

Description

BACKGROUND OF THE INVENTION

The present invention relates to a record head used in a record device for providing output picture on record paper capable of dealing with a wide variety of needs of industries ranging from the printing industry where high speed output of high quality picture is requested, the printer industry based on business or personal request to the electric appliance industry where general output devices and the like at low price using various kinds and uses of record paper are requested.

According to a slit jet system that is a kind of a conventional electrostatic attraction system in ink jet recording (Susumu Ichinose et al: "A slit jet recording system", Proceeding of 1st. Symposium of Nonimpact Printing Technology, page 119-124, 1984), as shown by Fig. 10, in a record head having an ink jet injection port 101 formed in a slit-like shape, an upper plate 102 and a lower plate 103 for forming the ink injection port 101, a record electrode 104 arranged on the lower plate 103 by a unit of a record pixel, an opposed electrode 105 arranged oppositely to the ink injection port 101, a record medium 110 moving along the opposed electrode 105 and a drive power source 106 for supplying voltage to a selected electrode of the record electrode 104, ink 108 is filled in the ink injection port 101 and a voltage pulse 107 is applied between the record electrode 104 and the opposed electrode 105 by which the ink 108 is injected and flown ink 109 is adhered and permeated onto the record medium 110 whereby desired output print or picture is obtained.

According to the conventional slit jet system, by replacing a nozzle used in ink jet recording by the ink injection port 101 having a slender slit-like shape, the resolution can be prevented from being restricted by the nozzle and further, cleaning of the ink jet port 101 can be facilitated.

Further, according to the slit jet system, a plurality of the ink injection ports 101 are used and the inks 108 having different colors are injected into the respective ink injection ports 101 by which color output printing can easily be provided.

The following problems are posed according to the conventional ink jet recording system.

(1) It is difficult to promote the resolution since nozzles are used for injecting ink.

(2) The ink jet recording system is classified into a continuous type and an on-demand type. According to the continuous type, although the record speed is high, the device is difficult to simplify due to recovery of unnecessary ink or the like whereas according to the on-demand type, although the constitution of the device is simplified, the record speed is difficult to accelerate.

The following problems are posed according to the slit jet system for resolving the above-described problems of the ink jet recording system.

(1) It is difficult to promote the resolution since ink is flown by arranging record electrodes in correspondence with the units of record pixels.

(2) It is difficult to optimize ink characteristic and control applied voltage and timing thereof since in applying voltage on the record electrodes, when a selected record electrode and a nonselected record electrode are contiguous to each other, discharge phenomenon is caused between the both electrodes.

Hence, according to the present invention, it is a problem thereof to provide a record unit in which highly fine and high quality printing is carried out at high speed and output printing in a noncontact state and where shape of a record medium is not selected can be carried out, and a record device using the record unit, a record unit and a record head used for the record device.

SUMMARY OF THE INVENTION

In order to resolve the above-described problems, according to the present invention, there is provided a record head having a transparent electrode formed on a substrate, a photoconductive film formed on the transparent electrode, means for supplying ink on the photoconductive film, a slit plate installed with a slit for controlling injection of the ink and an opposed electrode in this order, the slit plate and the opposed electrode being arranged with a gap therebetween sufficient for incorporating a record medium, and at least having a power source for applying a voltage between the transparent electrode and the opposed electrode and light irradiating means for supplying light in correspondence with a desired pixel to the photoconductive film in a form of a pulse.

Further, as other constitution of the present invention, according to the present invention, there is provided a record head having a transparent electrode formed on a substrate, a photoconductive film formed on the transparent electrode, means for supplying ink on the photoconductive film, a slit plate installed with a slit for controlling injection of the ink and an opposed electrode in this order, the slit plate and the opposed electrode being arranged with a gap therebetween sufficient for incorporating a record medium, and at least having a power source for applying a voltage between the transparent electrode and the opposed electrode and light irradiating means for irradiating light in correspondence with a desired pixel to the photoconductive film, wherein an ink storage groove for temporarily storing the ink is formed on the substrate along a longitudinal direction of the slit and the ink storage groove(s) are disposed in an ink chamber formed between the substrate and the slit plate and disposed at an upper side or a lower side or both sides of the slit in a direction of a plane of the substrate.

Embodiments of the present invention will now be described by way of example only and with reference to the accompanying drawings, in which:-

Fig. 1 is an explanatory view showing the constitution of a record head according to a first example of the present invention.

Fig. 2 is an explanatory view showing the constitution of a record head according to a second example of the present invention.

Fig. 3 is an explanatory view showing the constitution of a record head according to a third example of the present invention.

Fig. 4 is an explanatory view showing the constitution of a record head according to a fourth example of the present invention.

Fig. 5 is a disassembled perspective view showing the constitution of a head unit of the record head according to the fourth example of the present invention.

Fig. 6 is a disassembled perspective view showing the constitution of the record head according to the fourth example of the present invention and its peripheral mechanism.

Fig. 7 is an explanatory view showing the constitution of a record head according to a fifth example of the present invention.

Fig. 8 is a block diagram showing the constitution of a recording device using the record head of the present invention.

Fig. 9 is an explanatory view showing a first embodiment of a record head of the present invention.

Fig. 10 is an explanatory view showing a record head of a conventional slit jet system.

DETAILED DESCRIPTION OF THE INVENTION

Fig. 9 shows a first embodiment of a record head according to the present invention.

An explanation will be given of the constitution and operation of a record head according to a first embodiment in reference to Fig. 9 as follows.

First, an explanation will be given of the constitution of the record head.

A head unit 54 of the record head is constituted by a transparent substrate 58, a transparent electrode 2 formed on the transparent substrate 58 and a photoconductive film 4 formed on the transparent electrode 2, further, a slit plate 8 is installed on the photoconductive film 4 via a spacer 55 for forming an ink chamber 56 and a slit 57 for controlling injection of the ink 6 is formed at the slit plate 8. Further, ink supplying means 50 for supplying the ink 6 to the ink chamber 56 on the photoconductive film 4 is constituted at the head unit 54.

Further, an opposed electrode 1 is installed around the head unit 54 on the side of the slit plate 8 and the opposed electrode 1 is arranged such that a gap sufficient for incorporating a record medium 10 is formed between the opposed electrode 1 and the slit plate 8. Paper feeding means (not illustrated) for supplying the record medium 10 without being brought into contact with the slit plate 8, a power source 3 for applying voltage between the transparent electrode 2 and the op-

posed electrode 1 and light irradiating means 5 for supplying light in correspondence with a desired picture pixel to the photoconductive film 4 in a form of a pulse is installed on the rear face side of the transparent substrate 58.

Next, an explanation will be given of the operation. Light is irradiated to the photoconductive film 4 by using the light irradiating means 5 from the rear face side of the transparent substrate 58 in a state where high voltage is applied between the transparent electrode 2 and the opposed electrode 1 by the power source 3. By this operation, the resistance value of an irradiated region of the photoconductive film 4 is lowered and photocurrent is flown at the irradiated region. Thereafter, electric charge is charged in the ink on the photoconductive film 4 at the irradiated region of the photoconductive film 4 and the ink is converted into flown ink 12 and is injected toward the side of the opposed electrode 1 by receiving Coulomb's force while an amount and directionality of the ink are controlled by the slit plate 8. The flown ink 12 is moved, permeated and adhered to the record medium 10 on the opposed electrode 1 by Coulomb's force whereby the desired picture pixel is provided on the record medium 10.

The record head described in the first embodiment of the present invention sufficiently resolves the above-described problems. That is, it is easy to promote the resolution since it has no record electrode. Further, the record head has a feature in which there causes no discharge phenomenon between record electrodes since it has no record electrode and it is easy to optimize the ink characteristic and control applied voltage and timing thereof.

Further, attention has been paid to the following points in order to improve the record head described in the first embodiment.

That is, since high voltage is applied between the transparent electrode on the head side and the opposed electrode, in the recording operation, when a sufficient amount of ink is not supplied to the slit portion after flying ink having high insulating performance, the resistance value between the electrodes may be lowered and the discharge phenomenon may occur. Accordingly, the frequency of driving the record head described in the first embodiment is significantly dependent on the refilling rate of ink and the record speed is restricted thereby.

Therefore, in order to improve the record head of the first embodiment, the capacity of ink in the ink chamber must be enlarged and a mechanism capable of supplying ink sufficiently and at high speed is needed at the slit portion. Although it is appropriate to expand the ink chamber formed between the substrate and the slit plate in order to enlarge the ink capacity, when the expansion of the ink capacity is achieved by increasing, for example, the height of the ink chamber, that is, a distance of the gap between the photoconductive film face on the substrate and the slit plate, since the amount of ink injected from the slit depends significantly on the height

of the ink chamber, the injected ink amount is simultaneously increased and further, the amount of consumption of ink is increased and accordingly, as a result, the refilling rate of ink is not accelerated considerably. Further, the resolution is obliged to lower by an increase in the amount of injecting ink and since the amount of injecting ink is increased, energy necessary for injection, that is, a value of voltage applied between the both electrodes must be increased or time of injection needs to be prolonged.

Further, when the expansion of the ink capacity is achieved by expanding the ink chamber in the width direction of the ink chamber, that is, a horizontal direction in respect of the substrate face, since the amount of ink at the slit portion is not increased, the amount of injecting ink remains unchanged at the pertinent value and the refilling of ink is carried out at high speed, however, the record head per se must be enlarged in the direction of the substrate plane by an amount expanding the ink chamber in the direction of the substrate plate. The drawback is revealed significantly in arranging record heads and performing color printing whereby the device is magnified. Further, since the ink chamber is formed thinly with a wide area in the head, when the head is not used in a long period of time, the ink filled in the ink chamber is liable to evaporate by which a solidified component of ink such as a pigment or the like adheres to the slit portion and the slit portion is clogged, further, the direction of injecting ink is varied thereby, which may cause dimmed portions or nonuniformity of dots and print quality may be deteriorated.

Further, when the record head is constituted by a line head, the amount of consumption of ink per unit time period is increased since the slit width as a injecting portion is significantly wider than a serial head. Therefore, these problems are revealed significantly in the case of a line head.

Further, the ink is flown by using electrostatic force by applying high voltage between the electrodes and therefore, when impurities or the like having high conductivity are mixed in the ink, the discharge phenomenon may be caused.

According to the record head of the second embodiment of the present invention, higher quality and higher speed of print output are achieved by supplying ink stably and at high speed, discharge phenomenon between the electrodes caused by high voltage is prevented, ink is hardly clogged at the slit portion and small-size formation can be achieved.

An explanation will be given of the record head according to the second embodiment as follows.

