United States Patent [19]

Nishiyama et al.

[11] **3,741,651**

[45] **June 26, 1973**

[54] **RECORDING DEVICE**

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[21] Appl. No.: **188,354**

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Mar. 30, 1971	Japan	46/19350

[52] **U.S. Cl.** ..... **355/100**, 95/89 R, 219/216, 355/3, 355/13, 355/20, 355/28

[51] **Int. Cl.** **G03b 27/30**

[58] **Field of Search** 355/99, 100, 20, 355/12, 28, 106, 27; 226/24, 44; 219/216, 469

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Primary Examiner—Richard L. Moses
Attorney—Milton J. Wayne et al.

[57] **ABSTRACT**

A desired TV image displayed on a cathode-ray tube is transferred onto a recording paper which is placed in close contact with the faceplate of the tube, and the transferred image is then developed by a developing device. While the preceding exposed recording paper is being developed, the succeeding exposed recording paper is stored so that the problem that the developing time is lower than the exposure or image transfer time is overcome. Therefore, desired TV images may be recorded in a very small time interval.

6 Claims, 13 Drawing Figures

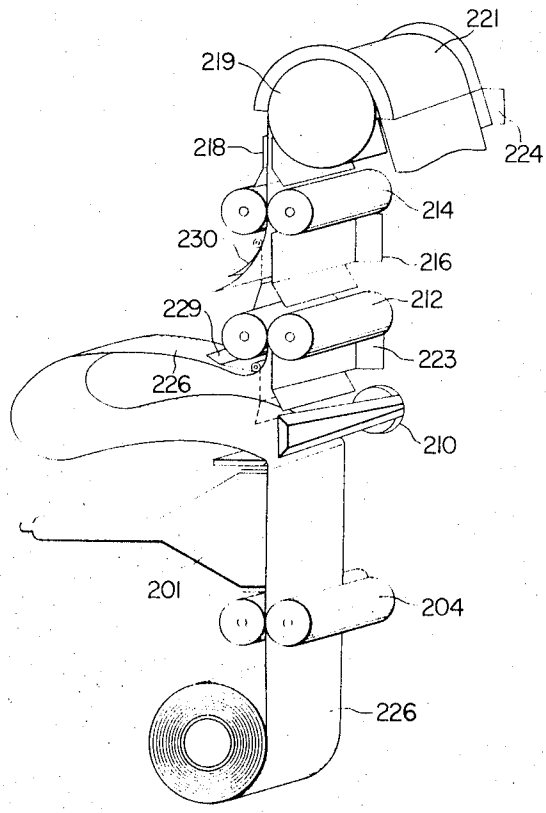


FIG. 1

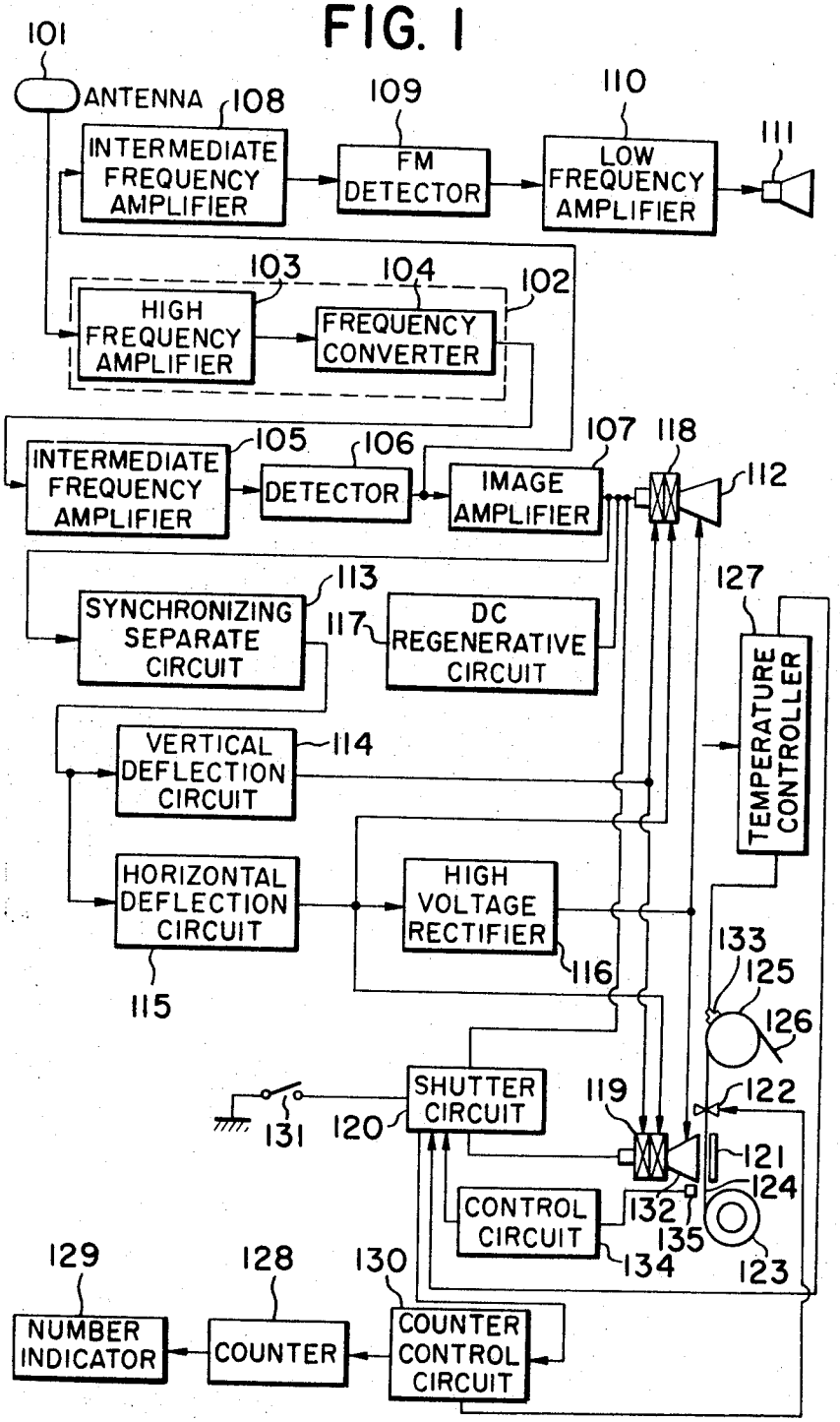

101
ANTENNA
108
INTERMEDIATE FREQUENCY AMPLIFIER
109
FM DETECTOR
110
LOW FREQUENCY AMPLIFIER
111
103
104
102
HIGH FREQUENCY AMPLIFIER
FREQUENCY CONVERTER
105
106
107
118
112
INTERMEDIATE FREQUENCY AMPLIFIER
DETECTOR
IMAGE AMPLIFIER
113
127
SYNCHRONIZING SEPARATE CIRCUIT
117
DC REGENERATIVE CIRCUIT
TEMPERATURE CONTROLLER
VERTICAL DEFLECTION CIRCUIT
114
HORIZONTAL DEFLECTION CIRCUIT
HIGH VOLTAGE RECTIFIER
116
115
133
125
126
SHUTTER CIRCUIT
119
122
131
120
121
124
CONTROL CIRCUIT
132
135
134
123
129
128
130
NUMBER INDICATOR
COUNTER
COUNTER CONTROL CIRCUIT

FIG. 2

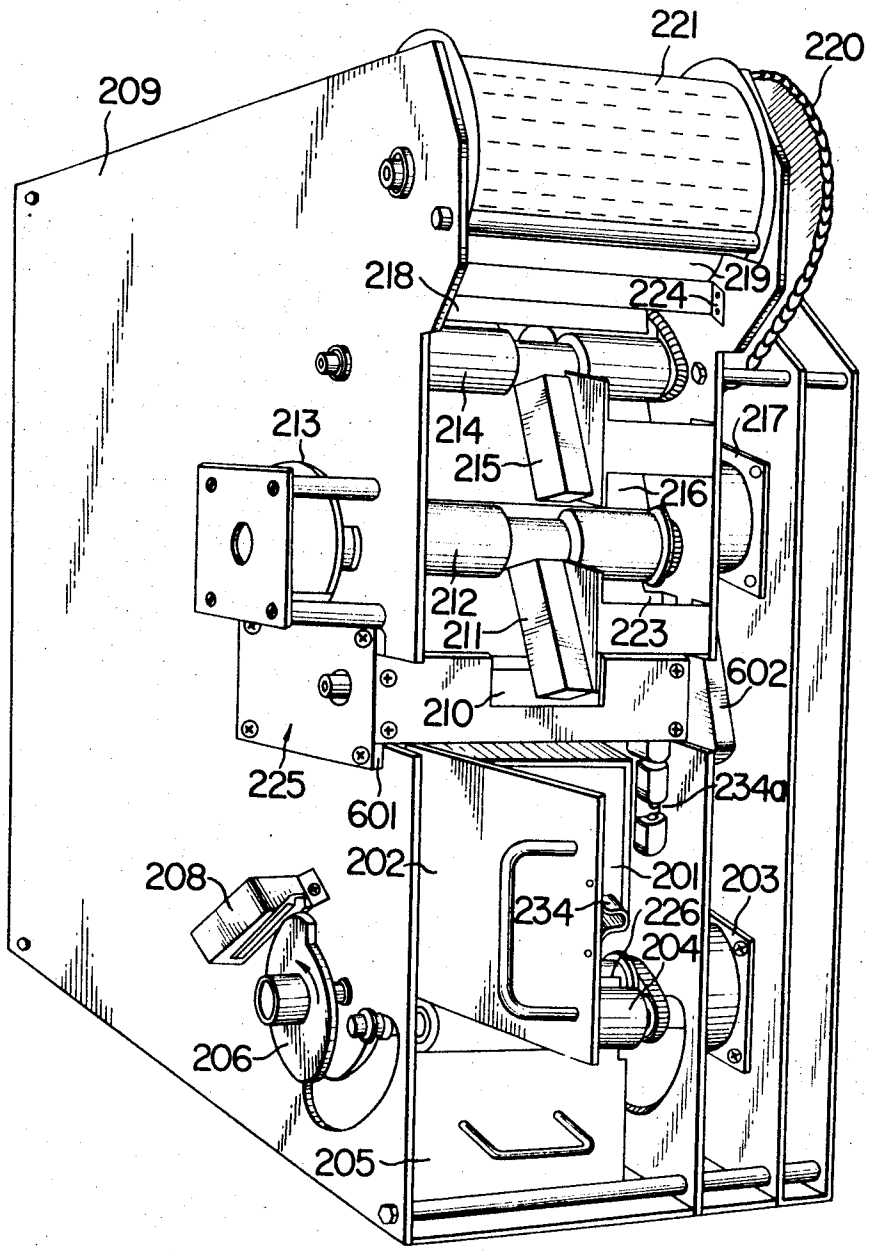

221
220
209
218
219
224
213
214
217
215
216
212
211
223
602
210
225
601
234a
208
202
201
203
234
226
204
206
205

