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Matsuzaki et al.

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[45] **July 3, 1973**

[54] **INFORMATION HOLDING APPARATUS**

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[73] Assignee: **Olympus-Optical Co., Ltd.,** Tokyo, Japan

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Apr. 22, 1972	Japan	47/48011

[52] **U.S. Cl.** ..... **95/10 CT,** 307/238, 307/246, 307/304, 307/311

[51] **Int. Cl.** **G03b 7/08**

[58] **Field of Search** ..... 95/10 CT; 307/238, 307/246, 304

[56] **References Cited**

UNITED STATES PATENTS

3,666,972	5/1972	Sangster	307/246 X
3,633,473	1/1972	Yashihiro	95/10
3,602,717	8/1971	Konig	95/10 X

Primary Examiner—Samuel S. Matthews
Assistant Examiner—Michael L. Gellner
Attorney—Solon B. Kemon et al.

[57] **ABSTRACT**

An information holding apparatus comprising an information input element so disposed as to allow the passage therethrough of certain current corresponding to input light being stored; a field effect transistor connected in series to said information input element; a constant voltage bias source for supplying ias voltage to the information input element and field effect transistor; a capacitor connected between the source and gate of the field effect transistor; and a switch for connecting the transistor to the input element at the time of storing information and selectively connecting the transistor to the load at the time of reading out the information.

14 Claims, 12 Drawing Figures

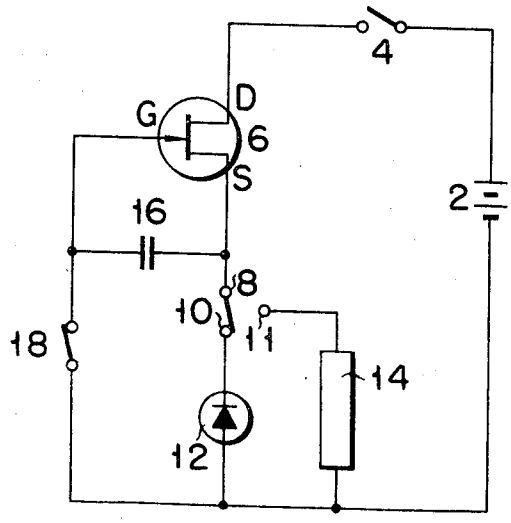

FIG. 1

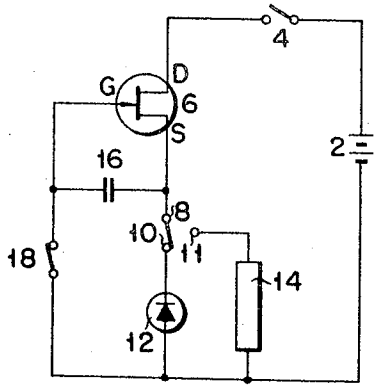
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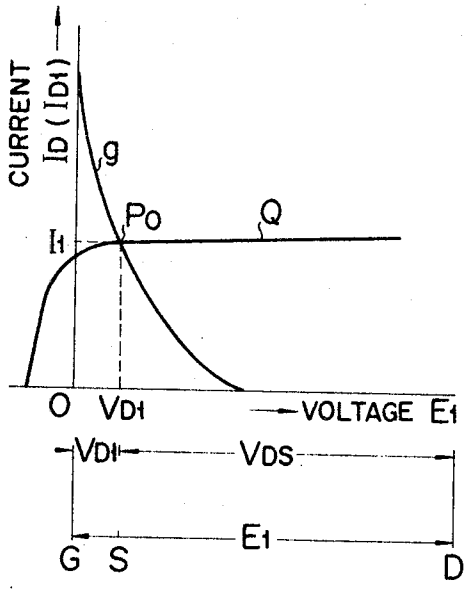
FIG. 2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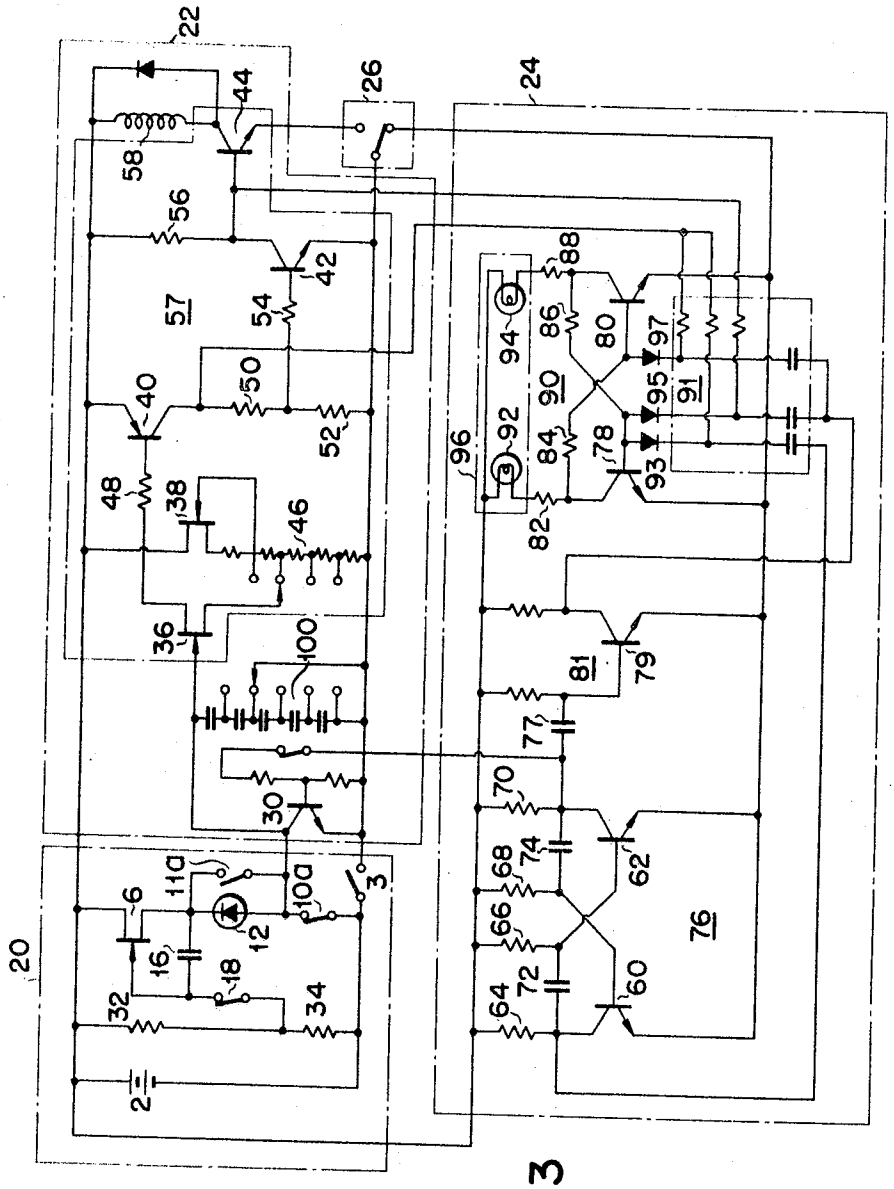
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FIG. 3