According to a first constitution of the second embodiment of the record head of the present invention, there is provided a record head having a transparent electrode formed on a substrate, a photoconductive film formed on the transparent electrode, means for supplying ink on the photoconductive film, a slit plate installed with a slit for controlling injection of the ink and an op-

posed electrode in this order, the slit plate and the opposed electrode being arranged with a gap therebetween sufficient for incorporating a record medium, and at least having a power source for applying a voltage between the transparent electrode and the opposed electrode and light irradiating means for supplying light in correspondence with a desired pixel to the photoconductive film in a form of a pulse wherein an ink storage groove for temporarily storing the ink is formed on the substrate along a longitudinal direction of the slit and the ink storage groove(s) are disposed in an ink chamber formed between the substrate and the slit plate and disposed at an upper side or a lower side or both sides of the slit in a direction of a plane of the substrate.

The record head having the above-described first constitution operates as follows.

When light is irradiated to the photoconductive film by using the light irradiating means from the side of the transparent electrode in a state where high voltage is applied between the transparent electrode and the opposed electrode by the power source, the resistance value of the photoconductive film at the irradiated region is lowered and photocurrent is flown at the irradiated region. Thereafter, a state where electricity is conducted between the ink and the transparent electrode is produced at the irradiated region of the photoconductive film, electric charge is charged to the ink on the photoconductive film, and the ink is flown toward the side of the opposed electrode by receiving Coulomb's force and adhered to the side of the record medium while the amount and the directionality of the ink are controlled by the slit plate. Thereby, desired picture pixels are provided on the record medium. Further, when the ink is flown, the ink to be refilled is supplied swiftly from the ink storage groove to the inside of the ink chamber, that is, the slit portion.

Further, according to a second constitution of the record head of the present invention, in the first constitution of the record head, the record head of this constitution is provided with a member having ink permeable fine pores in the ink storage groove.

The record head of the above-described second constitution operates as follows.

When light is irradiated to the photoconductive film by using the light irradiating means from the side of the transparent electrode in the state where high voltage is applied by the power source between the transparent electrode and the opposed electrode, the resistance value of the photoconductive film at the irradiated region is lowered and photocurrent is flown at the irradiated region. Thereafter, the state where electricity is conducted between the ink and the transparent electrode is produced at the irradiated region of the photoconductive film, electric charge is charged at the ink on the photoconductive film and the ink is flown toward the side of the opposed electrode by receiving Coulomb's force and adhered to the side of the record medium. Thereby, desired picture pixels are provided on the record medium.

Further, when the ink is flown, at the inside of the record head, the ink to be refilled is supplied at high speed to the inside of the ink chamber, that is, the slit portion by a constant amount after passing through the material having fine pores provided in the ink storage groove.

Furthermore, according to a third constitution of the record head of the present invention, in the record head of the first constitution or the record head of the second constitution, the record head of this constitution is provided with ink accelerating means for accelerating further flown ink.

The record head of the above-described third constitution operates as follows.

When light is irradiated to the photoconductive film by using the light irradiating means from the side of the transparent electrode in the state where high voltage is applied by the power source between the transparent electrode and the opposed electrode, the resistance value of the photoconductive film at the irradiated region is lowered and photocurrent is flown at the irradiated region. Thereafter, the state where electricity is conducted between the ink and the transparent electrode is produced at the irradiated region of the photoconductive film, electric charge is charged to inside of the ink on the photoconductive film, the ink is flown to the side of the opposed electrode by receiving Coulomb's force and thereafter, the flown ink is further accelerated by the accelerating means and adhered to the side of the record medium. Thereby, desired picture pixels are provided on the record medium. Further, when the ink is flown, the ink to be refilled is supplied swiftly from the ink storage groove to the inside of the ink chamber, that is, the slit portion.

Furthermore, according to a fourth constitution of a record head of the present invention, the record head described in the first, or the second, or the third constitution, is constituted in a line shape in correspondence with the print width of the record medium.

The record head of the above-described fourth constitution operates as follows.

When light is irradiated in a line shape to the photoconductive film by the light irradiating means from the side of the transparent electrode of the record unit in the state where high voltage is applied by the power source between the individual transparent electrodes and the opposed electrodes, the resistance value of the photoconductive film at the irradiated region is lowered and photocurrent is flown at the irradiated region. Thereafter, the state where electricity is conducted between the ink and the transparent electrode is produced at the irradiated region of the photoconductive film, electric charge is charged to inside of the ink on the photoconductive film, the ink is flown toward the side of the opposed electrode by receiving Coulomb's force, the flown ink is moved, permeated and adhered to the record medium on the opposed electrode and therefore, one line region of desired picture pixels are provided on the record medium. When the ink is flown, the ink to be refilled is supplied

swiftly from the ink storage groove to the inside of the ink chamber, that is, the slit portion.

Furthermore, as a fifth constitution of the record unit of the present invention, a plurality of the record heads having one of the first through the fourth constitutions are used and means for supplying inks having different colors to the respective record heads are provided.

The record unit having the above-described sixth constitution operates as follows.

When light is irradiated to the photoconductive film by the light irradiating means from the side of the transparent electrode of the record unit in the state where high voltage is applied by the power source between the individual transparent electrodes and the opposed electrode, the resistance value of the photoconductive film at the irradiated region is lowered and photocurrent is flown at the irradiated region. Thereafter, a state where electricity is conducted between the ink and the transparent electrodes is produced at the irradiated region of the photoconductive film, electric charge is charged to inside of the ink on the photoconductive film, the ink is flown toward the side of the opposed electrode by receiving Coulomb's force, the flown ink is moved, permeated and adhered to the record medium on the opposed electrode and accordingly, one dot, one line or one screen region of desired picture elements are provided at the record medium. When the ink is flown, the ink to be refilled is supplied swiftly from the ink storage groove to the inside of the ink chamber, that is, the slit portion. Further, by repeating the above-described procedure at the record heads of the respective colors, desired color print or color picture is provided on the record medium.

[Examples]

An explanation will be given of examples of record heads according to the second embodiment of the present invention in reference to the drawings as follows.

(Example 1)

Fig. 1 is an explanatory view showing the first constitution of a record head according to the present invention.

An explanation will be given of the total constitution of the record head in reference to Fig. 1.

In Fig. 1, the record head is constituted by the head unit 54, the ink supplying means 50 for supplying a necessary amount of ink to the head unit 54, the light irradiating means 5 arranged on the right side (hereinafter, rear face side) of the head unit 54 for irradiating light to the head unit 54, the opposed electrode 1 arranged on the left side (hereinafter, opposed face side) of the head unit 54 and the power source 3 for applying voltage between the opposed electrode 1 and an electrode in the head unit 54.

An explanation will be given of the constitution of

the head unit 54.

Numeral 58 designates a transparent substrate and the transparent substrate 58 is formed by a light transmitting material of glass, acrylic resin, plastic or the like for transmitting wavelength of light from the light irradiating means 5 arranged on the rear face side. Further, the transparent electrode 2 and the photoconductive film 4 are successively laminated on a face of the transparent substrate 58 on the opposed face side and the slit plate 8 is formed thereon via the spacer 55. In this case, the spacer 55 is disposed in the upward and downward directions and transverse directions from the slit 57 such that the slit 57 in an elongated hole shape formed on the slit plate 8 is not closed and further, ink is not leaked and by constituting in this way, there is formed a space of the ink chamber 56 that is hermetically sealed at other than the opening of the slit 57. Further, the ink storage groove 53 is formed in the ink chamber 56 on the transparent substrate 58 and the depth of the ink storage groove 53 is set to be sufficiently deeper than that of the ink chamber 56. Further, the ink storage groove 53 is formed to dispose on the upper side or the lower side of the slit 57 such that the ink storage groove 53 is not opposed to the position of opening the slit 57 in the slit plate 8.

As the material of the photoconductive film 4, an inorganic conductor of a photoconductive single crystal material of Se group, CdS group, ZnO group, BSO ($\text{Bi}_{12}\text{SiO}_{20}$) or the like, hydrogenated amorphous silicon of i type, pi type, pin type or the like, or a lamination type organic photoconductor such as CTL/CGL or the like can be used. As the photoconductive film 4, the photoconductivity is important and it is preferable that potential difference of surface potential caused by attenuation of light is large. The dark resistance of the inorganic photoconductor or the organic photoconductor falls in a range of 10^{13} through $10^{14} \Omega\cdot\text{cm}$ and the resistance value is lowered to 10^{10} through $10^{11} \Omega\cdot\text{cm}$ by irradiating light to the photoconductive film 4 by which photocurrent is flown in the irradiated region. Further, in respect of the film thickness of the photoconductive film 4, 10 through $20 \mu\text{m}$ is preferable and as electric properties, it is requested that the resistance value at the dark place is large and high sensitivity and fast light response are required which can be satisfied by the above-described photoconductor.

Further, when amorphous silicon is used as the photoconductive film 4, the dark resistance falls in a range of 10^9 through $10^{11} \Omega\cdot\text{cm}$ and the resistance value can be lowered to 10^4 through $10^6 \Omega\cdot\text{cm}$ by irradiating light to the photoconductive film 4 by which large surface potential difference can be ensured. Further, naturally, the larger the film thickness of the photoconductive film, the more increased is the dark resistance value, however, the resolution is deteriorated at the film thickness of 20 through $100 \mu\text{m}$ or higher and therefore, the optimum film thickness is $20 \mu\text{m}$ or lower, preferably, about $10 \mu\text{m}$.

Further, in order to increase the dark resistance value as well as realize jumping of ink having high resolution by minimizing expansion of electric charge in the direction of film face, it is preferable to use hydrogenated amorphous silicon of i type where impurity elements are removed.

As the transparent electrode 2, ITO (Indium-Tin-Oxide) or, a conductive high molecular material, a metal thin film having a thinness sufficient for passing light (for example, Al thin film having a film thickness of $0.03 \mu\text{m}$ or the like), or ZnO , or SnO_2 or compounds of these can be used. Further, as the opposed electrode 1 of the present invention, a material having excellent conductivity such as aluminum, copper, gold or the like can be used.

Next, an explanation will be given of the constitution of the ink supplying means 50.

Numeral 52 designates an ink tank for storing an supplying ink and ink filled in the ink tank 52 is supplied to the ink chamber 56 or the ink storage groove 53 of the record head unit 15 via an ink supply path 51 of a pipe or the like. In this case, the ink 6 is supplied firmly to the ink chamber 56 under the slit 57 or the ink storage groove 53 by setting the interface of ink of the ink tank 52 higher than the positions of the ink chamber 56 and the ink storage groove 53. In this case, the ink supplying means 50 may be constituted integrally with the head unit 54.

Next, an explanation will be given of the constitution of the light irradiating means.

