April 21, 1970 J. L. SOULE ET AL 3,507,575

DISPLAY-PRINT MODULE

Filed Oct. 16, 1968 2 Sheets-Sheet 1

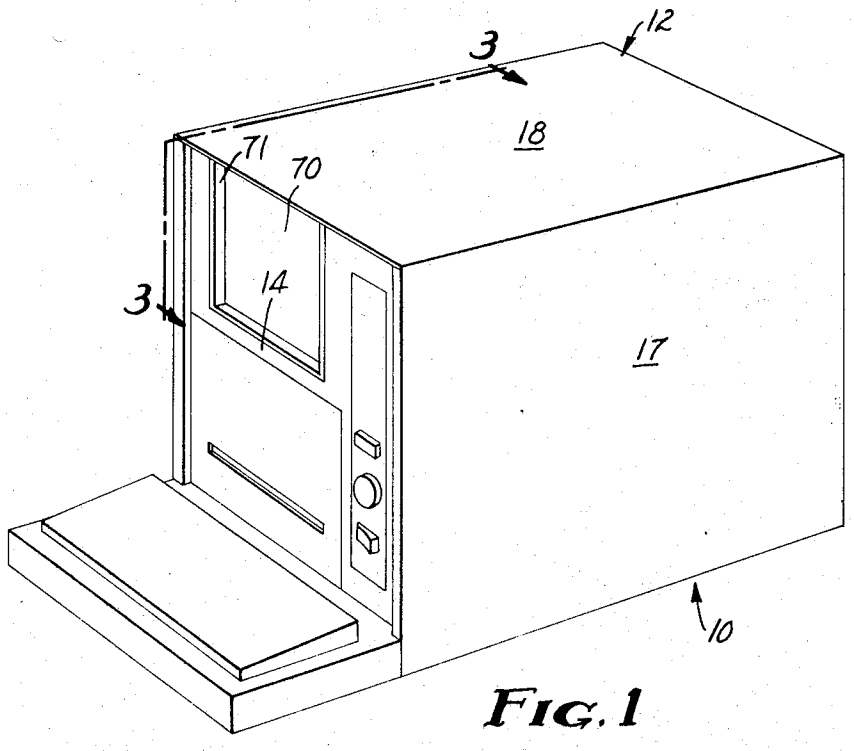