FIG. 3

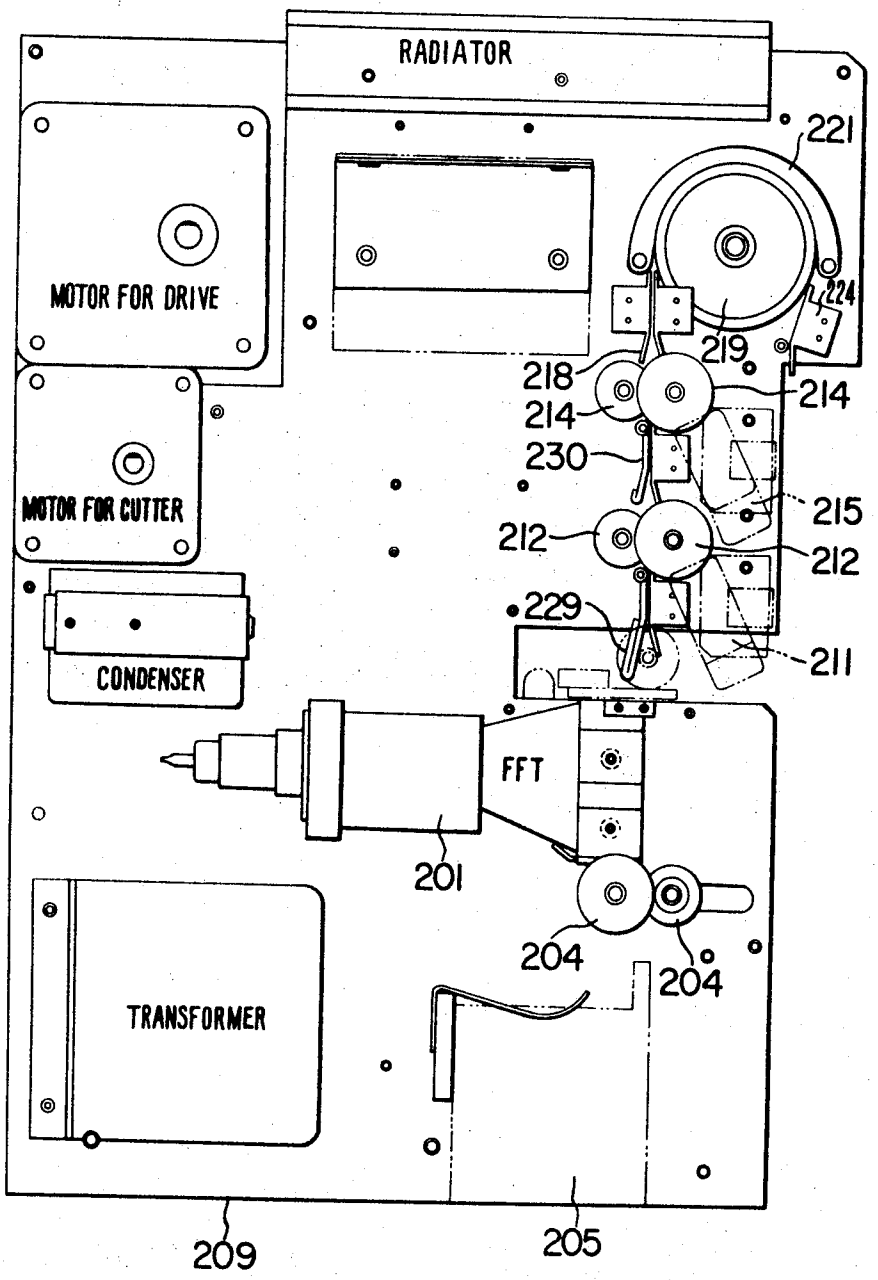

RADIATOR
MOTOR FOR DRIVE
MOTOR FOR CUTTER
CONDENSER
TRANSFORMER
FFT
221
224
219
218
214
214
230
215
212
212
229
211
201
204
204
209
205