As the light irradiating means 5 according to the present invention, a semiconductor laser can be used and laser beam is irradiated by the light irradiating means 5 in an arrow mark 7 direction from the rear face side of the transparent substrate 58 to a position on the photoconductive film 4 in correspondence with a desired picture pixel. Further, the irradiated light reaches the photoconductive film 4 after transmitting through the transparent substrate 58 and the transparent electrode 2. Thereby, the resistance value is lowered only at the irradiated desired picture pixel region on the photoconductive film 4. In this case, the photosensitivity can be promoted by promoting the light attenuation rate of the photoconductive film 4 by matching the oscillation wavelength of the laser beam with the absorption coefficient of the photoconductive film 4 in respect of the oscillation wavelength. Further, in respect of the laser beam 7, the intensity of irradiated light, the shape of focus light spot and the like of laser beam irradiated from a laser oscillation device of a semiconductor laser or the like, are optimized by an optical lens or the like and the laser beam can be constituted by a laser beam scanning mechanism composed of a polygonal mirror and the like at the light irradiating means 5. According to the record head of the present invention, laser beam is irradiated from the light irradiating means 5 and therefore, picture can be formed on the photoconductive film 4 at a position in correspondence with a desired picture pixel in a

noncontact state and at high speed. Although according to the example, a semiconductor laser is used as a light emitting source of the light irradiating means 5, the present invention is not limited thereto but He-Ne laser, a semiconductor laser array, an LED array, a halogen lamp or the like can be used sufficiently as the light emitting source. Further, naturally, a light shutter array or a liquid crystal television set may be used in place of the above-described laser scanning optical system. Further, slit light exposure may be performed by an analog optical system such as a copier and light may be irradiated directly to the head unit 54 via an optical system.

Next, an explanation will be given of the opposed electrode 1 and the power source 3.

The opposed electrode 1 comprises a conductive material and is arranged on the side of opposing the head unit 54 via a clearance of about 0.2 through 1 mm from the slit plate face of the head unit 54. In this case, the side of the opposed electrode 1 is connected to the positive pole of the power source 3 and the side of the transparent electrode 2 in the head unit 54 is connected to the negative side thereof, respectively, in printing, constant voltage is applied between the both electrodes by the power source 3 and electric field is generated at the clearance between the both electrodes. Although in Fig. 1, the shape of the opposed electrode 1 is constituted by a plane, it is preferable to concentrate the electric field by sharpening the opposed electrode face, constituting a shape having a radius of curvature or the like and in this way, energy necessary for injection of ink, that is, applied voltage or applied pulse can be reduced.

Next, an explanation will be given of the operation.

First, constant high voltage is continuously applied between the transparent electrode 2 and the opposed electrode 1 by the power source 3 by which a state where electric field is generated between both is produced. Further, light is irradiated by the light irradiating means 5 from the rear face side of the transparent substrate 58 toward the position of the slit 57 in correspondence with a desired picture recording portion. Then, light transmits through the transparent substrate 58 and the transparent electrode 2 and is irradiated to the photoconductive film 4.

At this moment, the photoconductive phenomenon is caused and photocurrent is flown at the light irradiated portion inside of the photoconductive film 4. That is, carriers are formed at the irradiated region of the photoconductive film 4 and transferred by the external electric field, as a result, the impedance is lowered and the photocurrent is flown. According to the embodiment, the negative pole is connected to the side of the transparent electrode 2 and accordingly, electrons emerge on the ink side at the light irradiated portion, however, this is because the charge characteristic of the ink according to the embodiment is defined as negative and the charge characteristic is not particularly limited thereto, although it is necessary to correspond to the charge characteristic of the ink.

Therefore, at the irradiated region of the photoconductive film 4, the ink 6 and the transparent electrode 2 are brought into a conductive state and negative charge is charged to inside of the ink 6 having high insulating performance on the photoconductive film 4. Further, the ink is attracted to the record medium 10 on the opposed electrode 1 by receiving Coulomb's force caused by the electric field developed between the transparent electrode 2 and the opposed electrode 1 and the flown ink 12 is injected from the slit 57 to the side of the opposed electrode 1 and is adhered to the record medium.

Further, after flying the ink, a pertinent amount of ink is filled from the ink storage groove 53 installed at the vicinity of the slit 57 to the flown ink portion sufficiently faster than a successive timing of injecting ink.

(Example 2)

Fig. 2 is an explanatory view showing the second constitution of a record head according to the present invention.

An explanation will be given of the total constitution of the record head in reference to Fig. 2.

In Fig. 2, the record head is constituted by the head unit 54, the ink supplying means 50 for supplying a necessary amount of ink to the head unit 54, the light irradiating means 5 arranged on the rear face side of the head unit 54 for irradiating light to the head unit 54, the opposed electrode 1 arranged on the opposed face side of the head unit 54 and the power source 3 for applying voltage between the opposed electrode 1 and the electrode in the head unit 54.

An explanation will be given of the constitution of the head unit 54.

Numerals 58 designates the transparent substrate and the transparent substrate 58 is formed by a light transmitting material of glass, acrylic resin, plastic or the like for transmitting wavelength of light from the light irradiating means 5 arranged on the rear face side. Further, the transparent electrode 2 and the photoconductive film 4 are successively laminated on the face of the transparent substrate 58 on the opposed face side and the slit plate 8 is formed thereon via the spacer 55. In this case, the spacer 55 is arranged on the upper side, the lower side and in the lateral directions of the slit 57 such that the slit 57 having an elongated hole shape formed on the slit plate 8 is not closed and ink is not leaked and by constituting in this way, a hermetically sealed space of the ink chamber 56 is formed at other than the opening of the slit 57. Further, the ink storage groove 53 is formed at inside of the ink chamber 56 on the transparent substrate 58 and the depth of the ink storage groove 53 is set sufficiently deeper than that of the ink chamber 56. Further, the ink storage groove 53 is formed to dispose on the upper side or the lower side of the slit 57 such that the ink storage groove 53 is not opposed to the position of opening the slit 57 in the slit plate 8. Further, a porous material 65 where fine pores

are formed is embedded in the ink storage groove 53 and the porous material 65 is formed by a foaming material comprising polyurethane, polyethylene, rubber, silicone rubber or the like.

Next, an explanation will be given of the constitution of the ink supplying means 50.

Numeral 52 designates an ink tank for storing and supplying ink and ink filled in the ink tank 52 is supplied to the ink storage groove 53 of the record head unit 54 via the ink supply path 51 of a pipe or the like. Further, the ink 6 in the ink storage groove 53 receives flow resistance by interposing the porous material 65 and the constant amount of ink is supplied to the ink chamber 56. The amount of ink supplied to the ink chamber 56, that is, the portion of the slit 57 can freely be controlled by the size of the pore and a number of pores per unit volume of the porous material 65. In this case, the ink 6 is firmly supplied to the ink chamber 56 under the slit 57 or the ink storage groove 53 by setting the interface of ink of the ink tank 52 higher than the positions of the ink chamber and the ink storage groove 53. In this case, the ink supplying means 50 may be constituted integrally with the head unit 54.

Next, an explanation will be given of the constitution of the light irradiating means.

As the light irradiating means 5 according to the present invention, similar to Example 1, a semiconductor laser can be used and laser beam from the light irradiating means 5 is irradiated in the arrow mark 7 direction from the rear face side of the transparent substrate 58 to the position on the photoconductive film 4 in correspondence with a desired picture pixel. Further, the irradiated light reaches the photoconductive film 4 by transmitting through the transparent substrate 58 and the transparent electrode 2. Thereby, a resistance value of only the irradiated desired picture pixel region is lowered on the photoconductive film 4.

Next, an explanation will be given of the constitutions of the opposed electrode 1 and the power source 3.

The opposed electrode 1 comprises a conductive material and is arranged on the opposed face side of the head unit 54 via a clearance of about 0.2 through 1 mm from the slit plate face of the head unit 54. In this case, the side of the opposed electrode 1 is connected to the positive pole of the power source 3 and the side of the transparent electrode 2 in the head unit 54 is connected to the negative pole thereof, respectively, constant voltage is applied between the both electrodes by the power source 3 in printing and electric field is generated at the clearance between the both electrodes.

Next, an explanation will be given of the operation.

First, constant high voltage is continuously applied between the transparent electrode 2 and the opposed electrode 1 by the power source 3 by which a state where electric field is generated between both is produced. Further, light is irradiated by the light irradiating means 5 from the rear face side of the transparent substrate 58 toward the position of the slit 57 in correspond-

ence with a desired picture recording portion. Then, light transmits through the transparent substrate 58 and the transparent electrode 2 and is irradiated to the photoconductive film 4.

At this moment, the photoconductive phenomenon is caused and photocurrent is flown at the light irradiated portion inside of the photoconductive film 4. That is, carriers are formed at the irradiated region of the photoconductive film 4 and transferred by the external electric field, as a result, the impedance is lowered and the photocurrent is flown.

Therefore, in the irradiated region of the photoconductive film 4, the ink 6 and the transparent electrode 2 are brought into a conductive state, and negative charge is charged locally in the ink 6 having high insulating performance on the photoconductive film 4. Further, the ink is attracted to the record medium 10 on the opposed electrode 1 by receiving Coulomb's force by electric field developed between the transparent electrode 2 and the opposed electrode 1 and the flown ink 12 is injected to the side of the opposed electrode 1 from the slit 57 and adhered to the record medium.

Further, after flying ink, a pertinent amount of ink is filled to the flown ink portion by the ink storage groove 53 installed at the vicinity of the slit 57 sufficiently faster than a successive timing of ink injection, further, impurities are removed by passing the ink 6 through the porous material 65 and the ink with a constant pressure and a pertinent amount is filled in the slit by receiving uniform flow resistance. Thereby, the ink is supplied always stably to the slit and the stable recording operation can be performed by firmly restraining the discharge phenomenon which may be caused between the opposed electrode and the transparent electrode under application of voltage by removing impurities in the ink.

(Example 3)

Fig. 3 is an explanatory view showing the third constitution of a record head according to the present invention.

An explanation will be given of the total constitution of the record head in reference to Fig. 3.

In Fig. 3, the record head is constituted by the head unit 54, the ink supplying means 50 for supplying a necessary amount of ink to the head unit 54, the light irradiating means 5 arranged on the rear face side of the head unit 54 for irradiating light to the head unit 54, the opposed electrode 1 arranged on the opposed face side of the head unit 54, the power source 3 for applying voltage between the opposed electrode 1 and the electrode in the head unit 54 and accelerating means for accelerating the injected ink in the flying direction.

An explanation will be given of the constitution of the head unit 54.

Numeral 58 designates the transparent substrate and the transparent substrate 58 is formed by a light transmitting material of glass, acrylic resin, plastic or the

like for transmitting wavelength of light from the light irradiating means 5 arranged on the rear face side. Further, the transparent electrode 2 and the photoconductive film 4 are successively laminated on the face of the transparent substrate 58 on the opposed face side and the slit plate 8 is formed thereon via the spacer 55. In this case, the spacer 55 is arranged on the upper side, the lower side and in the lateral directions of the slit 57 such that the slit 57 having an elongated hole shape formed on the slit plate 8 is not closed and ink is not leaked and by constituting in this way, a hermetically sealed space of the ink chamber 56 is formed at other than the opening of the slit 57. Further, the ink storage groove 53 is formed at inside of the ink chamber 56 on the transparent substrate 58 and the depth of the ink storage groove 53 is set sufficiently deeper than that of the ink chamber 56. Further, the ink storage groove 53 is formed to dispose on the upper side or the lower side of the slit 57 such that the ink storage groove 53 is not opposed to the position of opening the slit 57 in the slit plate 8.