FIG. 1

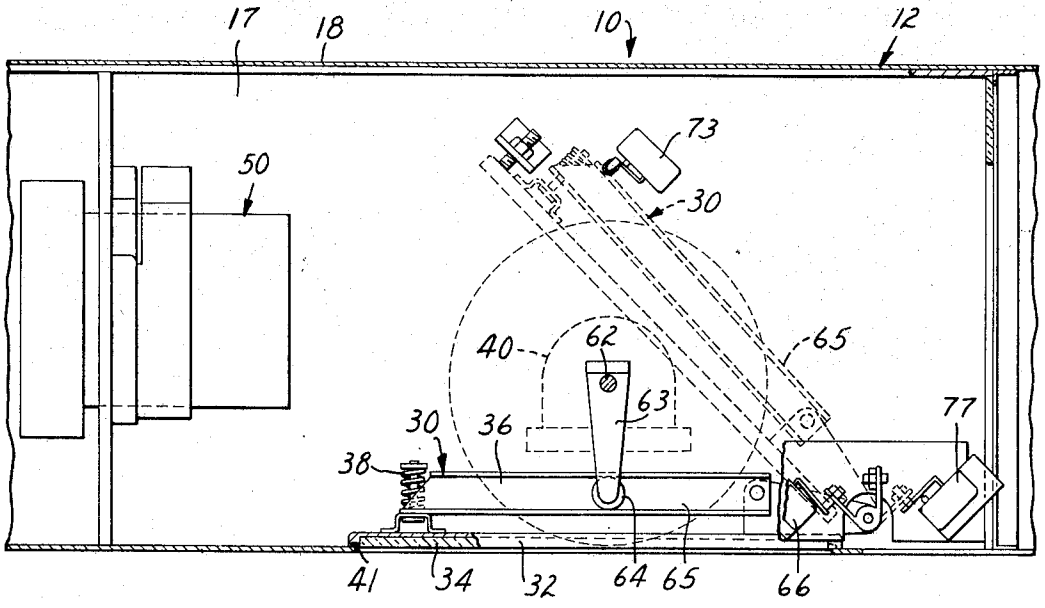


FIG. 3

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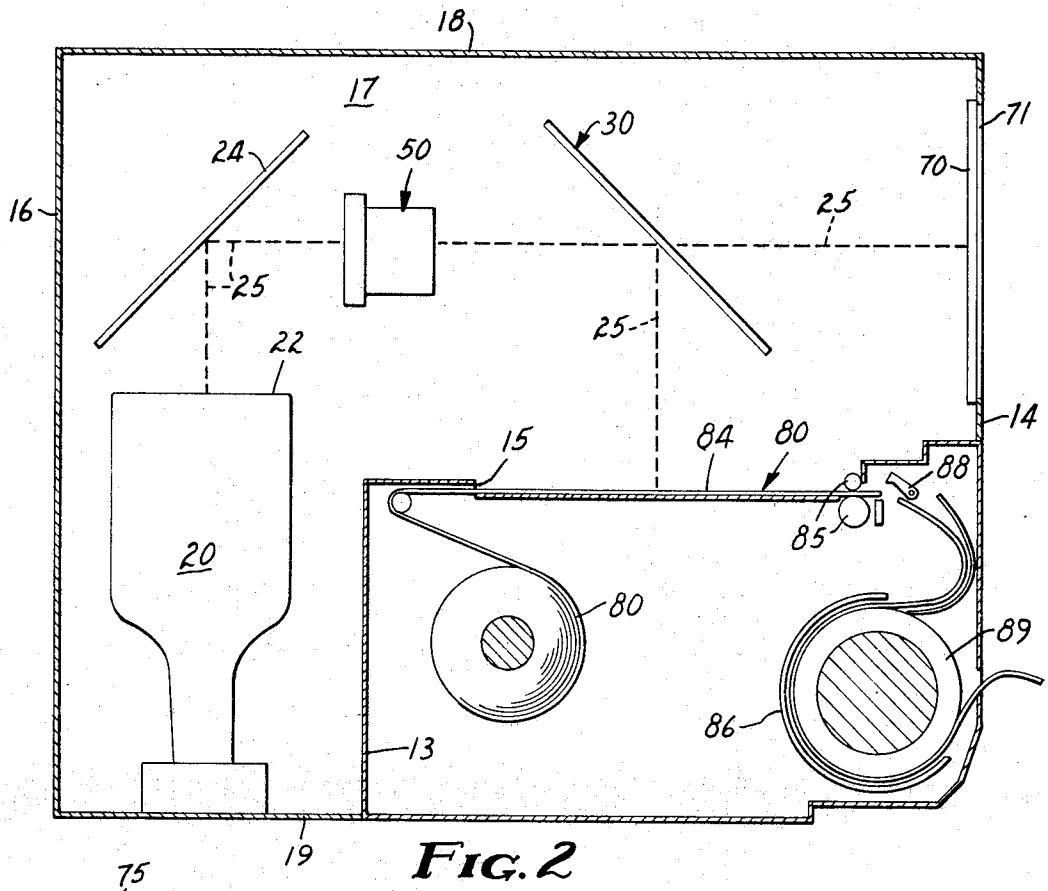


