for forming a further flow of impulses;  ·

and  means for uniting said first mentioned flow of impulses

with said further flow of impulses so as to form a united

flow of impulses, said command forming means being arranged

to form commands in response to the impulses of said united

flow of impulses.

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13. A system as defined in claim 9; and further

comprising a data reproducing element movable in synchro-

nism with the movement of said interrogating element.


14. A system as defined in claim 13; and further

comprising means for differentiating said flow of impul-

ses to form a derivative; and means for focusing said

reproducing element in accordance with the derivative

of the flow of impulses.


15. A system as defined in claim 9; and further

comprising means for limiting the movement of said

interrogating element including means for forming a

limiting impulse and means for supplying the limiting

impulse to said interrogating element so as to limit

the movement of the latter.


16. A system as defined in claim 13; and further·

comprising illuminating means connected with said for-

ming means and varying the illumination of an image

reproduced by said reproducing element in accordance

with said flow.
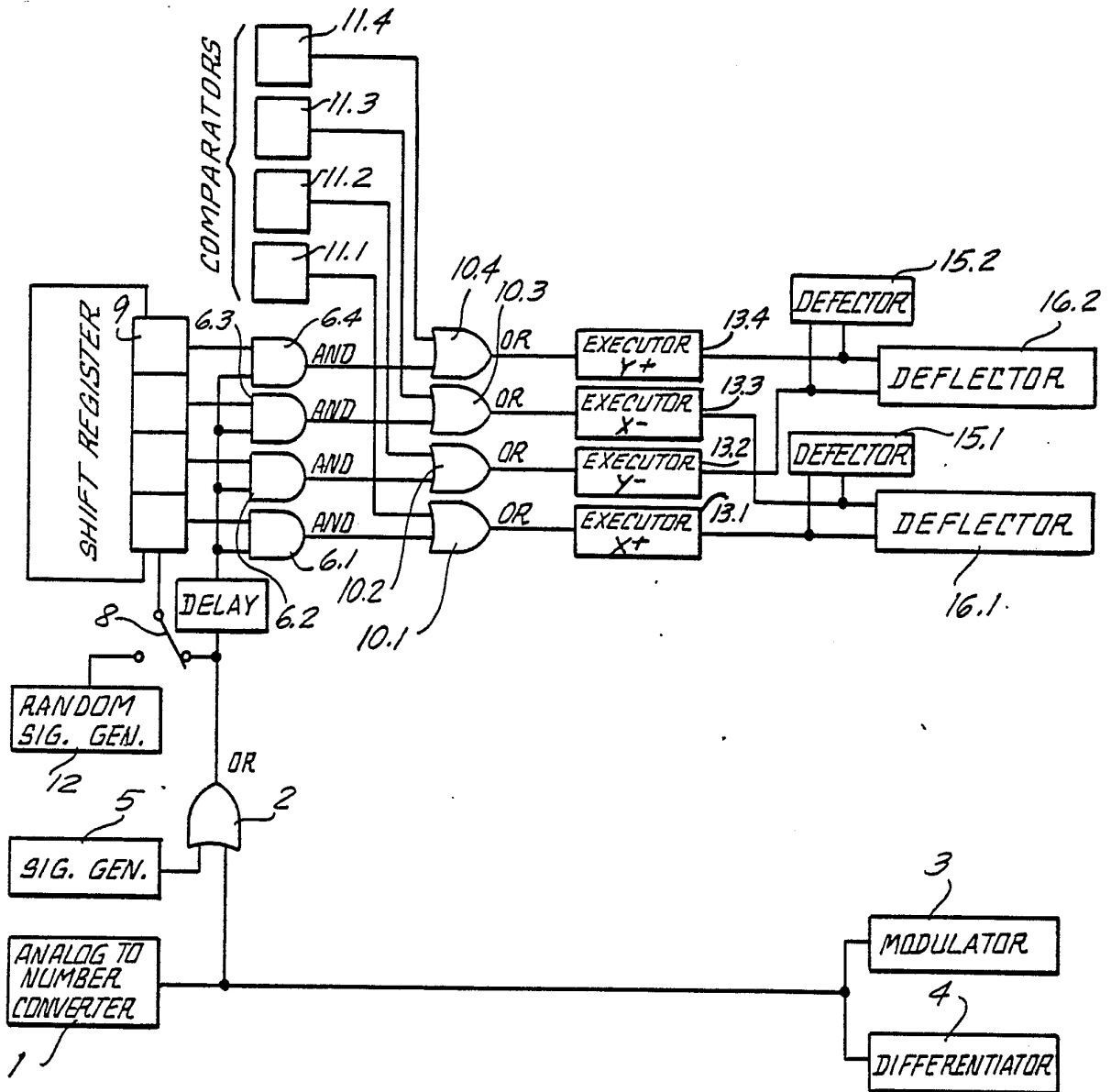
FIG. 1
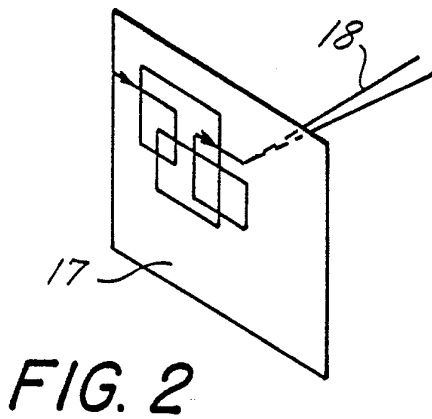