Next, an explanation will be given of the constitution of the ink supplying means 50.

Numerals 52 designates the ink tank for storing and supplying ink and ink filled in the ink tank 52 is supplied to the ink storage groove 53 or the ink chamber 56 of the record head unit 54 via the ink supply path 51 of a pipe or the like. In this case, the ink 6 is supplied firmly to the ink chamber 56 under the slit 57 or the ink storage groove 53 by setting the interface of ink of the ink tank 52 higher than the positions of the ink chamber 56 and the ink storage groove 53. In this case, the ink supplying means 50 may be constituted integrally with the head unit 54.

Next, an explanation will be given of the constitution of the light irradiating means.

As the light irradiating means 5 according to the present invention, similar to Example 1, a semiconductor laser can be used and laser beam from the light irradiating means 5 is irradiated in the arrow mark 7 direction from the rear face side of the transparent substrate 58 to the position on the photoconductive film 4 in correspondence with a desired picture pixel. Further, the irradiated light reaches the photoconductive film 4 after transmitting through the transparent substrate 58 and the transparent electrode 2. Thereby, the resistance value of only the irradiated desired picture pixel region is lowered on the photoconductive film 4.

Next, an explanation will be given of the constitutions of the opposed electrode 1 and the power source 3.

The opposed electrode 1 comprises a conductive material and is arranged on the opposed face side of the head unit 54 via a clearance of about 0.2 through 1 mm from the slit plate face of the head unit 54. In this case, the side of the opposed electrode 1 is connected to the positive pole of the power source 3 and the side of the transparent electrode 2 in the head unit 54 is connected to the negative pole thereof, respectively, con-

stant voltage is applied between the both electrodes by the power source 3 in printing and electric field is generated at the clearance between the both electrodes.

Next, an explanation will be given of the constitution of an accelerating means 14.

The accelerating means 14 is arranged between the slit plate 8 and the opposed electrode 1. The accelerating means 14 is fabricated by a material having excellent conductivity of aluminum, copper, gold or the like and may be of a condenser fabricated by a set of flat plates, or a member having a shape of a closed tube such as a cylinder or the like may be used.

The speed of the flown ink 12 is accelerated by the accelerating means 14 of the example and further, the amount of energy supplied to the photoconductive film 4 can be reduced by controlling a voltage value applied for flying the ink 6 and the light energy provided from the light irradiating means 5. Further, according to the accelerating means 14, voltage is applied to the accelerating means 14 from the electrode of the power source 3 on the side of the opposed electrode 1 via a resistor in this example. However, application of potential to the accelerating means 14 is not limited thereto but, for example, the potential difference between the transparent electrode 2 and the accelerating means 14 can be made larger than the potential difference between the transparent electrode 2 and the opposed electrode 1. This is determined by the amount of the flown ink 12, a distance between the accelerating means 14 and the surface of the ink 6 or the like.

Further, as shown by Fig. 3, by using a switch function in the opposed electrode 1, the ink 6 can be flown only by the accelerating means 14.

Next, an explanation will be given of the operation as follows.

First, constant high voltage is continuously applied between the transparent electrode 2 and the opposed electrode 1 by the power source 3 by which a state where electric field is generated between both is produced. Further, light is irradiated by the light irradiating means 5 from the rear face side of the transparent substrate 58 toward the position of the slit 57 in correspondence with a desired picture recording portion. Then, light transmits through the transparent substrate 58 and the transparent electrode 2 and is irradiated to the photoconductive film 4.

At this moment, the photoconductive phenomenon is caused and photocurrent is flown at the light irradiated portion inside of the photoconductive film 4. That is, carriers are formed at the irradiated region of the photoconductive film 4 and transferred by the external electric field, as a result, the impedance is lowered and the photocurrent is flown.

Therefore, a state where the ink 6 and the transparent electrode 2 are brought into a conductive state is produced at the irradiated region of the photoconductive film 4 and negative charge is charged locally at inside of the ink 6 having high insulating performance on the

photoconductive film 4. And the ink is attracted to the record medium 10 on the opposed electrode 1 by receiving Coulomb's force by electric field developed between the transparent electrode 2 and the opposed electrode 1, the flown ink 12 is injected from the slit 57 to the side of the opposed electrode 1, further, the flown ink 12 is accelerated by the accelerating means 14 and the flown ink 12 is adhered to the record medium 10 by inserting the record medium 10 between the opposed electrode 1 and the accelerating means 14 from paper feeding means (not illustrated).

Further, after flying ink, a pertinent amount of ink is filled to the flown ink portion by the ink storage groove 53 installed at the vicinity of the slit 57 sufficiently faster than a successive timing of ink injection.

(Example 4)

Fig. 4 is an explanatory view showing a record head of a line shape that is the fourth constitution according to the present invention. Further, Fig. 5 is a disassembled perspective view of the head unit 54 of the record head and Fig. 6 is a perspective view showing the constitution of the record head and its periphery.

First, an explanation will be given of the constitution of the record head in reference to Fig. 4 and Fig. 5.

An explanation will be given of the constitutions of the head unit and the ink supplying means.

Numeral 58 designates the transparent substrate that is longer than the length of the record medium 10 in the width direction (main scanning direction), a light transmitting material of acrylic resin, plastic or the like for transmitting wavelength of light from the light irradiating means 5 arranged on the rear face side of the substrate is used in the transparent substrate 58 and the ink storage groove 53 and the ink chamber 58 (The notation is not indicated in Fig. 4 and Fig. 5 to avoid complication of the drawings. Refer to Fig. 1 through Fig. 3 for details.) are formed by injection molding and the shape of spacer is integrally formed.

Further, the transparent electrode 2 and the photoconductive film 4 are successively laminated on the face of the transparent substrate 58 on the opposed face side by using screen printing or the like.

Further, the slit plate 8 having a slit opening portion of about the width of the record medium 10 is constituted on the opposed face side of the transparent substrate 58 such that a recessed portion where the ink storage groove 53 and the ink chamber 56 are formed, is closed. Thereby, the ink storage groove 53 and the ink chamber 56 are formed as a space hermetically sealed at other than the opening portion of the slit 57.

Further, in respect of the transparent electrode 2, the photoconductive film 4 is not laminated at the right end portion of the transparent substrate 58 in order to form a lead-out portion of the electrode and the transparent electrode 2 is in an exposed state and an electrode line of a flexible substrate 70 or the like is press-

contacted, bonded by conductive bonding or soldered to the portion thereby providing an electrode contact. Further, a gap portion between the transparent substrate 58 and the slit plate 8 produced when the slit plate 8 is attached, is filled with a sealing member 71 or an adhesive agent by which the portion where the transparent electrode 2 is exposed is prevented from being brought into contact with ink.

Further, ink supply holes 60 for flowing ink from the ink supply path 51 into the record head penetrate the bottom portion of the ink storage groove 53 of the transparent substrate 58 to the rear face side. The ink supply holes 60 are provided at two locations on the both ends of the transparent substrate 58 in the longitudinal direction and one of them constitutes a hole for air vent such that bubbles are not stored in the ink storage groove 53 and the ink chamber 56 when ink is injected.

Further, a reinforcing plate 59 is disposed on the rear face side of the transparent substrate 58 and the ink tank 52 is disposed on the rear face side of the reinforcing plate 59. The ink supply paths 51 are provided in the reinforcing plate 59 at positions the same as those of the ink supply holes 60 provided to the transparent substrate 58 and are formed to penetrate projected portions on the rear face side of the reinforcing plate 59. Further, by inserting the projected portions into the ink tank 52, ink in the ink tank 52 is flown through the ink supply paths 51. Further, although an adhesive agent or the like may be filled between the ink supply holes 60 and the ink supply paths 51 and between the ink supply paths 51 and the ink tank 52 such that ink is not leaked when the head is formed, it is preferable to insert sealing members of O rings, oil seals or the like between the respective substrates.

Further, the reinforcing plate 59 is provided simply for reinforcing the transparent substrate 58 and reducing warp thereof and fixing the ink tank 52 provided on the side of the reinforcing plate opposed to the substrate and is not necessarily needed when the above-described points are satisfied by the transparent substrate 58.

Next, an explanation will be given of the constitution of the light irradiating means 5.

As shown by Fig. 6, a polygonal scanner 61 using a semiconductor laser that is the light irradiating means, is disposed on the rear face side of the head unit 54 and laser beam condensed at the slit position of the head unit 54 via a condensing optical system or the like, is irradiated while being scanned in the slit direction.

Next, an explanation will be given of the constitutions of the opposed electrode 1 and the power source 3.

The opposed electrode 1 in a drum shape comprising a conductive material is arranged on the opposed face side of the head unit 54. The drum main body is disposed by maintaining a constant distance from the face of the slit 57 of the head unit 54 such that the drum main body is not brought into contact with the face of

the slit 57 and is pivotable in the clockwise direction, that is, paper feeding direction by a drive system, not illustrated. Further, according to the drum, electric contact is provided by bringing an elastic thin plate electrode in press-contact with the periphery of the drum or the axial end (not illustrated) and the electrode is connected to the power source 3.

Next, an explanation will be given of the constitution of paper feeding means 11 around the record head.

The paper feeding means 11 is constituted by paper supplying means 62 and paper transferring means 63 as shown by Fig. 4.

The paper feeding means 62 is arranged on the upstream side of the paper feeding means 11, the paper feeding means 62 is constituted by a drive roller and a rotatable pinch roller and the pinch roller is brought into press-contact with the drive roller in a rotatable state.

Paper guides 64 comprising an insulating material are arranged around the periphery of the drum of the opposed electrode 1 and guide the record medium 10 transferred by the paper feeding means 62 such that the record medium 10 is transferred along the shape of the drum.

Further, the drum of the opposed electrode 1 is pivoted by a drive system, not illustrated, with a motor speed of which can be controlled such as a pulse motor or a DC servo motor or the like as a drive source via a gear wheel train and a pulley belt drive system and an elastic pinch roller of rubber, urethane or the like is brought into press-contact with the lower end of the drum rotatably. Accordingly, a mechanism for transferring the record medium 10 supplied from the paper feeding means 62 by driving the drum of the opposed electrode 1, is constituted and the portion constitutes the paper transferring means 63.

Next, an explanation will be given of the operation of the record head and the paper feeding means 11 in reference to Fig. 4 and Fig. 6.

First, the record medium 10 is supplied to the side of the opposed electrode 1 by the paper feeding means 62, made to pass through a very small clearance between the drum peripheral face of the opposed electrode 1 and the paper guides and transfer to the paper transferring means 63 along the drum peripheral face of the opposed electrode 1. The front end of the record medium 10 is inserted between the opposed electrode 1 and the pinch roller and heading of record position is carried out by detecting position by using an edge sensor or the like and the transfer of the record medium 10 is once stopped.