FIG. 2

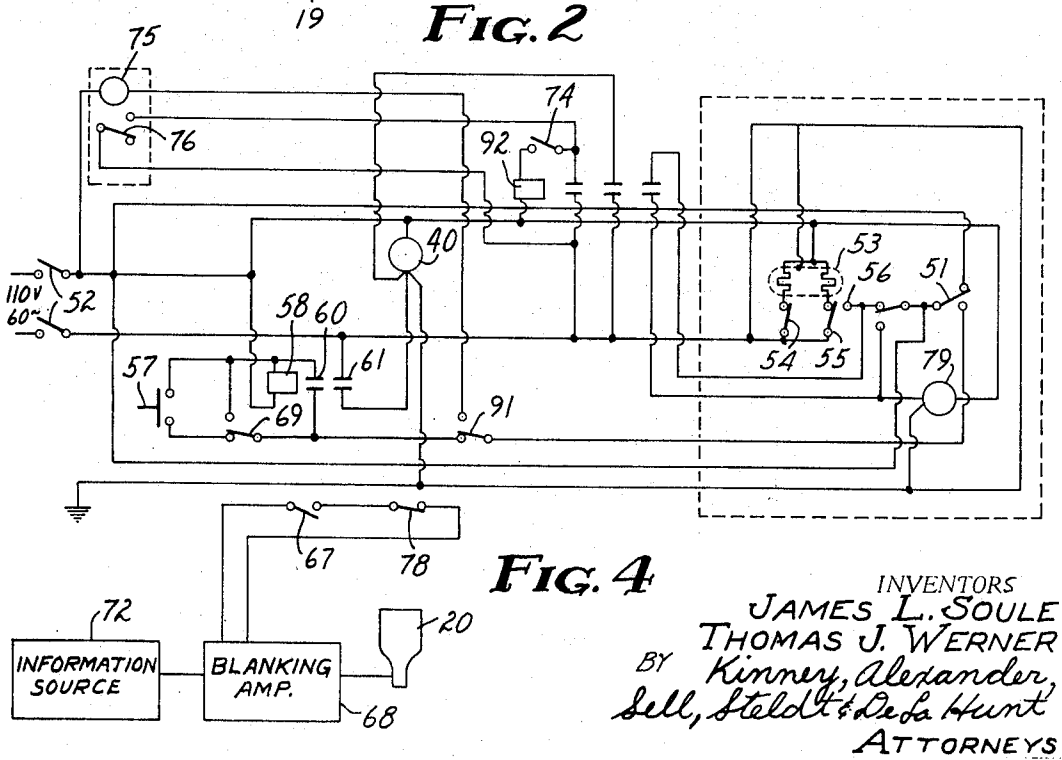


FIG. 4

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United States Patent Office 3,507,575
Patented Apr. 21, 1970

3,507,575

DISPLAY-PRINT MODULE

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Filed Oct. 16, 1968, Ser. No. 768,028
Int. Cl. G03b *13/24;* H04n *5/86*
U.S. Cl. 355—45 3 Claims

ABSTRACT OF THE DISCLOSURE

A display-print terminal wherein a light pattern from a cathode ray tube is enlarged and focused by a lens assembly onto a viewing screen or alternatively focused onto a data recorder via an oscillating mirror-shutter assembly for producing a printed or graphic copy of the light pattern upon demand of the operator.

BACKGROUND OF THE INVENTION

Display terminals are used to visually display computer-generated information to a user of the computer. These terminals, with the increased utilization of time-sharing and real-time data processing systems, are placing a computer within arm's reach of those who until now had, at best, only limited access to computer-generated information. Yet, while these display terminals have extended the usefulness of computers, the limited user continues to be beset with problems of how to better utilize the displayed information at a subsequent date. A compact device that would allow the operator of the display terminal to obtain a copy of the computer-generated information would greatly enhance the utilization of these terminals. However, such a device to achieve acceptance should be sufficiently compact to fit upon a desk-top and provide means for visually dsplaying the graphic pattern and means for obtaining a copy of the pattern upon demand of the operator.

SUMMARY OF THE INVENTION

The present invention relates to a display terminal and more particularly to a display-print module for visually displaying received information as a light pattern and for obtaining a hard copy of the light pattern upon demand of the operator.

Thus, the operator of a desk-top display-print module may visually examine the displayed pattern and, upon demand, obtain a copy thereof for subsequent use. In addition to electronic data processing, a display-print module may be used to record medical data such as electrocardiographs and electroencephalographs; to duplicate sustained TV facsimile displays; and to reproduce repeating waveforms displayed on cathode ray tube instrumentation recorders.

Other uses 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 drawing in which like numerals designate like parts throughout the figures and wherein:

FIGURE 1 is a perspective view of a desk-top display-print module;

FIGURE 2 is a diagrammatical side elevational view of the terminal of FIGURE 1;

FIGURE 3 is an enlarged side sectional view of the mirror-shutter assembly taken on the line 3—3 of FIGURE 1 looking in the direction of the arrows; and

FIGURE 4 is an electrical schematic of the terminal of FIGURE 1.

Referring now to the embodiment of FIGURE 1, there

is shown a desk-top display-print module **10** comprising a housing **12**, a cathode ray tube (CRT) **20**, (see FIGURE 2), a fixed mirror **24**, a rotatable mirror-shutter assembly **30**, a lens assembly **50**, a viewing screen **70** and a data recorder **80**.