FIG. 4

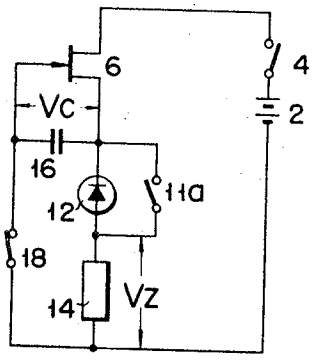


FIG. 5

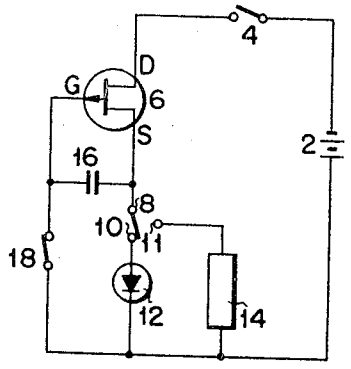


FIG. 6

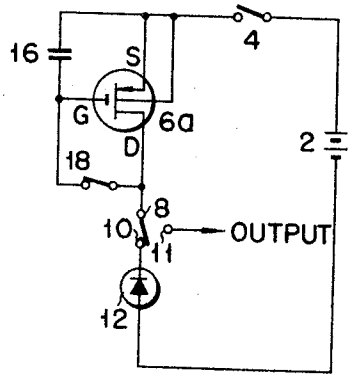


FIG. 7

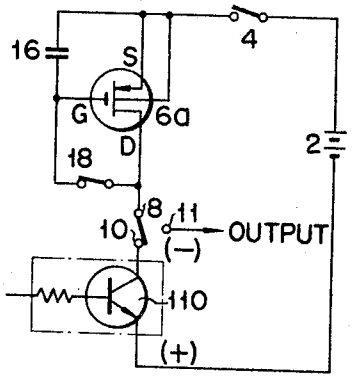


FIG. 8

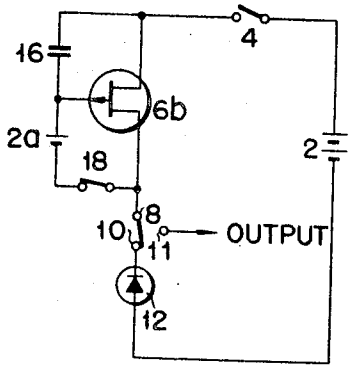
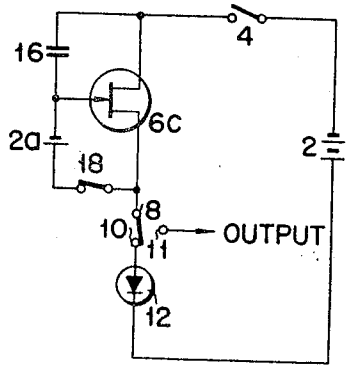