Thereafter, by continuously applying a constant voltage value set by the power source 3 between the transparent electrode 2 and the opposed electrode 1, a state where electric field is generated between both, is produced. Further, light is irradiated from the rear face side toward the slit position of the head unit 54 by the polygonal scanner 61 that is the light irradiating means in correspondence with a desired is the light irradiating

means in correspondence with a desired picture pattern.

Light incident on the head unit 54 transmits through the transparent substrate 58 and the transparent electrode 2 and is irradiated to the photoconductive film 4. At this occasion, the photoconductive phenomenon is caused in the photoconductive film 4 at the light irradiated portion, photocurrent is flown, a state where the ink 6 and the transparent electrode 2 are brought into a conductive state is produced at the irradiated region and negative charge is charged locally at inside of the ink 6 having high insulating performance on the photoconductive film 4. Further, by electric field developed between the transparent electrode 2 and the opposed electrode 1, the ink is flown and adhered to the record medium 10 on the opposed electrode 1 by receiving Coulomb's force.

After flying ink, a pertinent amount of ink is filled to the flown portion of the ink chamber 56 by the ink storage groove 53 provided at the vicinity of the slit 57 sufficiently faster than a successive timing of ink injection.

When the operation is repeated in the main scanning direction by the polygonal scanner 61 and 1 line of main scan is finished, the record medium 10 is transferred to a second line by driving the paper transferring means 63, that is, the drum of the opposed electrode 1 in the sub scanning direction by a dot pitch having necessary resolution.

By successively repeating the recording in the main scanning direction and the transferring the record medium 10 in the sub scanning direction, two-dimensional recording is carried out on the record medium 10.

Although as described above, according to examples 1 through 4, an explanation has been given of examples where the ink storage groove is disposed on the upper side of the slit in the direction of the face of the substrate, the ink storage groove may naturally be disposed on the lower side of the slit or both on the upper and the lower sides. The ink storage groove may be formed such that the portion of the slit is avoided, that is, at a position not blocking light from the light irradiating means.

(Example 5)

Fig. 7 is an explanatory view showing the sixth constitution of a record head 71 according to the present invention.

In Fig. 7, four of the record heads 71 each in a line shape in correspondence with the width of print of the record medium 10 as shown by Example 6, are laminated vertically and inks 6 of yellow (Y), magenta (M), cyan (C) and black (Bk) are supplied from the upper portions of the respective record heads 71 to the record heads 71. As procedure of recording, a state where high voltage is applied between the individual transparent electrodes 2 and the opposed electrode 1 is produced, light is irradiated in an arrow mark 7 direction from the side of the transparent electrode 2 of the yellow ink record

head 71 to the photoconductive film 4 by the light irradiating means 5, the resistance value of the photoconductive film 4 at the irradiated region is lowered and photocurrent is flown. Thereafter, a state where the ink 6 and the transparent electrode 2 are brought into a conductive state is produced at the irradiated region of the photoconductive film 4, electric charge is charged inside of the yellow ink on the photoconductive film 4, the yellow ink is flown toward the side of the opposed electrode 1 by receiving Coulomb's force, the flown yellow ink is moved, permeated and adhered to the record medium 10 on the opposed electrode 1 and accordingly, a desired pixel of yellow ink is provided on the record medium 10 in 1 line region. Next, the yellow ink record unit is moved in an arrow mark 17 direction and the desired pixel of magenta ink is provided on the record medium 10 in 1 line region by the magenta ink record head 71 through above-described recording procedure. Next, the magenta ink record head 71 is moved in the arrow mark 17 direction, a desired pixel of cyan ink is provided on the record medium 10 in 1 line region by the cyan ink record head 71 through the above-described recording procedure. Next, the cyan ink record head 71 is moved in the arrow mark 17 direction, the desired pixel of black ink is provided on the record medium 10 in 1 line region by the black ink record head 71 through the above-described recording procedure. Thereafter, the record medium 10 is moved in a 1 line arrow mark 19 direction by paper feeding means, not illustrated, the four record heads 71 are driven in an arrow mark 18 direction back to the home positions, the above-described procedure is repeated and the desired color pixels for each picture is provided on the record medium 10.

Although according to the embodiment, the inks 6 are constituted by 4 kinds, by increasing the number of the record heads 71 and supplying individually the inks 6 of multiple colors, highly fine output print or picture of full color with no restriction in the color of print is provided.

Further, although according to the example, an explanation has been given of a system where the record heads 71 of the present invention are driven at every time of transcribing the respective colors of YMCBk onto the record medium 10, by providing a structure of simultaneously making access to the respective pixel information of YMCBk in the light irradiating means 5, the record pixel information of the respective colors of YMCBk can naturally be irradiated onto the photoconductive film 4 simultaneously.

Although according to the example 5, an explanation has been given of the structure of the record head 71 in a line shape the present invention is not limited thereto but, for example, a plurality of serial heads may be arranged and the main scanning direction may be controlled respectively and independently from each other.

An explanation will be given of the operation of the record device when each of the record heads 71 com-

prising the constitutions of Examples 1 through 5 is used in reference to a block diagram shown by Fig. 8.

Fig. 8 is an explanatory view showing the constitution of the record device using each of the record heads 71 described in the first through the fifth examples of the present invention. In Fig. 8, a record device 30 inputs picture data 29 from an outside device 28, picture modifying processing or pattern recognition is carried out at a picture processing circuit 25, data transformation is carried out for each pixel and picture pixel data 31 is outputted. The picture pixel data 31 is transferred to inside of a record unit 24 in synchronism with a trigger signal 36 from a controller 26 and a flown ink 32 in correspondence with the picture pixel data 31 is adhered and transcribed from the record unit 24 to the record paper 10 that is the record medium. At this moment, synchronization of the flown ink 32 and the record paper 10 is carried out by outputting a control signal 33 from the controller 26 to paper feeding means 11. Further, a voltage value 34 in the record unit 24 is set to a power source unit 27 from the controller 26 and voltage 35 is supplied from the power source unit 27 to the record unit 24. Further, an output of a light control signal 37 of a light source irradiation light intensity and an irradiated pulse width in the record unit 24 or a drive processing signal 38 of an optical part or the like is controlled by the controller 26 whereby dots formed on the record paper 10 are controlled. By carrying out the above-described procedure, the record unit 24 of the present invention, as the record device 30, can perform highly fine 'printing with high quality at high speed and can provide output print in a noncontact state without selecting the shape of the record medium.

As has been explained, according to the present invention, in a record head having a transparent electrode formed on a substrate, a photoconductive film formed on the transparent electrode, means for supplying ink on the photoconductive film, a slit plate provided with a slit for 'controlling injection of ink and an opposed electrode in this order, the slit plate and the opposed electrode being arranged with a sufficient gap therebetween for incorporating a record medium and at least having a power source applying voltage between the transparent electrode and the opposed electrode and light irradiating means for irradiating light in correspondence with a desired pixel to the photoconductive film, an ink storage groove for temporarily storing ink on the substrate is formed along the longitudinal direction of the slit, the ink storage groove is disposed at inside of an ink chamber formed between the substrate and the slit plate and is disposed on the upper side, or the lower side, the both sides of the slit in the direction of the face of the substrate and accordingly, the following effects are achieved.

(1) A sufficient amount of ink can be supplied at high speed to the slit portion after flying ink in printing and accordingly, the drive frequency of the record head can be accelerated. That is, the record speed as the device

can be accelerated. Further, thereby, the discharge phenomenon between the opposed electrode and the slit which may occur by deficiency in supplying ink can be avoided.

(2) The ink injecting portion of the record head is provided with a slit shape and accordingly, different from a record head having a conventional nozzle shape, ink is communicated in one channel by the ink chamber and the ink storage groove and accordingly, ink is brought into the state of being difficult to dry. Further, the ink supply groove is provided at the vicinity of the slit portion in the record head and therefore, ink is filled always sufficiently in the slit portion. Therefore, ink clogging of the slit portion caused by evaporation or solidification of ink is difficult to occur and stable high quality recording can be performed.

(3) Regardless of the amount of ink in the ink tank, a constant amount of ink is stored always in the ink storage groove and therefore, a necessary amount of ink can be supplied stably to the slit portion by which stable recording can be performed.

(4) The ink supply amount is increased by deepening the groove in the depth direction according to the ink supply groove in the record head and therefore, the ink chamber is not expanded in the direction of the plane of the substrate, the head can be constituted while saving space and particularly in forming the device such that colors can be constituted by arranging the record heads of the respective colors, the device can be downsized.

Further, when a member having very fine pores whereby ink can be communicated to the ink storage groove is provided in the record head, the following effects are achieved in addition to the above-described effects.

(5) A proper supply amount of ink can be controlled by flow resistance which ink receives in passing through the member.

(6) Impurities in ink at very fine pores can be removed by passing the ink through the member by which the discharge phenomenon caused by clogging of ink at the slit or the ink path or by mixing impurities can be prevented.

The foregoing description has been given by way of example only and it will be appreciated by a person skilled in the art that modifications can be made without departing from the scope of the present invention.