The minimized exterior dimensions of the housing **12**, thus the compactness of the display-printer, is an important aspect in inducing people to use the terminal in a casual manner. However, this compactness constrains the functional operation of the components therewithin. As for example, the data recorder **80** must be minimal in size, the optic system should be folded and include a magnification lens assembly **50** to enlarge the image from the compact CRT **20** to a generally acceptable projection, for easy viewing and copying, of approximately 8 x 10 inches. Thus, the desirable compactness of the terminal dictates physical size restrictions placed on the other components therewithin.

The housing **12** supports the components of the module and comprises a front wall **14**, a rear wall **16**, two side walls **17**, **17**, a top wall **18** and bottom wall **19**. In addition to these exterior walls, the housing includes an interior partition **13** having an aperture **15** therein. This partition provides a chamber for the data recorder **80**. Information, in the form of electrical signals, is supplied to the module by electrical components not part of this invention. This electrical information is converted into a light pattern by the CRT **20** and displayed on its faceplate **22**. The keyboard **23**, not a part of this invention, may be used by the operator of the terminal to update and change the light pattern appearing on the screen by the operator communicating with the computer.

For any kind of practical viewing of the light pattern in ambient room light, the screen **70** has to have a brightness of approximately 6 foot-candles. Therefore, the CRT **20** has to be compact to satisfy the space restriction and of extraordinary brightness to adequately illuminate the screen **70**. The faceplate **22** is substantially flat, at least within a 4 inch square raster, so that the image on the faceplate **22** may be optically imaged as a flat and naturally appearing image upon the screen **70** and recorder **80** in an efficient manner. Although similar CRTs may be used, the CRT utilized in this embodiment is a Sylvania SC 4369 available from Sylvania Electric Products Co., Seneca Falls, N.Y.

The rear projection viewing screen **70**, structurally supported by the front wall **14** and overlapping the opening **71** therewithin, receives the light pattern from the CRT. An operator of the module may then visually observe the light pattern appearing on the screen **70**.

A self-contained data recorder **80** provides the operator, upon demand, with a copy of the light pattern. Although other data recorders could be utilized, the compact data recorder used in the preferred embodiment is a Model 144 Data Recorder available from the Minnesota Mining and Manufacturing Co., St. Paul, Minn. This unit includes a roll **82** of light-sensitive paper **83**, a print plane **84** on which the light-sensitive paper **83** is exposed to the light pattern appearing on the CRT for forming a latent image on the paper, feed rolls **85** for advancing the paper to the thermal processor **86** wherein the paper is heated to a temperature sufficient to develop the latent image to a visible image, a knife **88** for severing the exposed area or section of the paper from the unexposed paper and a delivery roll **89** for providing the operator with the graphic copy of the light pattern appearing on the viewing screen **70**.

The folded optical system, as shown in FIGURE 2, necessitated by the physical restrictions of the housing, comprises a fixed mirror **24** positioned at 45 degrees to the optical center line **25**, a rotatable mirror-shutter assembly **30** and a lens assembly **50**. The fixed mirror **24**

above the CRT **20** and the mirror **34** of the pivotal mirror-shutter assembly are made of ground and highly polished plate glass. The first surfaces of these mirrors are coated with aluminum with an overcoating of silicon monoxide to prevent the aluminum from oxidizing. This hard, highly reffective composition has a reflectivity of more than 90 percent.

