United States Patent

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[45] Patented **July 27, 1971**

[54] **FACSIMILE PRINTER-ENLARGER UTILIZING A DISPLACEABLE MARKING STREAM**
19 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** ..... **178/6.6 R,** 137/455, 340/15, 346/1, 346/75
[51] **Int. Cl.** **G01d 15/18,** H04n 1/24
[50] **Field of Search** ..... 346/1, 75; 178/6.6 A, 6.6, 6.6 R

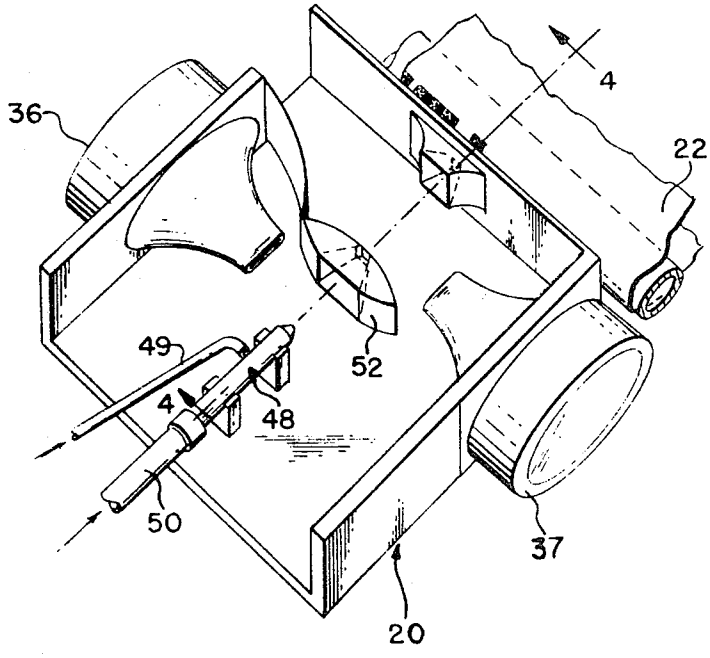
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ABSTRACT: A facsimile printer-enlarger comprising an optical-mechanical scanning system by which light patterns reflected off a graphic original are scanned line by line by a photocell which converts them into electrical signals. The signals are amplified and control two air-pulse generators that are situated upstream and downstream of a fulcrum nozzle through which a stream of marking ink is directed. An air pulse from the upstream generator deflects the ink stream a small amount which deflection is greatly increased downstream due to the leverage action of the nozzle. The downstream air-pulse generator assists in the deflection. A printout is established as the ink stream strikes a recording surface. The printout is enlarged either by optically increasing the size of the reflected light patterns, mechanically enlarging the scanning ratio of the photocell and printout, or both. In a modified form the downstream air-pulse generator may be a constant airstream to act as a biasing force. In a second modified form either pulse generator may utilize a constant airstream that is modulated in accordance to the signals received. In still another form the pulse generators are staged for recording enlargements or for general fluid-amplification applications. A method of making an enlarged facsimile is also disclosed.