Claims

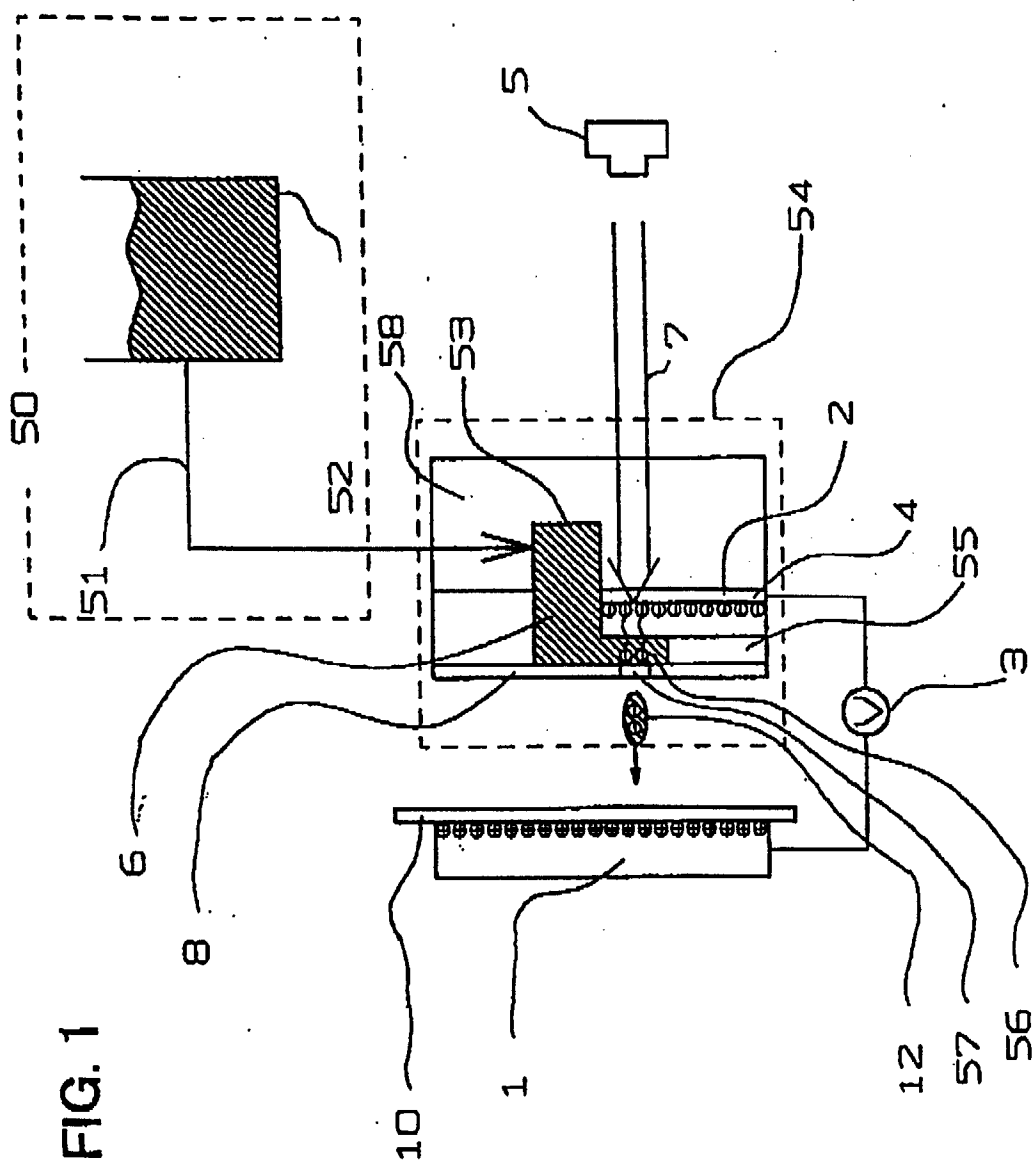
1. A record head having a transparent electrode formed on a substrate, a photoconductive film formed on the transparent electrode, means for supplying ink on the photoconductive film, a slit plate having a slit or slot for controlling ejection of the ink and an opposed electrode, the slit plate and the opposed electrode being arranged with a gap therebetween sufficient for receiving a recording

medium, and having a power source for applying a voltage between the transparent electrode and the opposed electrode and light irradiating means for irradiating light on to the photoconductive film in correspondence with a desired pixel:

wherein an ink storage groove for temporarily storing ink is formed on the substrate along a longitudinal direction of the slit, the ink storage groove being disposed in an ink chamber formed between the substrate and the slit plate and disposed at an upper side or a lower side or both sides of the slit in a direction of a plane of the substrate.

2. The record head according to claim 1, wherein a member having ink communicable fine pores is installed inside the ink storage groove.
3. The record head according to claim 1 or 2, wherein accelerating means for accelerating the ink is provided between the slit plate and the opposed electrode.
4. The record head according to any one of claims 1 to 3, wherein the record head is provided with a line shape in correspondence with a print width of the recording medium.
5. A record head, wherein a plurality of the record heads according to any one of claims 1 to 4 are used, including means for supplying inks having different colours to the respective record heads and pixels having a plurality of colours formed by the inks having different colours are adhered to the recording medium.
6. A record head having a transparent electrode formed on a substrate, a photoconductive film formed on the transparent electrode, means for supplying ink on the photoconductive film, a slit plate having a slit or slot for controlling ejection of the ink and an opposed electrode, the slit plate and the opposed electrode being arranged with a gap therebetween sufficient for receiving a recording medium, and having a power source for applying a voltage between the transparent electrode and the opposed electrode and light irradiating means for supplying light on to the photoconductive film in a form of a pulse and in correspondence with a desired pixel.