FIG. 9



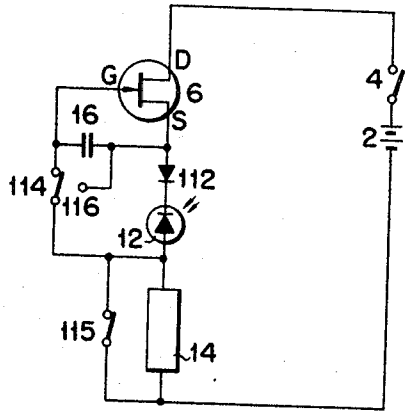


FIG. 10

FIG. 11

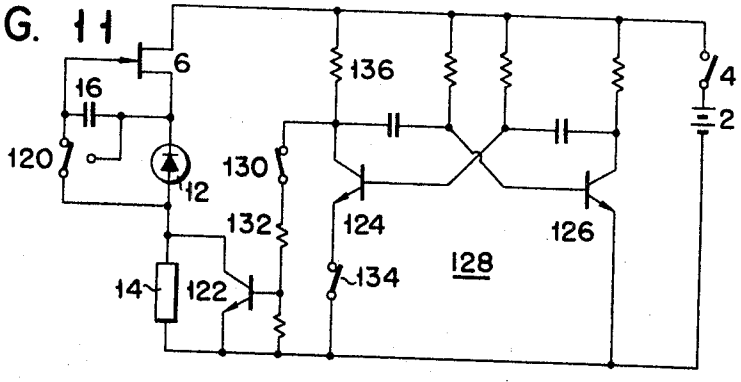
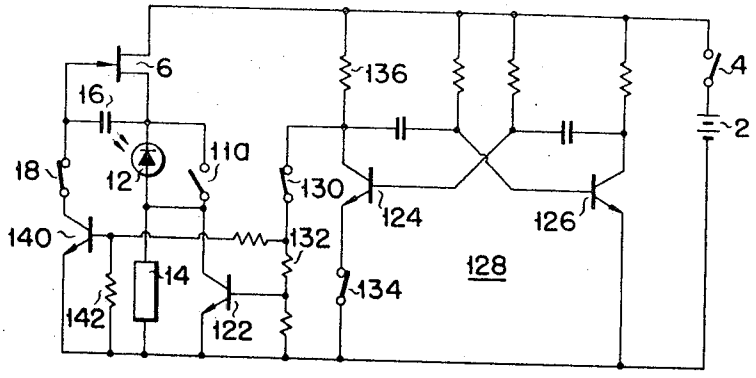


FIG. 12



INFORMATION HOLDING APPARATUS

This invention relates to an information holding apparatus and more particularly to a type for storing sufficiently large current to match the amount of analog input information.

An information holding apparatus is generally intended to reproduce given information later at a proper time and is used in various technical fields where information has to be stored and reproduced exactly in the analog form. Where there is controlled the speed of the shutter using information on the brightness of a foreground subject as measured by the exposure determining device of, for example, a TTL type monocular reflex camera, the determined exposure is temporarily stored to define the shutter speed. In this case, therefore, it is necessary to store accurate information on the brightness of the foreground subject.

It is accordingly an object of this invention to provide an information holding apparatus capable of storing sufficiently large current to match analog input information.

Another object of the invention is to provide an information holding apparatus adapted to store the result of exposure determination in the form of current exactly conforming therewith so as to define the accurate shutter speed of a photographic camera.

According to an aspect of this invention, there is provided an information holding apparatus comprising an information input element so disposed as to allow the passage therethrough of certain current corresponding to input light being stored; a field effect transistor connected in series to said information input element; a constant voltage bias source for supplying bias voltage to the information input element and field effect transistor; a capacitor connected between the source and gate of the field effect transistor; and a switch for connecting the transistor to the input element at the time of storing information and selectively connecting the transistor to the load at the time of reading out the information.

The present invention can be more fully understood from the following detailed description when taken in connection with reference to the accompanying drawings, in which:

FIG. 1 is a circuit diagram of an information holding apparatus according to an embodiment of this invention;

FIG. 2 is a curve diagram illustrating the operation of the apparatus of FIG. 1;

FIG. 3 is a circuit diagram of the electrical equipment of a TTL type monocular reflex camera including the information holding apparatus of the invention; and

FIGS. 4 to 12 are circuit diagrams of information holding apparatuses according to different embodiments of the invention.

Referring to FIG. 1, a constant voltage D.C. bias source 2 has its positive terminal connected to the drain of a junction type N channel field effect transistor (hereinafter abbreviated as FET) 6 through a first switch 4. The source of FET 6 is connected to the cathode of a solar cell 12 through the normally closed contact 10 of a switch 8. The anode of the solar cell 12 is connected to the negative terminal of the bias voltage source 2. The normally open contact 11 of the switch 8 is connected to the negative terminal of said source 2 through a load 14. Between the gate and source of

FET 6 is connected a capacitor 16, the junction of the gate with the capacitor 16 being connected to the anode of the solar battery 12 through a second switch 18.

There will now be described by reference to the curve diagram of FIG. 2 the circuitry of the embodiment of FIG. 1 arranged as described above. Referring to FIG. 1, let it be assumed that there is irradiated input light representing information being stored in the solar cell 12 and photoelectric current I_1 is ready to flow. Then the capacitor 16 is charged until the first switch 4 is thrown in, with the gate side of FET 6 rendered positive and the source side thereof negative. At this time, there is impressed bias voltage across the gate and source of FET 6 so as to render the gate positive, so that when the switch 4 is closed, FET 6 becomes conducting. Where FET 6 is thus brought to an activated state, then the solar cell 12 is supplied in a backward direction with voltage equal to a fraction of the voltage E of the bias voltage source 2 according to the operating condition of FET 6. Accordingly, the capacitor 16 is now charged in such a manner as to render the source of FET 6 positive and the gate thereof negative. Across the gate and source of FET 6 is impressed bias voltage in a backward direction to decrease the drain current of FET 6. Since the gate of FET 6 is connected to the negative terminal of the bias voltage source 2 by a switch 18, the backward voltage of the solar cell 12 is eventually made equal to the terminal voltage of the capacitor 16 bringing about an equilibrium condition. This equilibrium condition may be indicated, as illustrated in FIG. 2, by the intersection P_0 of the curve g showing the charge characteristics of the capacitor 16 of FIG. 1 and the curve Q denoting the current characteristics of the solar cell 12. The current I_1 at said intersection P_0 represents photoelectric current I_D conducted through the solar cell 12, which is equal to the drain current of FET 6 at that time. The terminal voltage of the capacitor 16 is equal to the backward voltage of the solar cell 12, and constitutes an optimum backward bias voltage to make the drain current of FET 6 equal to the photoelectric current I_D.