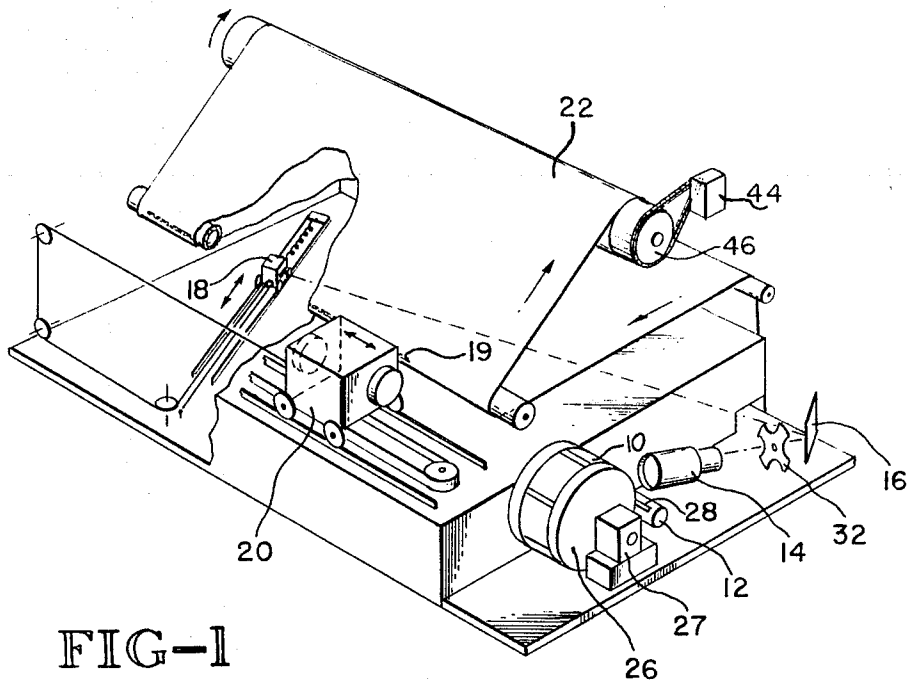


FIG-1

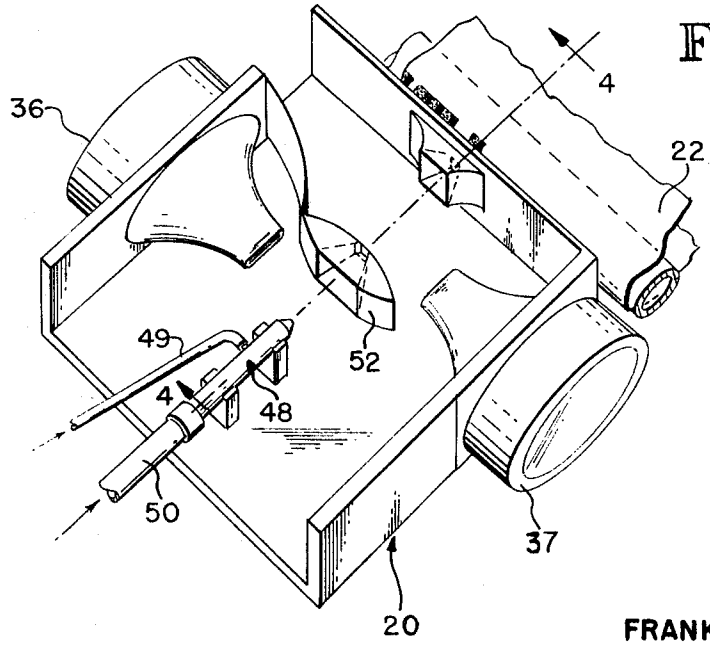
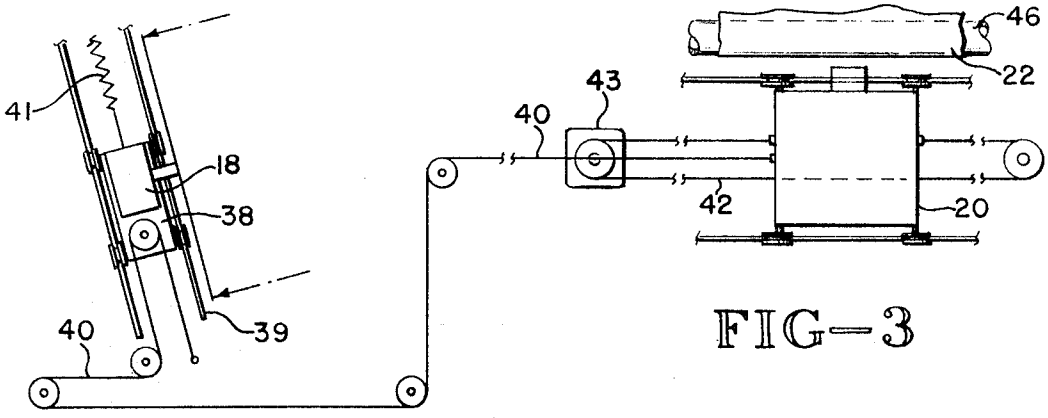
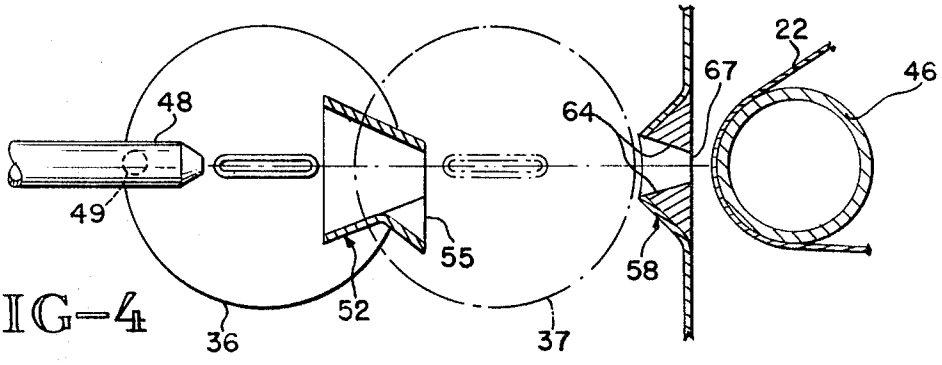