FIG. 4A

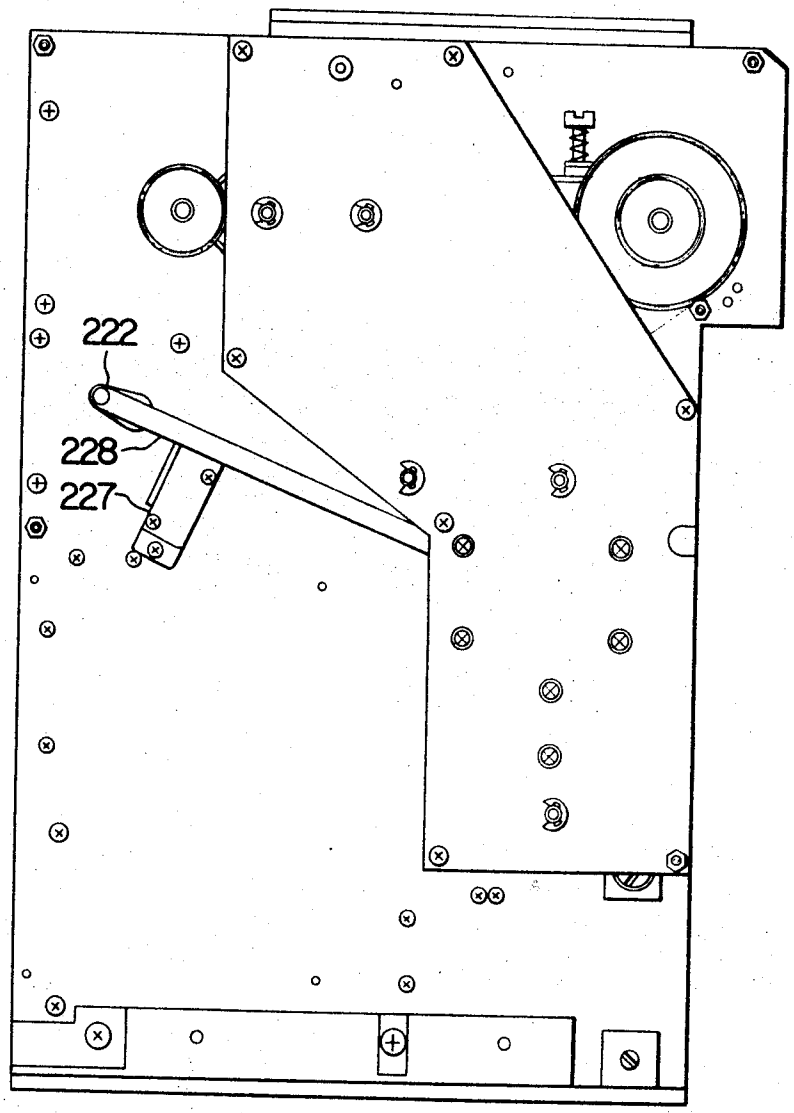


FIG. 4B

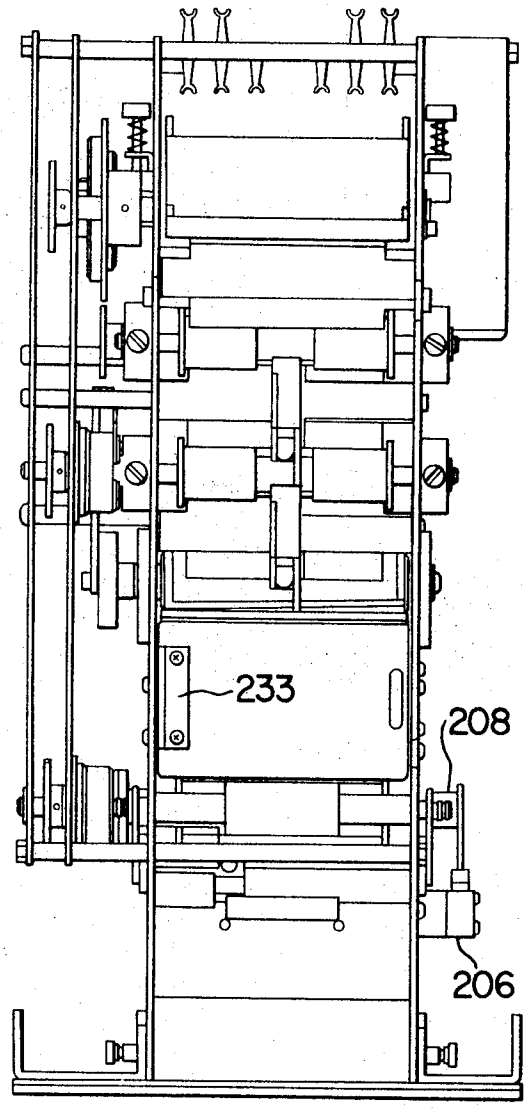


FIG. 5

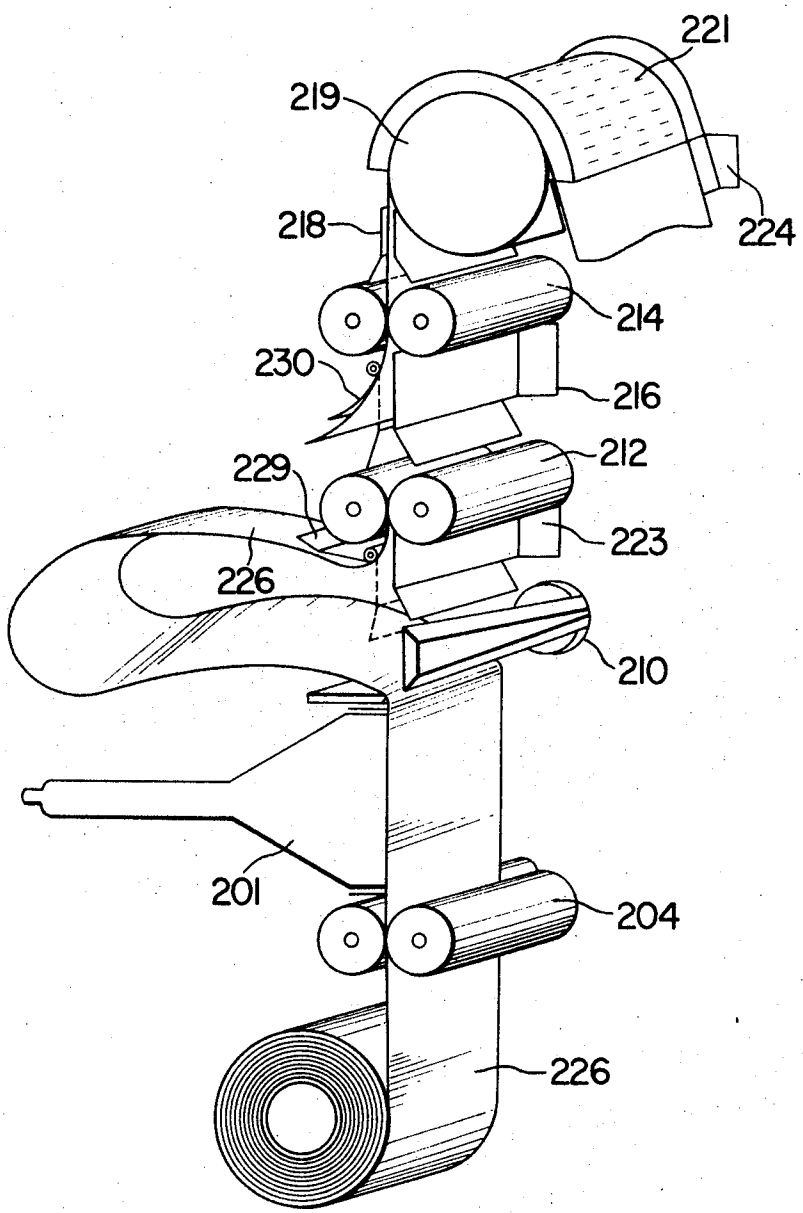


FIG. 6

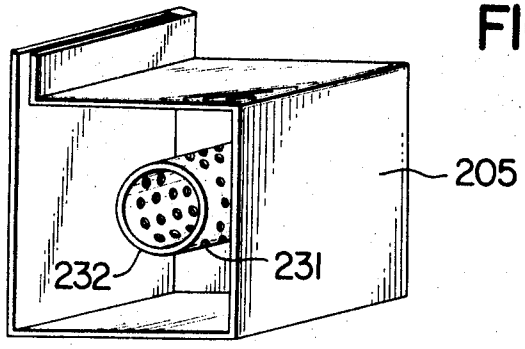


FIG. 7

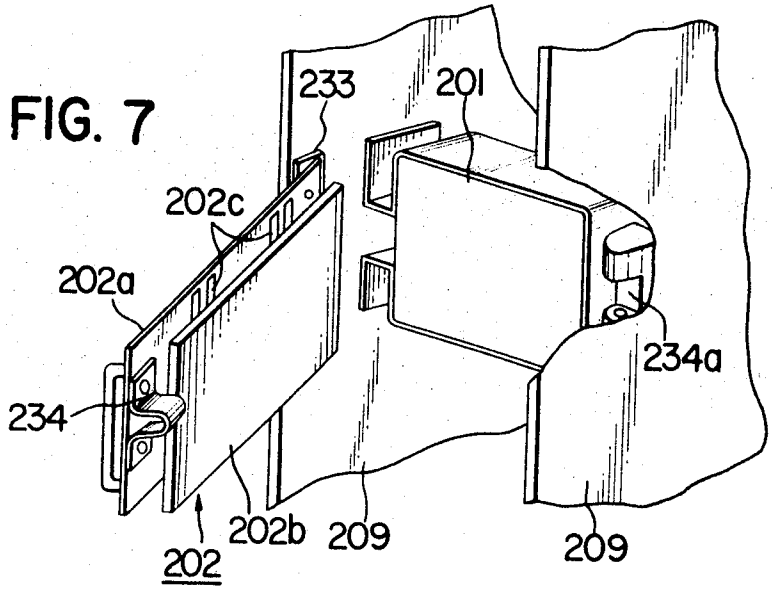


FIG. 8

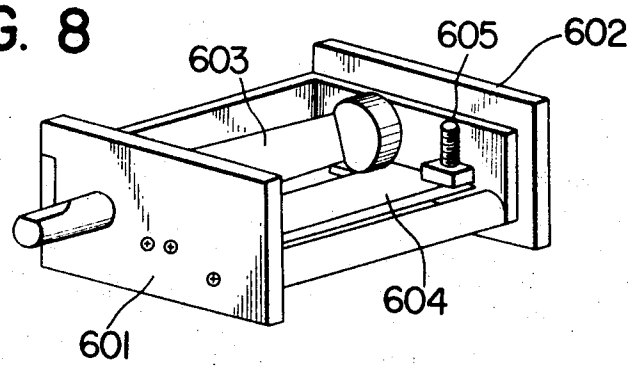


FIG. 9

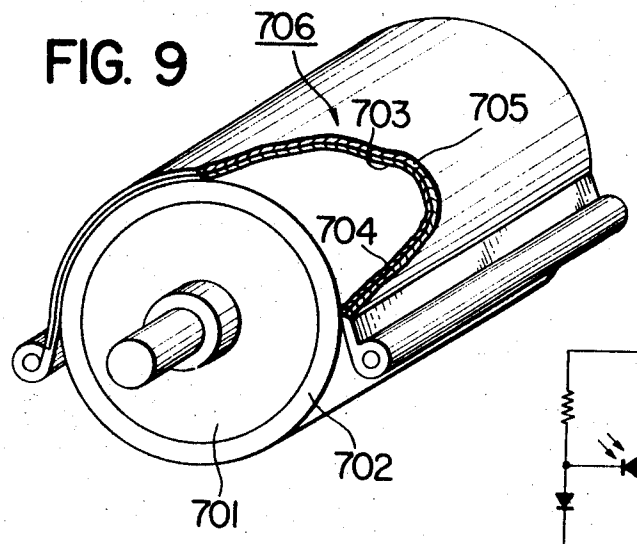


FIG. 10

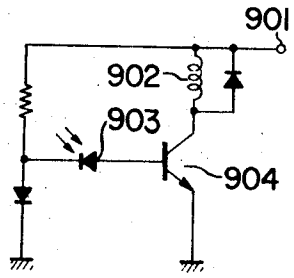


FIG. 11

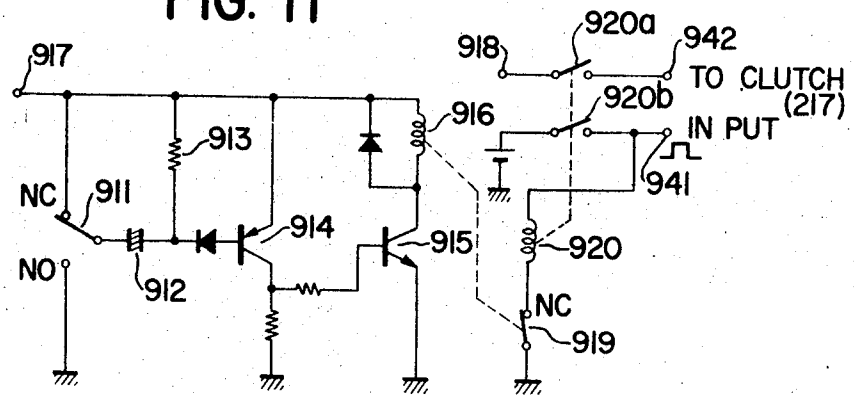
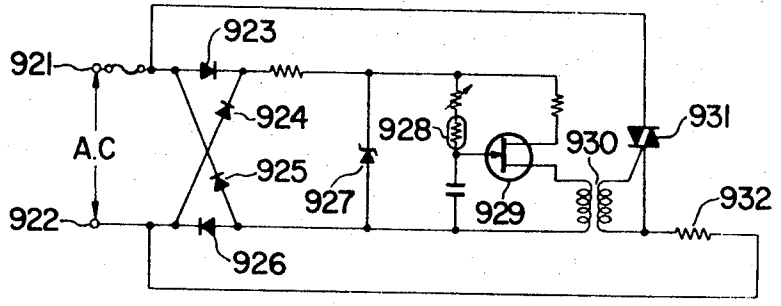


FIG. 12



RECORDING DEVICE

BACKGROUND OF THE INVENTION

The present invention relates to a device for recording a desired TV image.

There has been proposed a method for recording a desired TV image by a camera using a film. Since the desired TV images to be recorded are displayed randomly, it is extremely difficult to set the camera in such a manner that a desired TV image that is instantaneously displayed is recorded only by depressing the shutter button.

In a recording method in which a photosensitive recording paper is placed in contact with the faceplate of a cathode-ray tube to transfer the TV image displayed on the faceplate thereof onto the recording paper, the image transfer time or exposure time is shorter than the developing time, but it is frequently desired to reproduce the desired TV images successively in a short time interval. Therefore the recording devices of the type described must be so arranged as to overcome these problems.

SUMMARY OF THE INVENTION

One of the objects of the present invention is therefore to provide a device capable of recording or reproducing a desired TV image in a simple manner.

A second object of the present invention is to provide a device capable of successively recording or reproducing desired TV images in a shorter time interval so that the problem that the developing time is much longer than the image transfer or exposure time may be overcome.

A third object of the present invention is to provide a practical arrangement of recording paper by a slack loop best suited for accomplishing the above second object of the present invention.

A fourth object of the present invention is to provide a magazine best suited for storage of the recording paper.

A fifth object of the present invention is to provide a pressure plate best suited for placing the recording paper into good contact with the faceplate of a cathode-ray-tube.

A sixth object of the present invention is to provide a cutter device best suited for cutting a recording paper into a predetermined size.

A seventh object of the present invention is to provide a developing means best suited for carrying out the thermal developing process.

Briefly stated, according to the present invention there is provided a slack pool on the side of the inlet of a developing device for temporarily storing the exposed recording paper before it is developed. Therefore when the recording paper is present at the inlet of the developing device, the succeeding recording paper is prevented from being fed into the developing device, and when the recording paper has passed through the inlet of the developing device, the succeeding recording paper is fed into the developing device. The transportation of the recording paper in the recording device in the manner described is controlled by the combination of relays in an electric circuit for actuating the recording paper transportation means for detecting whether the recording paper is present in the inlet of the developing device or not.