FIG. 1



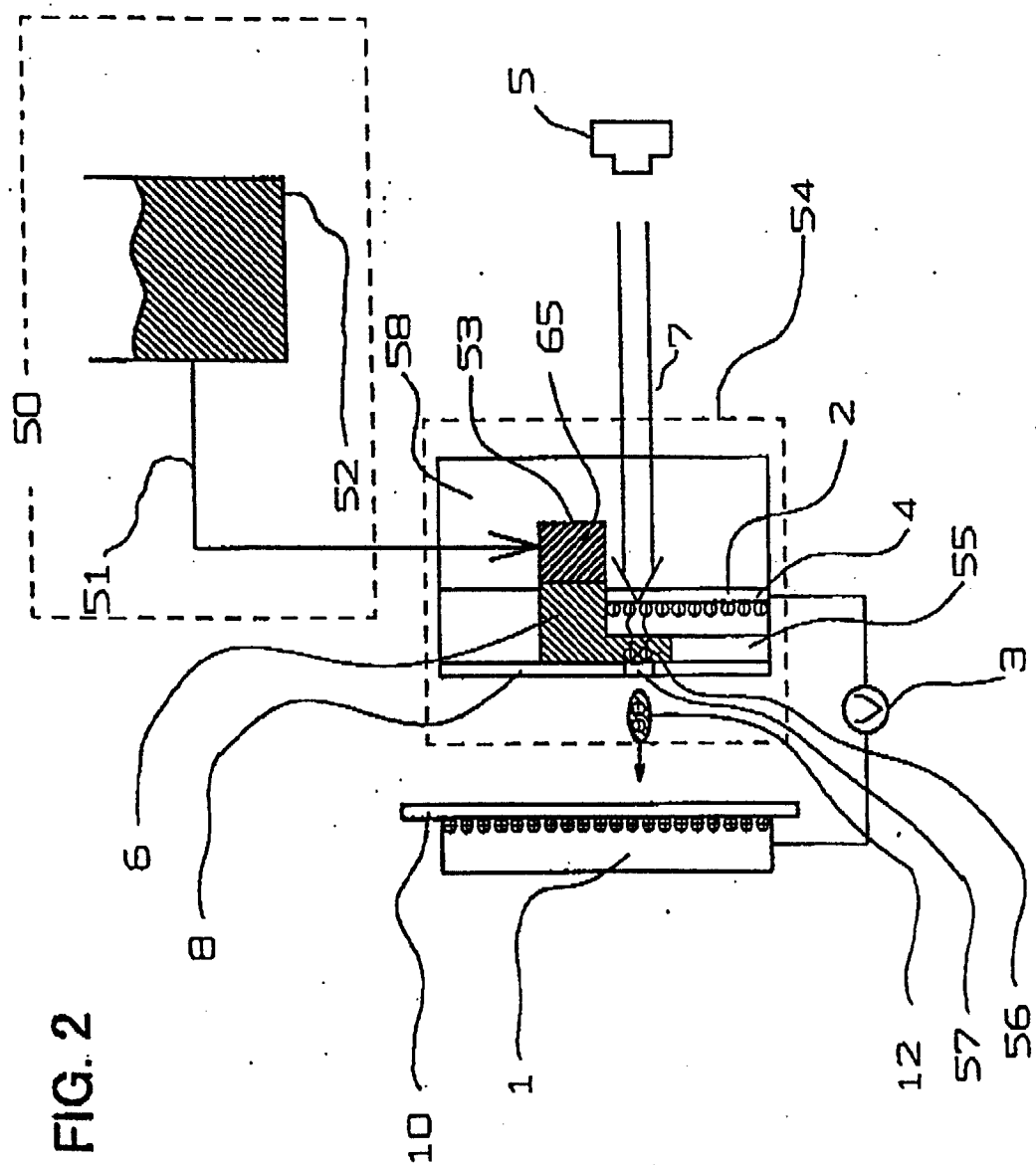


FIG. 3

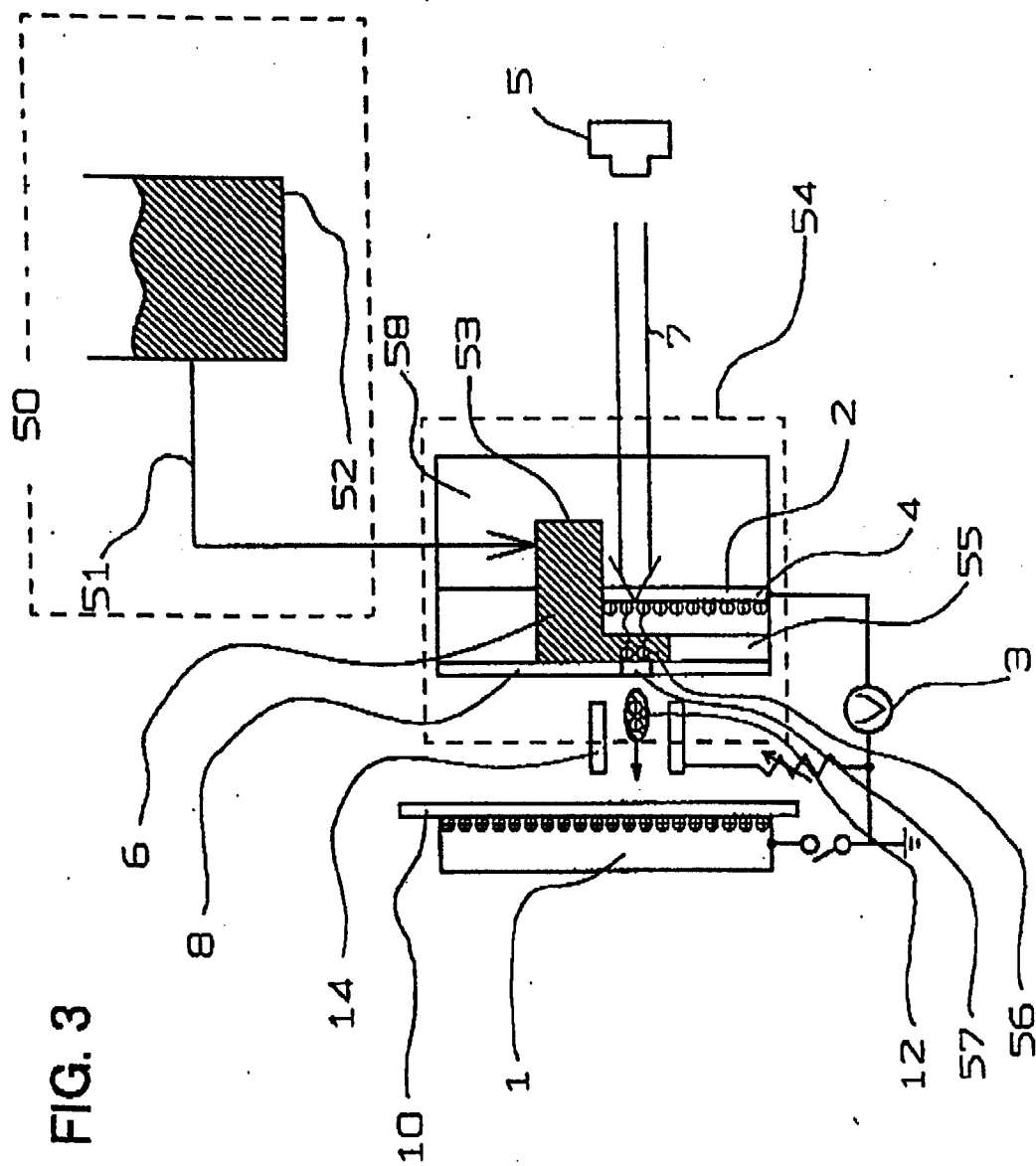


FIG. 4

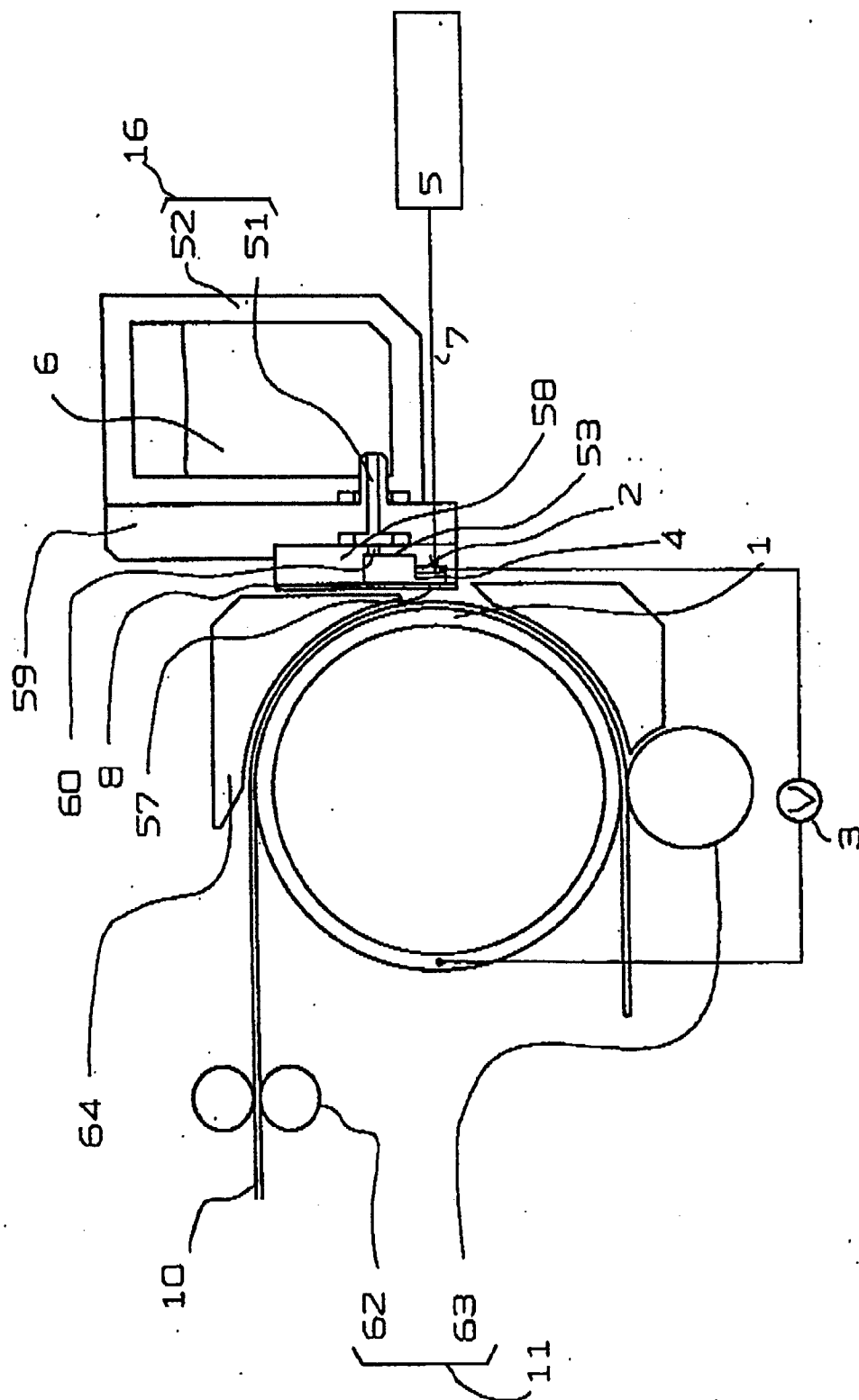
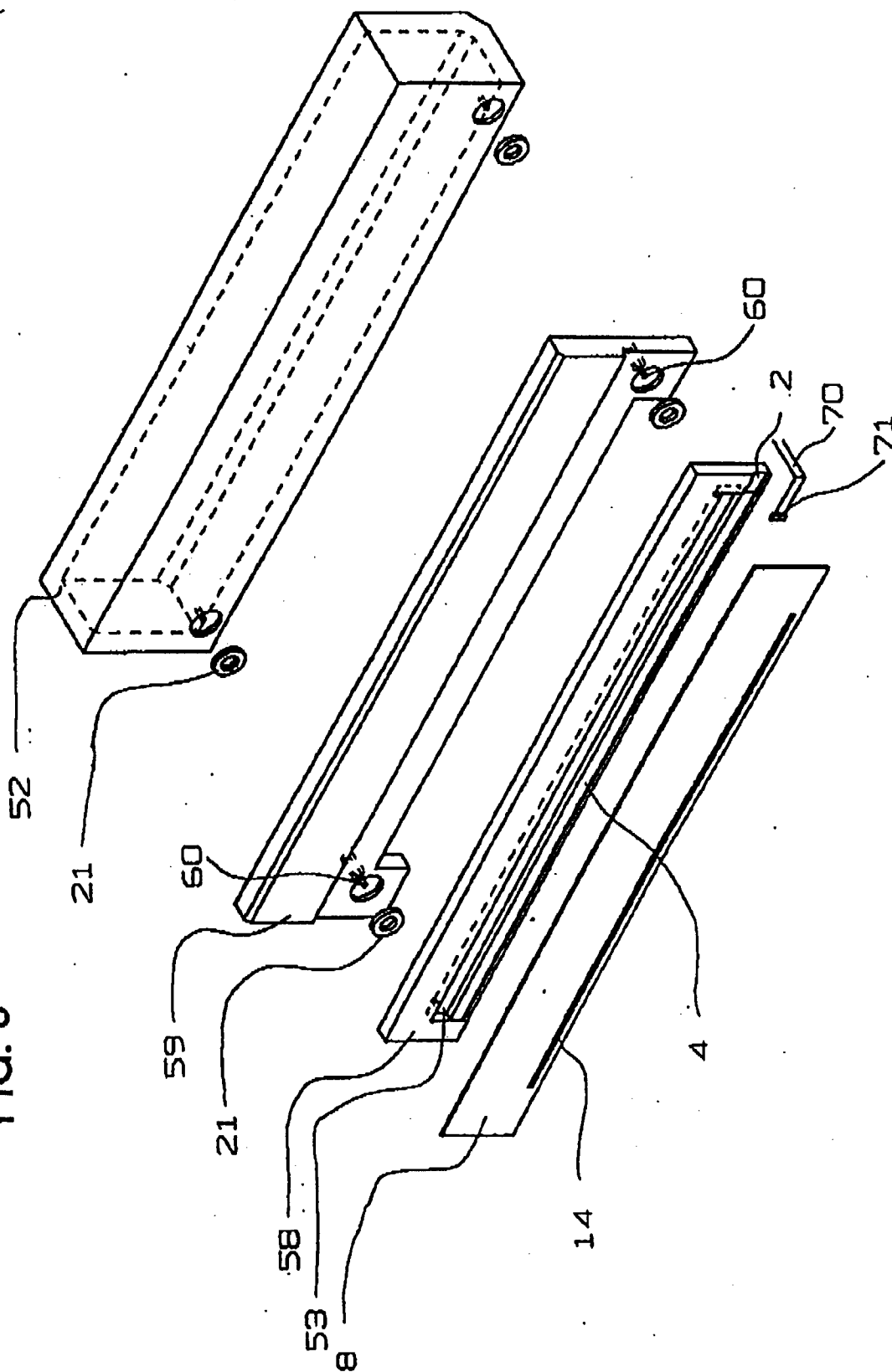