The mirror-shutter assembly **30**, as shown in FIGURE 3, comprises a beam **32** pivotably supported by the housing **12**, an arm **36** pivotably connected to the beam and resiliently connected to the beam by a bolt-spring assembly **38**, an actuating motor **40** for pivotably moving the assembly between an upper position and a lower position, and a mirror **34** affixed to the beam **32**. It is important that the CRT **20** not be illuminated when the mirror assembly is between the upper and lower positions to avoid smearing of the image on the light-sensitive paper **83**. When the assembly is in the upper position, the mirror will intercept the optical path between the lens **50** and the screen **70** at an angle of 45 degrees to the optical center line **25** and reflect the light pattern onto the print plane **84**. As shown in FIGURE 3, the actuating motor **40** is connected via the pitman **63** and the roller **64** to the channel **65** of the arm **36** to actuate the mirror-shutter assembly **30** between the upper and lower positions. As the assembly **30** reaches the upper position, the beam **32** is stopped by the abutment, which accuraely positions the mirror **34** in the upper position, while the arm **36** continues to pivot relative to the beam **32** compressing the bolt-spring assembly **38** (see FIGURE 3) wherein the arm **36** actuates the mirror up switch **73**. Thus, the CRT **20** can not be illuminated until after the mirror **34** has been stopped and positioned in precise optical alignment relative to the print plane **84**. When the assembly is in the lower position the light pattern may be received by the viewing screen and the assembly **30** acts as a shutter together with a gasket **41** abutting the partition **13** around the periphery of the aperture **15** to seal the light-sensitive paper on the print plane from light generated from the illuminating CRT **20**.

In operation of the display-print module **10**, light-sensitive paper **83** is inserted into the data recorder **80** to provide light-sensitive paper **83** over the print plane **84**. Insertion of the paper closes the paper sensing switch **51**, shown open in FIGURE 4. The main switch **52** is turned on and power is supplied to the module to preheat the heaters **53** of the data recorder to their operating temperatures. Heat from the heaters **53** will deffect the bimetal switches **54**, **55** and thus open switch **54** and move switch **55** to the electrical contact **56**. The information source **72** is providing electrical signals to the CRT **20** by a separate switch (not shown). When the operator desires to make a copy of the light pattern appearing on the viewing screen **70**, the print switch **57** is closed to energize the relay **58**. Energization of the relay **58** closes the contacts **60** and **61** which start the mirror drive motor **40** and continues to energize the motor **40** after switch **57** has been released. The motor **40** actuates the movement of the mirror-shutter assembly **30** via (see FIGURE 3) the shaft **62**, the pitman **63** and the roller **64** operating within the channel **65** of the arm **36**.

As the assembly **30** begins to move away from the lower position, the contact **67** of CRT control switch **66** is closed to blank the illumination of the CRT via the blanking amplifier **68** and contacts **74** are closed. As the assembly **30** reaches the upper position the mirror **34** is accurately positioned and the arm **36** continues to pivot to electrically connect the contact **91** of the mirror up switch **73**, the mirror drive motor **40** is turned off and the timer **75** is energized at the same time the contacts **78** of the CRT control switch **77** is open which illuminates the CRT via the blanking amplifier **68**. After the light-sensitive paper **83** has been exposed, the timer **75** closes contact **76** which energizes relay **90** to return the assembly **30** to the lower position and starts the paper drive motor **79**.

When the assembly reaches the lower position the mirror down switch **91** is actuated to drop out relay **92** to stop the mirror drive motor **40**. As the mirror begins to move down from the upper position the CRT control switch **78** is closed which blanks the CRT. The mirror up switch **91** is actuated to turn off the timer **75**. As the mirror returns to the lower position the interlock switch **69** and the CRT control switch **67** are actuated to return the machine to the start position. Before the mirror returns to the lower position and the relay **92** is de-energized, the paper feed switch **93** is actuated to power the paper drive motor **79** to complete the cycle.

While one embodiment of the invention has been shown and described, it will be appreciated that this is for the purpose of illustration and that numerous modifications may be made therein without department from the spirit and the scope of the invention.

What is claimed is:

1. A display-print module for receiving information supplied to the module and for visually displaying the information as a light pattern and for providing a copy of the light pattern upon demand of the operator, comprising:

(1) a cathode ray tube having a light pattern formed on its face plate from the information supplied to the module;

(2) screen means for receiving the light pattern from said cathode ray tube and visually displaying the light pattern;

(3) data recorder means for making a copy of the light pattern from said cathode ray tube, including

(a) a print plane having light-sensitive heat developable paper thereon for receiving the light pattern and forming a latent image thereon;

(b) means for heating the light-sensitive paper and developing the latent image into a visible image;

(c) means for feeding the light-sensitive paper having the latent image thereon to said developing means; and

(d) means for delivering from the module the light-sensitive paper having the visible image thereon whereby a copy of the light pattern is provided to the operator;

(4) movable means having an upper position for reflecting the light pattern onto said print plane and a lower position for alternatively permitting the light pattern to be received by said viewing means, said movable means including