The above and other objects, features and advantages of the present invention will become more apparent from the following description of one preferred embodiment thereof taken in conjunction with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram of a recording device in accordance with the present invention;

FIG. **2** is a perspective view illustrating the mechanical components thereof;

FIG. **3** is a side view thereof with a side wall removed;

FIGS. **4A** and **4B** are left side and top views thereof;

FIG. **5** is a schematic perspective view illustrating a recording paper transportation mechanism thereof;

FIG. **6** is a perspective view of a recording paper magazine;

FIG. **7** is a perspective view of a pressure plate for placing the recording paper in good contact with the faceplate of a cathode-ray tube in the recording device;

FIG. **8** is a perspective view of a cutter device;

FIG. **9** is a perspective view, partly in section of a thermal developing device;

FIG. **10** is a circuit diagram of a control circuit for stopping the operation of the recording device when the recording paper in the magazine is consumed;

FIG. **11** is a circuit diagram of a control circuit for controlling the recording paper transportation mechanism or pairs of recording paper feed rollers; and

FIG. **12** is a circuit diagram of a temperature controller for the thermal developing device.

DESCRIPTION OF THE PREFERRED EMBODIMENT:

Referring to FIG. **1**, the circuit components **101-118** are similar to those in a conventional television receiver, that is they are an antenna **101**, a tuner **102** consisting of a high-frequency amplifier **103** and a frequency converter **104**, an intermediate frequency amplifier **105**, a detector **106**, an image amplifier **107**, a horizontal and vertical deflecting coil **118**, a picture tube **112**, an intermediate frequency amplifier **108**, an FM detector **109**, a low frequency amplifier **110**, a loudspeaker **111**, a DC restorer **117**, a synchronizing separate circuit or sync separator **113**, a vertical deflection or sweep circuit **114**, a horizontal deflection or sweep circuit **115**, and a high voltage rectifier **116**. Some of these circuit components described above are also used to drive a cathode-ray tube **132** for printing connected in parallel with the picture tube **112** and to circuit components **119-131**, that is vertical and horizontal deflecting coils **119**, a shutter circuit **120** for determining a time interval during which a received TV image is displayed on the cathode-ray tube **132**, a pressure plate **121** for placing a recording paper **124** into good contact with the faceplate of the cathode-ray tube **132**, a magazine **123** of recording paper, a thermal developer **125** with the recording paper thermally developed being indicated by **126**, a temperature control circuit **127** which compares a preset temperature of the thermal developer **125** with that of a temperature detector **133** comprising for example a ceramic thermistor or the like and maintains the preset temperature, the temperature controller **127** also having the function of preventing the shutter circuit **120** from being actuated before the temperature of the thermal developer **125** reaches the predetermined temperature, a number

indicator **129** for displaying the output of a counter **128**, that is a number of available frames of the recording paper **124** in the magazine cartridge **123**, a counter control circuit **130** for controlling a cutter device **122**, and a shutter switch **131**.

A control circuit **134** is provided to detect if there remains a sufficient length of recording paper **124** to be pressed against the faceplate of the cathode-ray tube **132** by means of a photosensor **135** and to control the shutter circuit **120** in response to the result of detection.

Next the mode of operation will be described, but the functions of the circuit components **101-118** are similar to those of the conventional TV receiver so that their detailed explanation will not be made in this specification. First as far as the shutter switch **131** is not depressed or closed, the shutter circuit **120** is not actuated so that no printing operation is carried out. When a desired image is displayed on the picture tube **112**, the shutter switch **131** is depressed so that the shutter circuit **120** is actuated. As a consequence, the image displayed on the picture tube **112** is also displayed on the cathode-ray tube **132** for one frame time interval, that is one-thirtieth second according to the television standards in Japan, and is transferred onto the recording paper **124**. A predetermined time after the image is transferred from the cathode-ray tube **132** to the recording paper **124**, the latter is advanced a length slightly greater than the height of the faceplate of the cathode-ray tube **132**, and is automatically cut into a predetermined length by the cutter device **122**. The cutout recording paper **124** is next developed by the thermal developer **125**.

The optical efficiency may be increased and a picture with a high resolution may be obtained when a fiber faceplate tube which will be referred to as FFT hereinafter and whose faceplate comprises a great number of optical fibers is used for the cathode-ray tube **132** for printing. Especially when a newly developed 1.5 or 2.5 inch FFT is used, a recording paper with a smaller width may be used and the resolution of the image transferred onto the recording paper may be much improved.

The transfer of a desired image from the cathode-ray tube **132** to the recording paper **124** takes about one-thirtieth second as described previously, but the development takes about 15 seconds in the recording device in accordance with the present invention so that the thermal developer **125** cannot successfully develop the recording papers **124** successively exposed on the faceplate of the cathode-ray tube **132** and advanced to the thermal developer **125**. Therefore the exposed recording papers **124** must be temporarily stored until they are developed. A temporary storage device for this purpose will be described in more detail hereinafter.

Next referring to FIG. **2** illustrating a perspective view of the recording device in accordance with the present invention and to FIG. **5** illustrating the path of the recording paper **124**, the mode of operation will be described in more detail hereinafter. When the shutter switch **131** (see FIG. **1**) is depressed and there is no recording paper **226** between two pairs of feed rollers **212** and **214**, the recording paper **226** in contact with the faceplate of the cathode-ray tube **201** is exposed to form a latent image. In this case, a clutch **203** is almost simultaneously actuated to permit the rotation of a roller **204** so that the recording paper **226** is advanced a length almost equal to the height of the faceplate of the cathode-ray tube **201**. The rollers **212** are also rotated in unison with the feed rollers **204**. As the pair of feed rollers **204** rotate, a cam **206** is carried by the shaft of one of the feed rollers **204** rotates to actuate a microswitch **208** after the recording paper **226** has been advanced by one frame so that in response to the output of the microswitch **208** the cutter device **210** is actuated to cut the recording paper **226** into a predetermined length. However, it should be noted that when the recording paper **226** is held between the pair of feed rollers **214**, the cutter device is not actuated. Upon completion of the operation of the cutter device **210**, a microswitch **227** is actuated by an arm **228** so that a clutch **217** is actuated to rotate the pair of feed rollers **212** until the recording paper **226** passes over the pair of feed rollers **212**. In this case the pair of feed rollers **214** and a developer drum **219** are normally rotated by a motor (not shown) through a chain drive **220** so that the recording paper **226** is fed into the space between the developer drum **219** and the pressure plate **221** from the pair of feed rollers **214**. To ensure the proper passage of the recording paper in the recording device, there are provided guides **223**, **216**, **218** and **224**.