FIG. 2
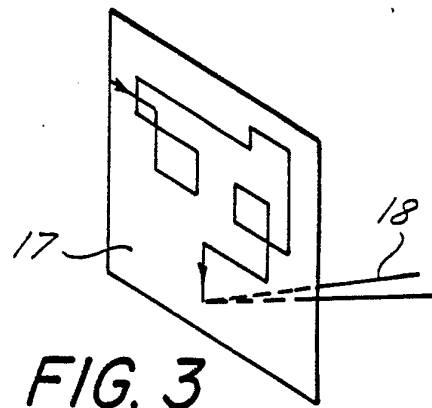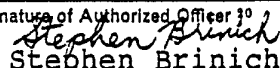


FIG. 3

# INTERNATIONAL SEARCH REPORT

## I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) 3

According to International Patent Classification (IPC) or to both National Classification and IPC

INT. CL. (4)      H04N 5/30

U.S. CL.          358/209

## II. FIELDS SEARCHED

### Minimum Documentation Searched 4

| Classification System | Classification Symbols |
|---|---|
| U.S. | 358/106, 107, 209, 212, 213, 216, 217; 382/66 |

### Documentation Searched other than Minimum Documentation
### to the Extent that such Documents are Included in the Fields Searched 5

## III. DOCUMENTS CONSIDERED TO BE RELEVANT 14

| Category * | Citation of Document, 16 with indication, where appropriate, of the relevant passages 17 | Relevant to Claim No. 18 |
|---|---|---|
| A | US, A, 2,904,629, (Scherbatskoy) 15 September 1959 | |
| A | US, A, 3,002,125, (Stevens et al.) 26 September 1961 | |
| A | US, A, 3,429,990, (Hobrough) 25 February 1969 | |
| A | US, A, 4,011,401, (Presti) 08 March 1977 | |
| A | US, A, 4,575,751, (Duschl) 11 March 1986 | |
| A | GB, A, 2,102,122A, (West et al.) 26 January 1983 | |

* Special categories of cited documents: 15

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

## IV. CERTIFICATION

| Date of the Actual Completion of the International Search 3 | Date of Mailing of this International Search Report 2 |
|---|---|
| 01 July 1986 | 14 JUL 1986 |

| International Searching Authority 1 | Signature of Authorized Officer 20 |
|---|---|
| ISA/US | Stephen Brinich |

Form PCT/ISA/210 (second sheet) (October 1981)