When the switch 18 is opened and the switch 8 is shifted from the normally closed contact 10 to the normally open contact 11, then FET 6 is supplied with drain current equal to the photoelectric current I_D by the bias voltage of the capacitor 16. Said drain current travels from the normally open contact 11 of the switch 8 to the load 14. Thus the intensity of input light is converted to the photoelectric current I_D and stored as the charge voltage of the capacitor 16 for defining bias voltage being impressed across the gate and source of FET 6, that is, as current being conducted through FET 6.

Generally speaking, the information holding apparatus of this invention makes it possible to store under intact condition the information current obtained by fully storing, reproducing and converting photoelectric current by FET 6 and store and reproduce the resultant information signal in a state exactly true to its quality and amount. Further, the apparatus of the invention stably works without being affected by any variation in the properties of various elements included therein, offering great advantage in quantity production.

There will now be described the case where the information holding apparatus of this invention is applied to a TTL (through the lens) type monocular reflex cam-

era. With this camera, the image pickup optical system includes a movable reflector and the image pickup lens is used as part of a finder optical system, making it possible to observe in the visual field of the finder an image exactly the same as that picked up by the pickup optical system. At the time of image pickup, the movable reflector is retracted from the course along which there passes photographing light, and the image pickup lens is used as part of the image pickup optical system.

Where, however, such type of camera is fitted with an automatic iris mechanism interlockingly operable with an actinometer or photometer known as the EE (electric eye) system or an electric shutter for automatically determining the shutter time, then a light measuring element is incorporated in a finder optical system. When, therefore, the movable reflector is put into operation at the time of image pickup, introduction of light into the photometer element is temporarily obstructed, and the shutter is operated while light is thus obstructed. Unless, therefore, the measured value of information light is stored during said period so as to keep the original information light intact, the shutter could not be properly controlled.

The information holding apparatus of this invention is quite adapted for use as a memory device required for such purpose. There will now be described by reference to the circuitry of FIG. 3 the operation of a TTL type monocular reflex camera provided with an electric shutter and additionally with the information holding apparatus of the present invention. This arrangement enables the shutter speed (expressed in seconds) exactly to conform with the chosen size of the iris, ASA sensitivity and the brightness of a foreground subject. The following description refers to the so-called EE camera wherein the iris diaphragm is first adjusted before the shutter speed is determined, that is a type wherein the shutter speed is determined with the aperture of said diaphragm fully opened.

The parts of FIG. 3 the same as those of FIG. 1 are denoted by the same numbers. In this case, the solar cell 12 is disposed as a photometer element at a suitable point in a camera. The requisite condition for such type of camera is that the amount of light received by the solar cell 12, that is, photoelectric current be temporarily maintained. With the TTL type camera, however, the light receiving element is open located close to the eyepiece. The amount of light received at this point is about 800 lux (EV 18) at maximum in terms of illumination on the surface of the photometer element. The minimum amount of light is as small as about EV 0 to 5 as when night scenes are photographed.

If said minimum amount of light is taken to be 800×2^{-20} lux, then it will represent illumination equal to about one-millionth of 800 lux, presenting difficulties even in measuring light intensity. On the other hand, the solar cell 12 used in the TTL type camera generates photoelectric current of about two microamperes for illumination of 100 lux, which is equal to about EV 15 based on the brightness of a foreground subject. With respect to an EV value of −5, therefore, the solar cell 12 must hold photoelectric current equal to a one hundred thousandth part of 2 microamperes, that is, 2×10^{-6} microamperes or 2 micromicroamperes.

If, in this case, photoelectric current is fully large relative to backward leakage current occurring in the solar cell 12, the information holding apparatus of this invention will display a prominent photometric function. Experiments made with a TTL camera including the apparatus of this invention show that the camera gave extremely good results in this respect.

Referring again to FIG. 3, a block 20 enclosed with broken lines represents an information holding apparatus of this invention, and a block 22 similarly surrounded with broken lines denotes an electric shutter device for determining the shutter time (seconds) based on the information received from the block 20. Number 24 is the later described exposure alarm device. The electrical shutter device 22 and exposure alarm device 24 are selectively connected to the information holding apparatus 20 by a switch 26.

The information holding apparatus of FIG. 3 is essentially the same as that of FIG. 2. However, same improvements are provided for the apparatus of FIG. 3 for its incorporation in a camera. If, in FIG. 11, the switch 8 is shifted to the normally open contact 11 where the switch 18 is turned on, then the energy stored in the capacitor 16 will be discharged through the load 14, making it necessary to turn off the switch 18 where the load 14 is to be supplied with the saturated drain current of FET 6. Accordingly, a camera equipped, as illustrated in FIG. 3, with the electric shutter device 22 and exposure alarm device 24 is designed to eliminate the undermentioned difficulties which might otherwise take place.