(a) a mirror-shutter assembly including

(1) a pivotable beam;

(2) a mirror affixed to said beam;

(3) an arm having one end pivotably connected to said beam and the other end resiliently connected to said beam;

(4) abutment means for stopping the pivotable movement of said beam at the upper position for reflecting the light pattern onto said print plane and for stopping said beam at the lower position to permit the light pattern to be received by said viewing screen and to lightably seal said print plane from the illumination of the cathode ray tube;

(b) means operatively connected to said arm for actuating said mirror-shutter assembly between said upper and lower positions, whereby movement of said actuating means will pivotably rotate said beam until said beam is stopped by said abutment means in said upper position to accurately position said mirror in optical alignment with said print plane and said arm will continue to pivot relative to said beam to permit electrical

switch actuation after said mirror has been optically positioned to illuminate said cathode ray tube; and

(5) lens means for imaging the light pattern from said cathode ray tube upon said viewing means or on said print plane via said movable means.

2. A display-print module for receiving information supplied to the module and for visually displaying the information as a light pattern and for providing a copy of the light pattern upon demand of the operator, comprising:

(1) a cathode ray tube having a light pattern formed on its face plate from the information supplied to the module;

(2) screen means for receiving the light pattern from said cathode ray tube and visually displaying the light pattern;

(3) data recorder means for making a copy of the light pattern from said cathode ray tube, including

(a) a print plane having light-sensitive heat developable paper thereon for receiving the light pattern and forming a latent image thereon;

(b) means for heating the light-sensitive paper and developing the latent image into a visible image;

(c) means for feeding the light-sensitive paper having the latent image thereon to said developing means; and

(d) means for delivering from the module the light-sensitive paper having the visible image thereon whereby a copy of the light pattern is provided to the operator;

(4) movable means for reflecting the light pattern onto said print plane or for alternatively permitting the light pattern to be received by said viewing means, said movable means including

(a) a mirror-shutter assembly including

(1) a pivotable beam;

(2) a mirror affixed to said beam;

(3) abutment means for stopping the pivotable movement of said beam at an upper position in the optical path for reflecting the light pattern onto said print plane and at a lower position for permitting the light pattern to be received by said viewing screen and for lightably sealing said print plane from the illumination of the cathode ray tube;

(4) an arm

(a) pivotably connected to said beam;

(b) resiliently connected to said beam;

(b) means operatively connected to said arm for actuating said mirror-shutter assembly between said upper and lower positions, whereby movement of said actuating means will pivotably rotate said beam until said beam is stopped by said abutment means to accurately position said mirror in optical alignment with said print plane;

(c) first switch means for blanking the illumination of the cathode ray tube when said mirror-shutter assembly begins to move from the lower position to thereby restrict illumination of the light-sensitive paper while said mirror-shutter assembly is moving from said lower position to said upper position;

(d) second switch means for unblanking the illumination of the cathode ray tube when the mirror-shutter assembly has reached said upper position to thereby illuminate the light-sensitive paper with the light pattern; and

(5) lens means for imaging the light pattern from said cathode ray tube upon said viewing means or on said print plane via said movable means.

3. The display-print module according to claim **2** wherein said second switch means is actuated by pivotable movement of said arm after said beam has been stopped by said abutment.

References Cited

UNITED STATES PATENTS

2,561,612	7/1951	Culver	346—110 X
2,623,117	12/1952	Hammond	178—7.4
2,680,148	6/1954	Purington et al.	178—6.7
2,938,427	5/1960	Alves	355—45
3,047,871	7/1962	Hider et al.	346—110
3,339,543	9/1967	Richard	346—110 X

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U.S. Cl. X.R.

178—6.7; 346—17, 110

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,507,575 Dated April 21, 1970

Inventor(s) J. L. SOULE ET AL

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, Line 44, cancel "4369" and insert --4639--. Column 3, Line 6, cancel "reffective" and insert --reflective--; Column 3, Line 28, cancel "accuraely" and insert --accurately--; Column 3, Line 50, cancel "ffect" and insert --flect--.

SIGNED AND
SEALED
OCT 13 1970

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents

USCOMM-DC 60376-P69
U.S. GOVERNMENT PRINTING OFFICE 1969 O—366-334