FIG. 5



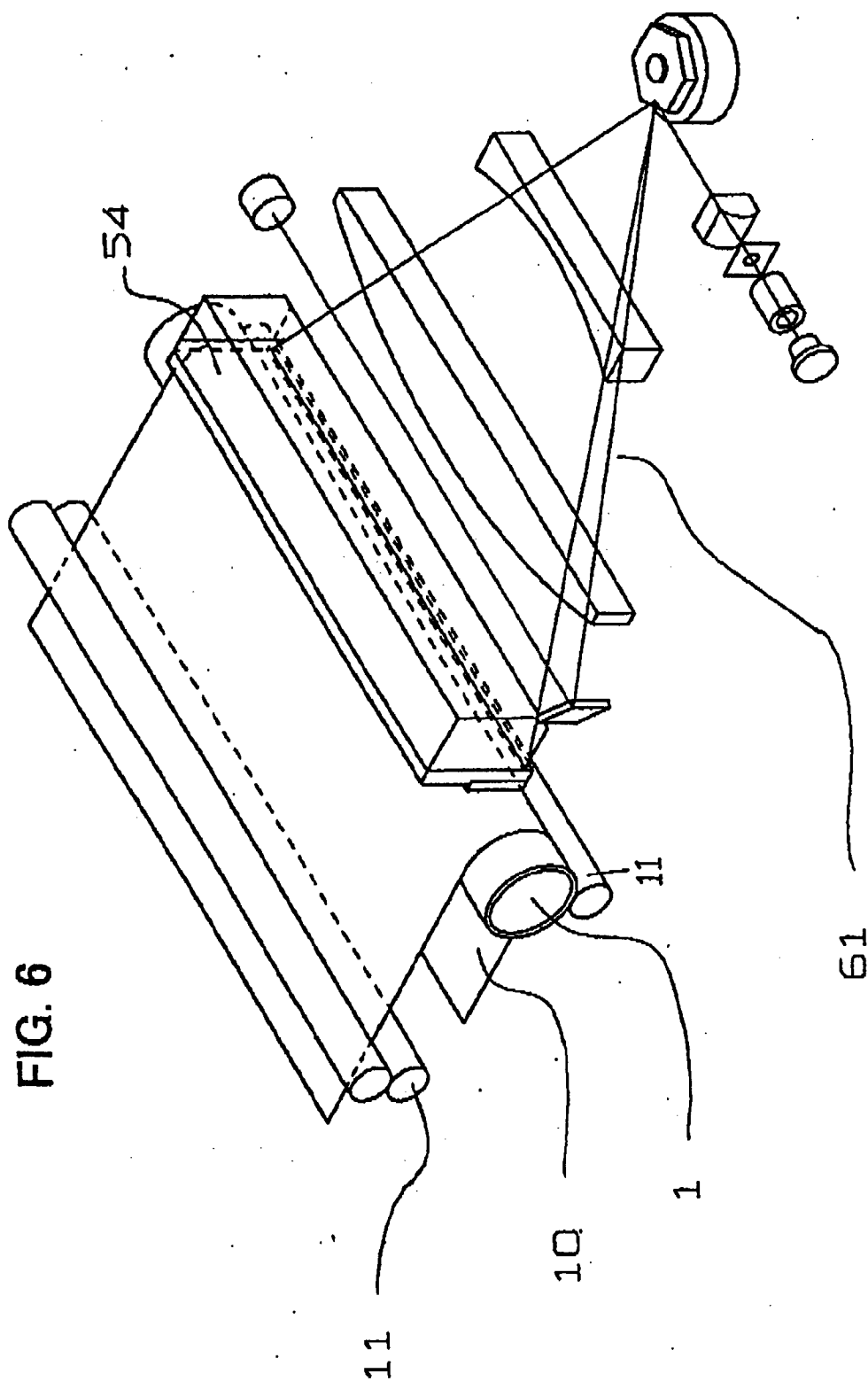


FIG. 7

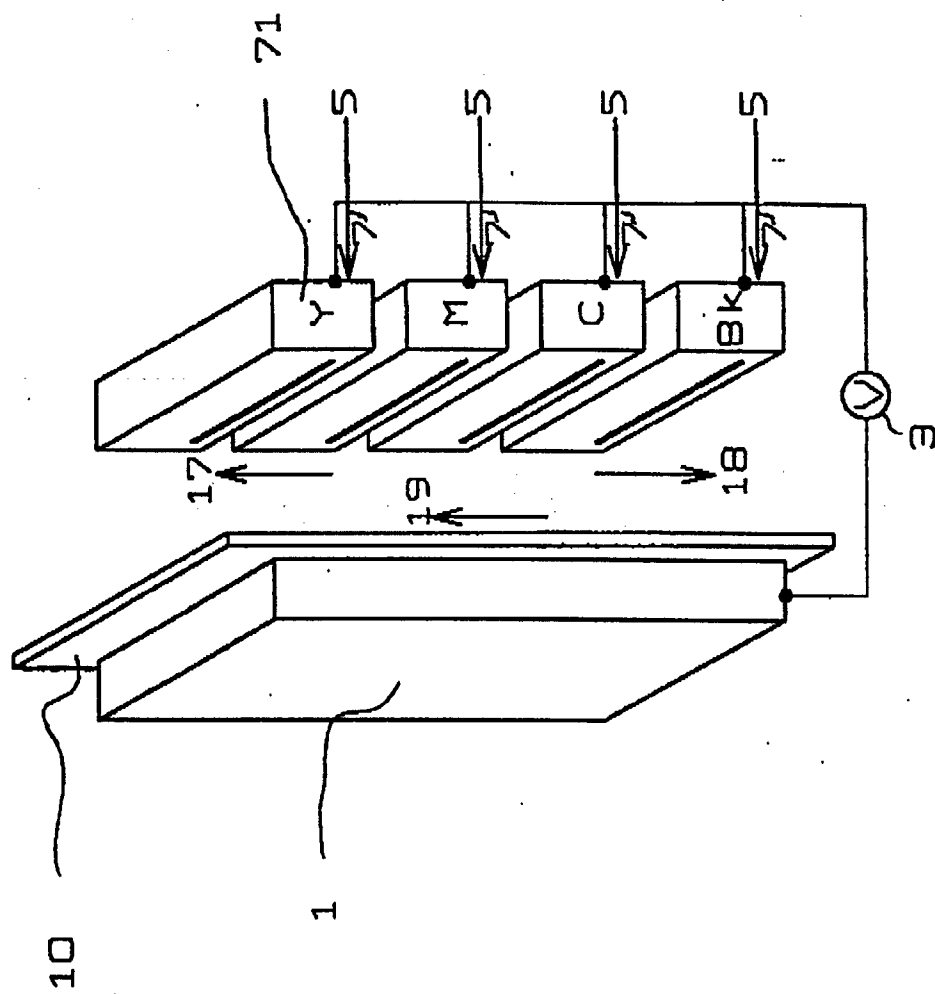


FIG. 8

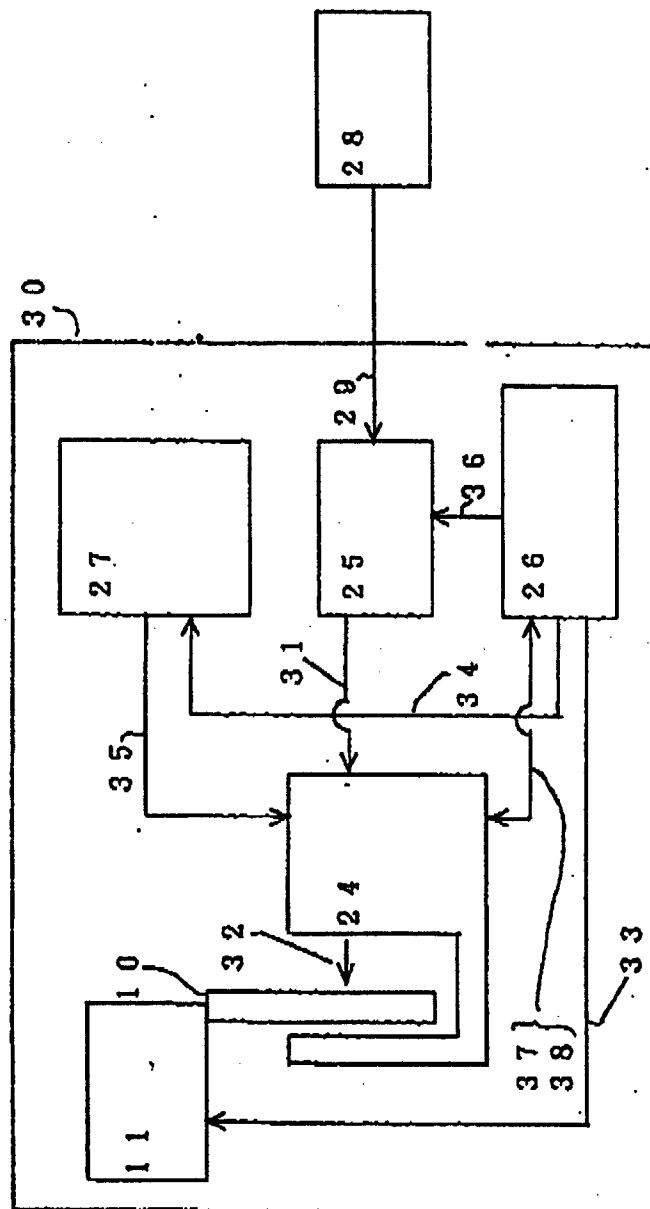


FIG. 9

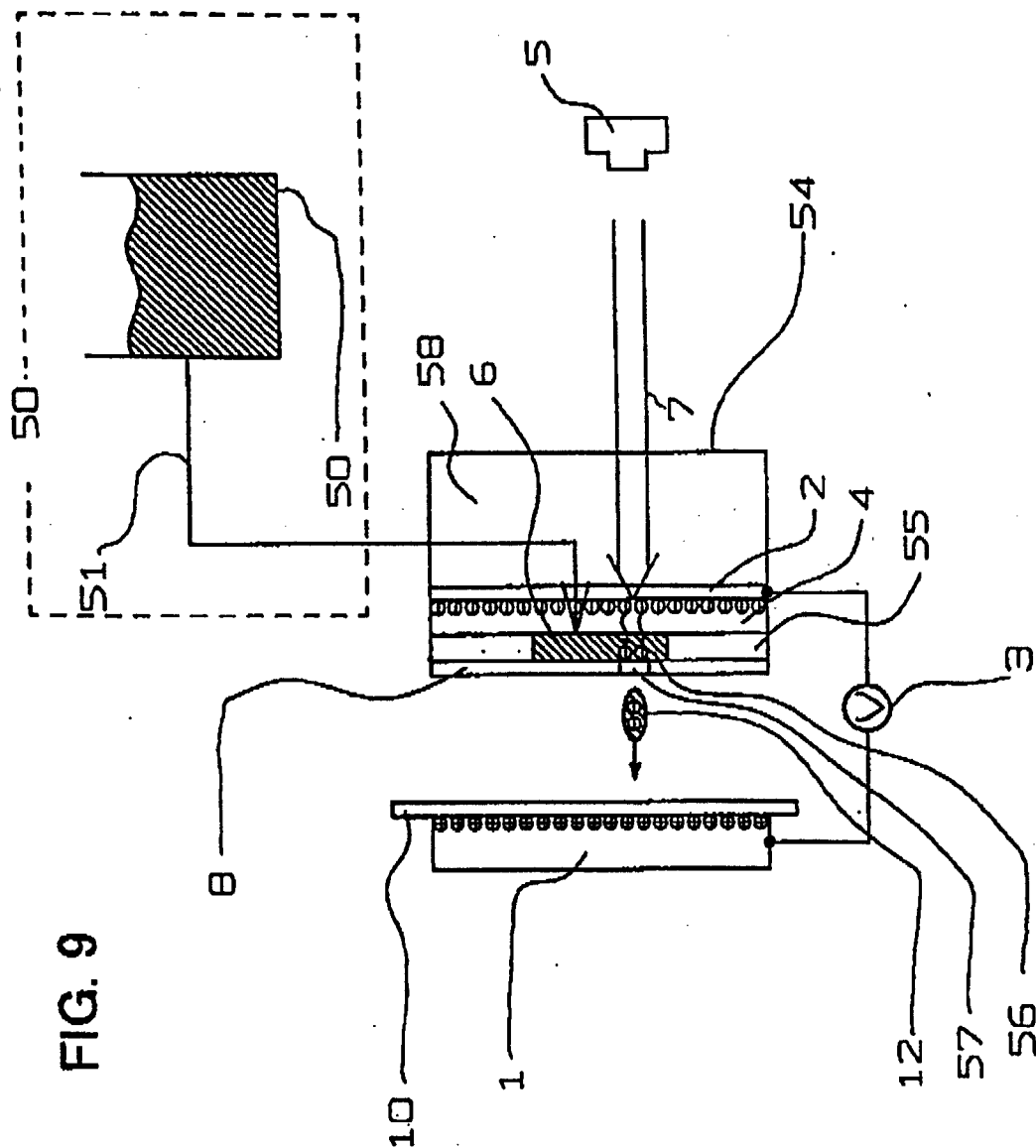


FIG. 10 PRIOR ART