Where input information light is small and the resultant shutter speed is extremely low, or where said light is too large for the shutter speed to be mechanically controlled with the resultant occurrence of overexposure, then the aforementioned exposure alarm device will warn the camera user not to operate the electric shutter. In this case, said alarm device is operated in place of the electric shutter.

With the information holding apparatus of FIG. 1, the switch 18 is turned on and off in two steps by depression of shutter button. After there is measured the amount of light introduced, the first step consists in turning off the normally closed contact 10 of the switch 18, turning on the normally open contact 11 thereof, and throwing the switch 26 of FIG. 3 toward the exposure alarm device 24 so as to detect whether proper exposure will be possible. The second step consists in throwing the switch 26 toward the electric shutter 22 to release the shutter in the undermentioned manner and effect exposure only for a length of time corresponding to the drain current running through FET 6. Therefore, if, during operation of the exposure alarm device, a foreground subject itself or its position is changed, with the resultant variation of exposure condition, then the shutter button will have to be depressed again to measure the amount of light brought in a second time.

The information holding device of FIG. 3 is therefore improved in that the anode of the solar cell 12 is connected to the negative terminal of the power supply source 4 through the switch 10a and also through the transistor 30 of the electric shutter 22 as a load. This arrangement enables photoelectric current to be conducted from the solar cell 12 to the electric shutter 22 as a load even when the switches 2 and 18 are turned on and the switches 10*a* and 11*a* are turned off. The resistors 32 and 34 (though not shown in FIG. 1) included in the information holding apparatus 20 are potential dividing resistors for supplying the gate of FET 6 with a proper potential.

The electric shutter **22** of FIG. **3** comprises a switching circuitry **57** wherein there are connected, as indicated, bipolar transistors **40, 42** and **44**, a variable resistor **46**, and resistors **48, 50, 52, 54** and **56**. When there is excited a magnet **58** connected to the output terminal of said switching circuitry **57**, a mechanism engaging the rear membrane of a focal plane shutter is actuated.

When the switch **10***a* is turned on, holding current from FET **6** runs thereto to prevent the terminal voltage of a capacitor **100** from being raised. Accordingly, that section of the switching circuitry **57** which follows a transistor **36** is rendered inoperative. Among the transistors constituting said switching circuitry **57**, FET **36** is rendered conducting when its gate voltage resulting from the terminal voltage of the capacitor **100** takes a certain value with respect to its source voltage determined by the variable resistor **46** connected in series to FET **38**. The variable resistor **46** is designed to present resistance corresponding to the ASA sensitivity of a photographic film used with a camera. Output from FET **36** is amplified by the transistor **40** and conducted to the transistor **42**. Outputs from these transistor **40** and conducted to the transistor **42**. Outputs from these transistors **40** and **42** are supplied to the exposure alarm device **24** where said outputs are used in estimating the later described overexposure or the possible shaking of a camera when the shutter button is depressed by hand. Output from the transistor **42** is brought to the transistor **44**, which constitutes the drive circuit of a magnet **58** which, when excited, causes the rear membrane of the shutter to be held back and, when deenergized, advances it to complete exposure.

Before the shutter is operated, it is necessary that information be fully stored in the information holding circuit **20**, the front membrane of the shutter be opened by depression of a release button and the capacitor **100** be charged with current from said information holding circuit **20** by the simultaneous opening of the switch **3**. Excitation of a magnet holding the rear membrane of the shutter is effected by shifting the switch **26** from the alarm circuit to the exposure circuit. At this time the capacitor **100** is charged with current from the holding circuitry **20**. When the gate voltage of FET **36** attains a certain level, it is turned on together with other FET's **40** and **42**, and FET **44** is turned off to deenergize the magnet **58** and release the rear membrane of the focal plane shutter from a held position, thereby completing exposure.

The exposure alarm device **24** comprises an astable multivibrator **76** consisting of FET's **60** and **62**, resistors **64,66,68** and **70** and capacitors **72** and **74**; a bistable multivibrator **90** including FET's **78** and **80** and resistors **82, 84, 86** and **88**; an alarm lamp **94** for warning overexposure; and a circuit **96** for lighting a proper exposure indicating lamp **92**.

Since the switch **26** is normally thrown in toward the alarm device **24** while the switch **2** is closed except where the shutter is operated, the astable multivibrator **76** is actuated to generate pulses having a period or width of, for example, 30 milliseconds. This output is supplied to the base of the transistor **30** constituting the discharge circuit of the capacitor **100** through a switch **31** to render said transistor **30** on and off at a time interval of 30 milliseconds. Output from the astable multivibrator **76** is conducted through a capacitor **77** to a standard time signal generating circuit **81** constituted by a transistor **79**. Output from said circuit **81** has a period or width of, for example, 1 millisecond and is supplied, together with outputs from FET's **40** and **42**, to a comparator **91** formed of a capacitor and resistor and connected to the bistable multivibrator **90**. The comparator **91** is also impressed with 30 millisecond output from the astable multivibrator **76**. The aforementioned four outputs have their pulse widths compared with each other by said comparator **91**, the output from which is conducted to the bistable multivibrator **90** through diodes **93, 95** and **97**. Energization of either of the transistors **78** and **80** included in said bistable multivibrator **90** operates the overexposure alarm lamp **92** or proper exposure indicating lamp **94**. Where output from the transistor **40** has a pulse width of less than one millisecond, then the transistor **80** is turned on to light the overexposure alarm lamp **94**. Where said output has a pulse width ranging between 1 and 30 milliseconds, then the transistor **78** is turned on to operate the proper exposure indicating lamp **92**. Further where said pulse width exceeds 30 milliseconds, then the transistors **78** and **80** are alternately actuated to energize both lamps by turns.