When the recording paper **226** has passed beyond the pair of feed rollers **212**, the shutter switch **131** (see FIG. **1**) is reset. When the shutter switch **131** is depressed again, the recording paper **226** is again advanced in the manner similar to that described. In this case, the pair of feed rollers **212** are retarded by a brake device **213** so that the idle rotation of the pair of feed rollers **212** due to the recording paper **226** being advanced may be prevented during the time when the recording paper **226** is still held in the nip between the pair of feed rollers **214**. Furthermore, the pair of feed rollers **214** are so arranged that the cutter device **210** is not actuated when the recording paper is still held in the nip between the pair of feed rollers **214**, and the rotation of the feed rollers **212** is prevented even when the first pair of feed rollers **204** are rotated. Therefore, upon depression of the shutter switch **131**, the first pair of feed rollers **204** are rotated to advance the recording paper **226** step by step, but the second pair of feed rollers **212** are not rotated so that as long as the recording paper **226** is held by the nip between the third feed rollers **214**, the recording paper **226** being advanced is bowed or stored as shown in FIG. **5**. Whether the recording paper **226** is held by or passed through the nips between the second and third pairs of feed rollers **212** and **214** or not is detected by means of microswitches **211** and **215**.

Next the recording paper slack loop mechanism will be described in more detail. A recording paper guide **229** is swingably fixed to a side wall **209** with a hinge (not shown) and is suspended freely when the recording paper **226** is advanced straightly or without being bowed. But when the recording paper **226** is bowed as shown in FIG. **5** in the manner described hereinbefore, the guide **229** is raised by the recording paper **226** as shown in FIG. **5**. Therefore, the recording paper **226** may be stoned or bowed. The function of the guides **224** and **230** is similar to that of the guide **229**. When there is provided a detector-indicator (not shown) capable of detecting and indicating the length of the recording paper **226** stoned or bowed, the temporary storage of the recording paper **226** beyond a predeter-

mined capacity of the recording device may be prevented.

In summary, the shutter switch **131** is inoperative when one of the first and second pairs of feed rollers **204** and **212** and the cutter devices **210** is actuated. Except for this case, the shutter switch **131** is automatically set to be depressed unless the recording paper **226** is completely consumed in the recording device. When there is no recording paper held by or passing through the nips of the second and third pairs of feed rollers **212** and **214** when the shutter switch **131** is depressed, both of the first and second pairs of feed rollers **204** and **212** are rotated to advance the recording paper **226** and then the cutting device **210** is actuated to cut the recording paper **226** into a predetermined length. The third pair of feed rollers **214** continue their rotation until the recording paper **226** has passed beyond them. When upon depression of the switch **131** there is the recording paper **226** held by the nip of the second pair of feed rollers **212,** the first and third pairs of feed rollers **204** and **214** are rotated if there is no recording paper **226** held by the nip between the third pair of feed rollers **214,** and the cutter device **210** is actuated only after when the recording paper **226** has passed the third pair of feed rollers **214.** However, when there is the recording paper **226** held by the nips between the second and third pairs of feed rollers **212** and **214,** only the first pair of feed rollers **204** are rotated and the cutter device **210** is actuated and the third pair of feed rollers **214** are rotated only when the recording paper **226** has passed the second pair of feed rollers **212.**

Next the recording paper magazine will be described in detail by reference to FIG. **6.** The photosensitive surface of the recording paper is applied with a thin film of resin or chemical compound so that it is easily subjected to deterioration when the humidity exceeds a certain level. Therefore, the recording paper must be stored in a dried magazine or the like. According to the present invention, this problem is overcomed by the novel arrangement in which a hollow recording paper spool **232** disposed in a black or light-tight box **205** is perforated or made of a porous material, and is packed with a desiccating or drying agent such as silica gel. Therefore, the recording paper magazine may be designed compact in size and convenient to replace the drying agent.

Various adjustments such as the spot adjustment of the FFT **201** are required to attain and maintain the highest possible resolution, but it is very inconvenient and troublesome to remove the accessories which must be disposed in front of the faceplate of the FFT **201.** To overcome this problem, the present invention provides the recording paper pressure plate **202** which places the recording paper **226** into close contact with the faceplate of the FFT **201** and is fixed to the side plate **209** with a hinge **233** so that the pressure plate **202** may be easily opened away from the faceplate of the FFT **201** when required. The pressure plate **202** may be easily held in position by means of a pair of locking members **234** and **234***a*. The pressure plate **202** in this embodiment is shown as comprising a pair of plates **202***a* and **202***b* spaced apart from each other by means of elastic elements **202***c* made of phosphor bronze.

Next the cutter device **122** in FIG. **1,** and **210** in FIGS. **2** and **5** will be described. In the instant embodiment, the cutter device is of a plug-in type and is placed in the position indicated by **225** in FIG. **2.** Referring to FIG. **8,** a cutter **603** is rotatably interposed between a pair of side walls **601** and **602,** and the recording paper **226** is passed between the rotary cutter knife **603** and a stationary cutter knife **604,** and is cut into a predetermined length when the rotary cutter knife **603** rotates. The position of the fixed cutter knife **604** may be adjusted by an adjusting screw **605.** Since the cutter device is a plug-in type unit, it may be readily replaced so that the maintenance and repair of the recording device may be much facilitated.

Next will be described in more detail the thermal developer by reference to FIG. **9.** In the instant embodiment, a thermal developing process is employed, so that the developer drum **701** has its peripheral surface coated with a silicon resin layer **702.** Alternatively a silicon resin tube may be fitted over the developer drum **701.** The heater-pressure plate **706** arcuate in cross section is disposed around the drum **701** in spaced apart relation therewith, and comprises an inner layer made of polyfluoroethylene an outer heater layer **705** and a steel plate **704** interposed between the inner and outer layers **703** and **705.** The heat is directly applied from the polyfluoroethylene layer **703** so that the photosensitive layer of the recording paper is in direct contact with the polyfluoroethylene layer. Therefore, in order to prevent the photosensitive layer from being damaged, the inner layer **703** must be made of a good heat resistant substance whose coefficient of friction is small and which will not adhere or stick to the recording paper. Therefore, in the instant embodiment, polyfluoroethylene is employed. The outer layer of the drum **701** must be made of a substance (in the instant embodiment a silicon resin) having a greater coefficient of friction because the recording paper should not stick to the drum and a good heat-resistivity to withstand the heat applied from the inner layer **703.** In summary, the heater-pressure plate **706** presses the recording paper **226** against the drum **701** to heat the recording paper and move it relative to the heater-pressure plate **706** without causing any surface flaws of the recording paper.