There will now be described the electric shutter **22** which is worked by the under mentioned operation of the normally closed switches **10***a* and **18**, normally open switch **11***a*, power source switch **2** and switch **26** for selective connection of the electric shutter device **22** and exposure alarm device **24** to the information holding apparatus.

Light measurement is effected with the power supply switch **2**, and switches **10***a* and **18** turned on, switch **11***a* turned off and switch **26** shifted toward the exposure alarm device **24**. The capacitor **16** is so charged as to supply FET **6** with a saturated drain current as large as photoelectric current corresponding to information light supplied from a foreground subject to the solar cell **12**. Under this condition, there is depressed a two-step operable shutter button. Where the switch **10***a* is turned off simultaneously with the first step working of the shutter button, the transistor **30** is turned off or on according as the transistor **62** of the astable circuit is turned on or off. Where the transistor **30** is turned off, output current from the information holding apparatus is conducted to the capacitor **100** to actuate the switching circuitry **57** following FET **36**. Output from the switching circuitry **57** is conducted to the exposure alarm circuitry **24** to have its time width compared with the standard time width. Either of the aforesaid lamps **92** and **94** is lighted according to the result of said comparison. Under this condition, the capacitor **16** has its charge varied so as to permit the passage through FET **6** of a drain current as large as photoelectric current corresponding to change of information light introduced into the solar cell **12**.

Where photographing is confirmed to be possible by the lighting of either of the indication lamps **92** and **94**, the shutter button is further depressed to open the shutter after the mirror lifting operation. Prior to that, the switch **18** is turned off, the switch **11***a* is turned on and the switch **26** is shifted from the side of the exposure alarm device **24** to that of the electric shutter device **22** interlockingly with the shutter releasing operation and the mirror lifting operation.

Accordingly, the transistor **44** included in the switching circuitry **57** of the electric shutter device is turned on to excite the magnet **58** and actuate a mechanism

engaging the rear membrane of the focal plane shutter, thereby opening the shutter upon its release.

The variable capacitor **100** connected to the input side of the switching circuitry **57** of the electric shutter device **22** begins to be charged with the saturated drain current of FET **6** by the opening of the switch **3**. When the energy stored in the variable capacitor **100** attains a prescribed value, then the transistor **44** of the switching circuitry **57** is turned off and the magnet **58** is deenergized so as to close the shutter. In this case, time required for the capacitor **100** to be charged to a prescribed voltage varies with the magnitude of photoelectric current. Said time represents the period during which the shutter is left open, that is, the shutter speed. Thus the shutter speed is controlled by the drain current of FET **6** as large as photoelectric current corresponding to information light, each time it is introduced into the solar cell **12**, enabling photographing to be effected with proper exposure. The fact that the capacitor **100** is made variable is also utilized in introducing information on the aperture of the iris diaphragm which may be varied at the time of light measurement.

Signals read out from the information holding device of this invention are current signals having a fixed magnitude and in consequence the capacitor **100** for setting the shutter speed is charged with a fixed amount of energy, offering great convenience in exactly determining the shutter speed.

The information holding device of FIG. **4** lacks the switch **10***a* used in that of FIG. **3**. If the voltage Vc charged in the capacitor **16** is larger than the value Vz to which the voltage of the load **14** has fallen, then the arrangement of FIG. **4** will serve the purpose.

In the embodiment of FIG. **5**, the power source **2** included in the device of FIG. **1** has its polarity reversed, FET **6** is changed to a P channel type and the solar cell **12** also has its polarity reversed. These are the only differences of FIG. **5** from FIG. **1**.

The embodiment of FIG. **6** includes an MOS enhancement FET **6***a*. The capacitor **16** is connected between the source and gate of the MOS-FET **6***a* and the switch **18** is connected between the drain and gate thereof. In other respects, the embodiment of FIG. **6** is operated in the same manner as that of FIG. **1**.

There will now be described the operation of the embodiment of FIG. **6**. Where the solar cell **12** receives information light with the switch **8** shifted to the side of the terminal **10** and the switches **4** and **18** closed, then said information light is converted to photoelectric current by the solar cell **12** and the energy stored in the capacitor **16** is supplied to the gate of FET **6***a* to impress negative bias voltage thereacross. Where there is impressed zero volt across the gate and source of the enhancement P channel MOS-FET **6***a*, then zero current is known to pass between the drain and source thereof. Where, therefore, there is impressed negative bias voltage across the gate and source, then there flows current across the drain and source. Namely, the gate of FET 6a brought to negative voltage by photoelectric current is so biased as to allow drain current to run therethrough, thereby rendering FET **6***a* conducting. The solar cell has its anode kept positive and its cathode negative until the switch **4** is closed.

The reverse connection of the solar cell **12** to the power source **2** characterizing the circuit arrangements of all the embodiments of this invention described herein has such function that not only where the solar cell **12** is connected in series to FET **6***a*, but also where the cell **12** is connected in series to other circuit elements including active transistors, there does not result an exactly matching relationship between the reverse potential of said cell **12** to that of the power source **2** and the photoelectric current generated therein, but the potential of said cell **12** is freely determined according to the condition in which it is operated upon receipt of light.

According to the embodiment of FIG. **6**, FET **6***a* is additionally fitted with a circuit for permitting negative feedback by the capacitor **16**, so that a reverse potential relative to photoelectric current takes a certain value. Namely, when FET **6***a* begins to be energized, the capacitor **16** is charged with the photoelectric current of the solar cell **12** to render the source of said FET **6***a* positive and its gate negative, causing drain current to run through said FET **6***a*. When the drain current becomes equal to the photoelectric current, the associated circuit is brought to an equilibrium state. Where the drain current increases over the photoelectric current, the backward voltage of the solar cell and in consequence the gate of FET **6***a* are more shifted toward the positive side. This reduces the negative bias voltage impressed on the gate of FET **6***a* to bring the drain current to its original level.

In the embodiment of FIG. **7**, the solar cell **12** of FIG. **6** is replaced by a constant current source **12***a* consisting of a transistor **110**. This transistor **110** is designed to have its base supplied with current corresponding to the intensity of information light being stored. When the transistor **110** receives the base current, there flows a constant current across the collector and emitter thereof. The other parts of the embodiment of FIG. **6** are constructed and operated in the same way as those of FIG. **6**.

In the embodiment of FIG. **8**, the MOS-FET **6***a* of FIG. **6** is replaced by a junction type P channel FET **6***b*. Since this FET **6***b* must have its drain and source impressed with negative voltage, there is connected a bias voltage source **2***a* in series to the switch **18** disposed between the gage and drain of said FET **6***b*, thereby supplying an initial bias voltage thereto. The other parts of FIG. **8** are constructed and operated in the same way as those of FIG. **6**.

In the embodiment of FIG. **9**, the junction type P channel FET **6***b* of FIG. **8** is replaced by a junction type N channel FET **6***c*, causing the power supply sources **2** and **2***a* and solar cell **12** to be reversed in polarity.

The embodiment of FIG. **10** is used particularly where the solar cell **12** of FIG. **1** receives a small amount of information light and, after stored, said light is to be continuously reproduced within a short period of time, that is, where a foreground subject having an extremely low brightness is to be continuously photographed by a TTL type monocular camera fitted with the information holding apparatus of this invention.

In FIG. **10**, there is provided a diode **112** of reverse polarity to the solar cell **12** in series thereto. Where the stored information light is reproduced by throwing a switch **114** toward a contact **116** to turn off a switch **115**, said diode **112** prevents the energy stored in the charge section of the solar cell **12** from being uselessly discharged, and also the terminal voltage of the capacitor **16** from being decreased due to the changeover of the switch **114**, thereby enabling an accurate amount of photoelectric current to be reproduced from FET **6**

as often as required for supply to the load **14.** The other parts of FIG. **10** are constructed and operated substantially in the same manner as those of FIG. **1.**

Among all the foregoing embodiments, the operating range of that of FIG. **4** alone is limited by the voltage impressed across its gate and source, that is, the terminal voltage of the capacitor **16** for storing information light if there is drawn out current from the embodiment of FIG. **4** with the switch **18** closed. Since the terminal voltage of the capacitor **16** is relatively small, there occurs the drawback that FET can not be operated over the entire allowable range. However, the other embodiments are not accompanied with such drawback.

The embodiment of FIG. **11** has substantially the same arrangement as FIG. **10.** FET **6,** solar cell **12** and load **14** are connected in series to the power supply switch **2** through the switch **4.** There is provided, as in FIG. **10,** a switch **120** for selectively connecting the gate or source of FET **6** to the junction of the solar cell **12** with the load **14.** To the load **14** is connected in parallel a transistor **122** in place of the switch **15** of FIG. **10.** For control of said transistor **122,** there is used an astable multivibrator consisting of transistors **124** and **126.** The collector of the transistor **124** is connected to the base of the transistor **122** through a switch **130** and resistor **132.** The emitter of the transistor **124** is connected to the negative terminal of the power supply source **2** through a switch **134.**

With the above-mentioned arrangement, where the switch **120** is thrown toward the gate side of FET **6** to close the power supply switch **4** with the switch **134** opened, then the transistor **122** has its base supplied with current through a resistor **136** connected to the collector of the transistor **124** which is kept off at this time as well as through the switch **130** and resistor **132.** Accordingly, the transistor **122** is rendered conducting to short-circuit the load **14,** bringing the information holding device to a state ready to store information light. Where the switch **134** is turned on to actuate the astable multivibrator **128,** then the transistor **124** is turned on and the transistor **122** is turned off, causing photoelectric current to be conducted from the solar cell **12** to the load **14.** Thus, either electric shutter circuit or exposure alarm circuit of FIG. **3** can be actuated as desired. In this case, the capacitor **16** is charged through the load **14,** so that the gate potential of FET **6** is increased by a voltage drop in the load **14** with the resultant rise in the source potential thereof. Therefore, any increase in the terminal voltage of the load **14** will not vary the voltage of the capacitor **16,** nor obstruct the information storing operation.