Next the control circuit **134** in FIG. **1** will be described in detail by reference to FIG. **10.** The control circuit comprises a terminal **901** to be connected to a power source, a relay driving coil **902,** a photoelectric element **903** which is shown as the photosensor **135** in FIG. **1** and a transistor **904.** A light source which emits the light in wavelength to which the photosensitive layer of the recording paper is insensitive is disposed on one side of the path of the recording paper so that the emitted light may be intercepted by the photoelectric element **903** when there is no recording paper in the path. However, when there remains the recording paper in the magazine **123,** the light from the light source is not intercepted by the photoelectric element **903** so that the element **903** is non-conductive. As a consequence the transistor **904** is also non-conductive. However, when the recording paper in the magazine is consumed, the light from the light source is intercepted by the photoelectric element **903** so that the latter becomes conductive. As a consequence the transistor **904** also becomes conductive to flow the current through the relay coil **902.** The relay is so connected that when it is energized it de-energizes the shutter circuit **120** even when the shutter switch **131** is depressed. Therefore erratic operation may be prevented when there is no recording paper in the recording paper magazine.

A circuit shown in FIG. **11** is provided to permit one rotation of the first feed rollers **204** (see FIG. **2**) and then to stop them, and comprises a switch **911** which is shown as the microswitch **208** in FIG. **2**, a charging capacitor **912**, a charging and discharging resistor **913**, switching transistors **914** and **915**, a coil **916** for a relay, a pair of terminals **917** and **918** for connection with the power source, a normally closed contact **919** of the relay coil **916**, a relay coil **920** having a pair of contacts **920***a* and **920***b*, an input terminal **941** to which is applied a pulse for starting the rotation of the first pair of feed rollers **204**, and a terminal **942** for connection with the clutch **217** (see FIG. **2**).

Next the mode of operation of the control circuit shown in FIG. **11** will be described.

The detail of the temperature controller shown by **127** in FIG. **1** is illustrated in FIG. **12**. The controller **127** comprises a pair of terminals **921** and **922** to which are applied the AC of commercial frequency, diode rectifiers **923–926**, a constant voltage diode **927**, a detector **928** which is shown as the temperature sensor or detector **133** in FIG. **1**, a field-effect transistor **929**, a coupling transistor **930** for triggering a triac **931**, and a heater **932** for the developer. The gate potential of the FET **929** is controlled in response to the internal resistance of the detector **928**, and in response to the switching operation of the FET **929** the triac **931** is triggered through the coupling transformer **930** so that the conduction or phase angle of the current or voltage to be applied to the heater **932** is controlled. Therefore, the power in proportion to a preset temperature of the thermal developing device may be supplied thereto, and the preset temperature is maintained.

In the instant embodiment, it has been described that the latent image is formed on the recording paper and is developed by the thermal developing process into a visible image, but it is understood that an electrostatic photographic process may also be utalized by the recording device in accordance with the present invention when a pin tube is used as the cathode-ray tube for printing and a recording paper adapted for electrostatic photography is used.

What is claimed is:

1. A recording device comprising

a cathode-ray tube having a faceplate on which an image on one frame is displayed;

a recording paper which is placed in contact with the faceplate of said cathode-ray tube for transfer of the image thereon;

a first recording paper transportation means for intermittently transporting the recording paper from a recording paper magazine after the one frame of image displayed upon said faceplate of said cathode-ray tube has been transferred upon the recording paper;

a developing means for developing the image transferred onto the recording paper;

a second recording paper transportation means for transporting the recording paper from said cathode-ray tube into said developing means, said second transportation means having a store means for providing a loop of recording paper on an inlet side;

a third recording paper transportation means for transporting the recording paper from said cathode-ray tube into said second recording paper transportation means, said third transportation means being adapted not to be driven when the recording paper is held in said second recording paper transportation means, but adapted to be driven when there is no recording paper in said second recording paper transportation means;

a cutter means disposed between said third recording paper transportation means and said cathode-ray tube and adapted to cut the recording paper into a predetermined length when the recording paper has passed said second recording paper transportation means after said first recording paper transportation means has transported the recording paper;

a shutter switch which is inoperative when said first and third recording paper transportation means and said cutter means are actuated, but is operative upon completion of operation thereof; and

a shutter circuit for causing said cathode-ray tube to display one frame of image in response to the actuation of said shutter switch;

said store means comprising flat plate means whose ends are securely fixed to side plates on one side of the passage of the recording paper, and whose upper ends are rotatably fixed to said side plates in parallel with said flat plate means on the other side of said recording paper passage, said flat plate means being rotated by the deflection of the recording paper to define a space into which the recording is looped.

2. A recording device as set forth in claim **1** wherein said recording paper magazine comprises a casing within which a hollow spool which is perforated is provided and is packed with a drying agent and over which is wound the recording paper.

3. A recording device as set forth in claim **1** wherein said cathode-ray tube is provided with a pressure plate which is swingably fixed and is adapted to press the recording paper into close contact with the faceplate of said cathode-ray tube.

4. A recording device as set forth in claim **3** wherein said pressure plate comprises a first plate whose one side edge is hinged to the body of the recording device and whose the other side edge opposing said one side edge is provided with locking means which engages with mating locking means on the body of the recording device so as to retain said first plate in stationary position, and

a second plate resiliently supported by said first plate and adapted to press the recording paper against the faceplate of said cathode-ray tube.

5. A recording device as set forth in claim **1** wherein said cutter means comprises a stationary member which carries a fixed cutter knife and a movable cutter knife which makes an arcuate motion and which is removably placed into a space provided in the recording device in plug-in manner.

6. A recording device comprising a cathode-ray tube having a faceplate on which an image on one frame is displayed;

a recording paper which is placed in contact with the faceplate of said cathode-ray tube for transfer of the image thereon;

transferring means feeding unrecorded recording paper onto said faceplate intermittently from a recording paper container after the completion of transferring one frame of the image displayed;

a cutter which cuts said recording paper on which said image is formed;

a developing device composed of a drum said drum being coated with a silicon resin layer, to be rotated, a supporting plate having a circular cross-section covering a portion of the surface of said drum for holding said recording paper between said drum and said supporting plate and heating means for thermally developing said image on said recording paper, said supporting plate comprising a metal plate having a polyfluoroethylene layer to be contacted with said recording paper, a heater layer covering said metal plate; and

a feeding means for feeding said recording paper into said developing means.

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