Where the switch **120** is so operated as to open the gate and close the source of FET **6,** the load **14** is supplied with output current from FET **6** corresponding to the energy charged in the capacitor **16.** This arrangement broadens the operating range of FET **6,** offering great practical advantage.

The embodiment of FIG. **12** is constructed for the same purpose as that of FIG. **11.** One contact of the switch **18** is connected to the negative terminal of the power supply source **2** through a transistor **140,** whose base is connected to the negative terminal of the power supply source **2** through a resistor **142** and also between the switch **130** and resistor **132.**

Where, under such arrangement, the switch **134** is opened and the switch **4** is closed, then the transistors **122** and **140** have the base supplied with current through the collector resistor **136** of the transistor **124** which is turned off at this time and also through the switch **130.** Accordingly, the transistors **122** and **140** are rendered conducting to short-circuit the load **14** by the transistor **122** as previously described, thereby holding information light as in the preceding cases. Where, under this condition, the switch **134** is turned on to actuate the astable multivibrator **128,** then the transistor **124** is turned on and the transistors **122** and **140** are turned off. As the result, photoelectric current flows from the solar cell **12** to the load **14.** Since, at this time, the transistor **140** is subject to high impedance, that is, is turned off, the gate potential and source potential of FET **6** are raised by that extent. Where, under this condition, the switch **18** is turned off and the switch **11***a* is turned on, then the load **14** is supplied from FET **6** with fully high voltage equal to that of the photoelectric current already stored.

The astable multivibrator **128** used in the embodiment of FIG. **12** may be replaced by the astable multivibrator **6** included in the exposure alarm device **24** of FIG. **3.** In this case the transistor **30** has its base selectively supplied with current from the collector of the transistor **62** of said astable multivibrator **76** through a switch **150,** thereby carrying out the same function as described above.

What we claim is:

1. An information holding apparatus comprising means for receiving information being stored, a field effect transistor connected in series to said means; a capacitor connected between the gate and source of the field effect transistor; a switch for holding bias voltage across the gate and source of the field effect transistor at the time of storing information; and a power supply source for the aforementioned circuitry with operating voltage, whereby the drain current of the field effect transistor is fed back so as to have the same amount as the current of the information receiving means; and the bias voltage across the gate and source of the field effect transistor is maintained so as to generate the required drain current.

2. An information holding apparatus according to claim **1** which further includes a first switch means for selectively connecting the gate of the field effect transistor to the bias voltage source only at the time of storing information.

3. An information holding apparatus according to claim **2** wherein the information input means consists of a solar cell connected with reverse polarity to a first power supply source.

4. An information holding apparatus according to claim **3** wherein the field effect transistor is connected in series to the solar cell and load, and there is connected in parallel to the solar cell and a second switch means which is turned off at the time of storing information and is turned on at the time of reproducing said information.

5. An information holding apparatus according to claim **4** wherein there is connected a third transistor in series to the first switch means and the second transistor is connected in parallel to the load and which comprises a control circuit including an astable multivibrator for cutting off the second and third transistors only at the time of storing information.

6. An information holding apparatus according to claim **3** wherein the field effect transistor, solar cell and load are connected in series to the first bias voltage

source, and which includes a diode connected in series to the solar cell with reverse voltage thereto, a second switch for selectively connecting the anode of the solar cell to either of the gate and source of the field effect transistor and a third switch for bypassing the current running through the load at the time of storing information.

7. An information holding apparatus according to claim 3 wherein the field effect transistor, solar cell and load are connected in series to the first power supply source and which comprises a control circuit formed of a second switch for selectively connecting the anode of the solar cell to either of the gate and source of the field effect transistor, a second transistor connected in parallel to the load and an astable multivibrator for cutting off the second transistor only at the time of storing information.

8. An information holding apparatus according to claim 2 wherein the information input means is a transistor so connected as to have its base supplied with an amount of current corresponding to the input information.

9. An information holding apparatus according to claim 2 wherein the field effect transistor is of junction type.

10. An information holding apparatus according to claim 2 wherein the field effect transistor is of MOS type.

11. An information holding apparatus according to claim 7 wherein the first switch means is connected between the drain and source of the field effect transistor.

12. An information holding apparatus according to claim 11 wherein there is connected a second bias voltage source in series to the first switch means with the same polarity as that of the first power supply source.

13. An information holding apparatus according to claim 1 wherein the load has an electric shutter circuit which controls the shutter of a photographic camera; said circuit including a capacitor for being charged with the drain current of the field effect transistor at the time of reading out information, thereby determining the shutter speed of paid camera according to the length of time required for the capacitor to be thus charged.

14. An information holding apparatus according to claim 13 wherein the load further comprises an exposure alarm device consisting of an astable circuit for generating pulses of a prescribed width corresponding to the largest number of seconds required to eliminate the effect of the shaking of the hand depressing the shutter button of paid camera; a circuit for producing pulses of a prescribed width corresponding to the standard smallest number of seconds required to prevent overexposure; a circuit for comparing outputs from the astable circuit and pulse generating circuit with the shutter driving pulses obtained from the electric shutter circuit; and a device for detecting a proper length of time required for exposure by outputs from said comparator.

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