FIG-2

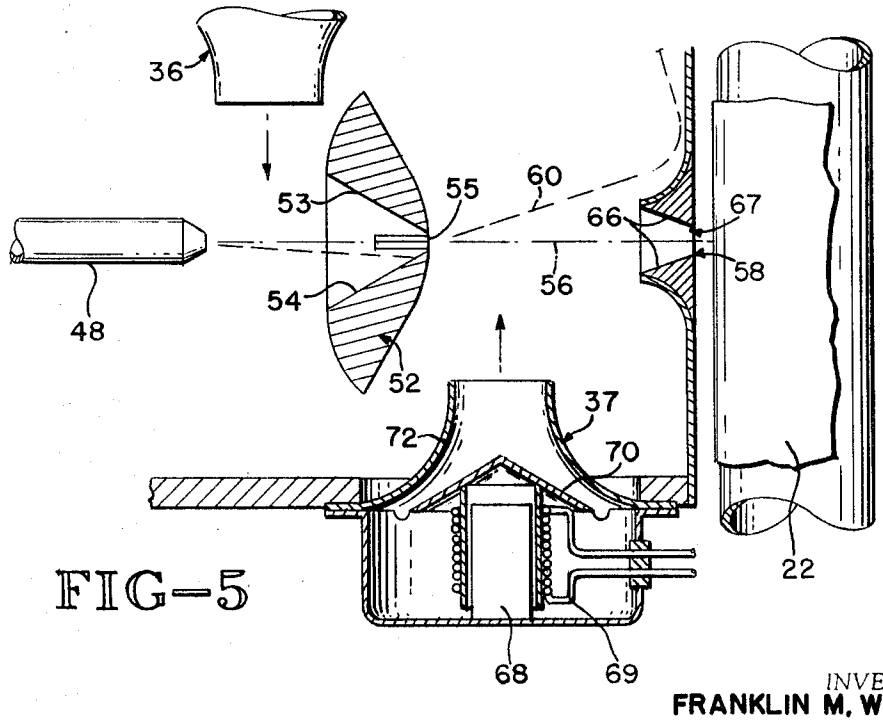
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FIG—3



FIG—4



FIG—5

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FIG-6A

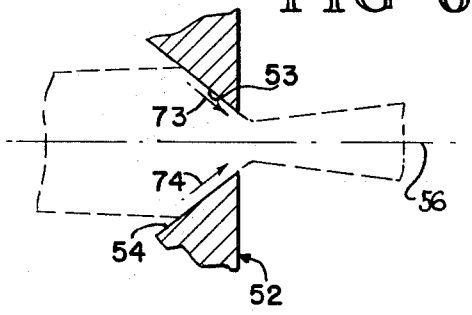


FIG-6B

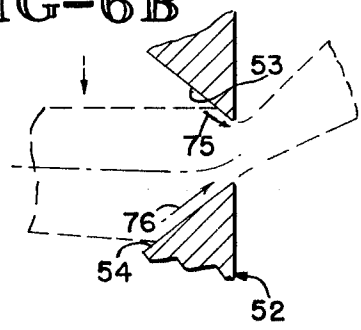


FIG-7

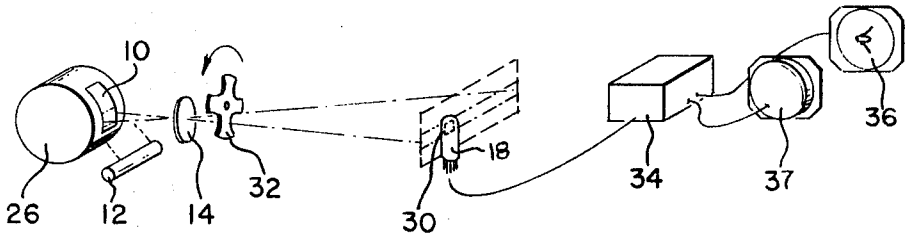


FIG-8

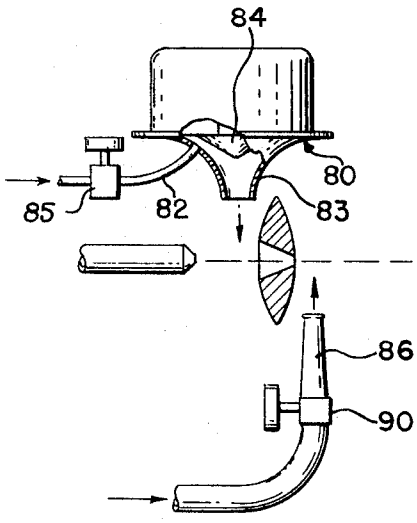
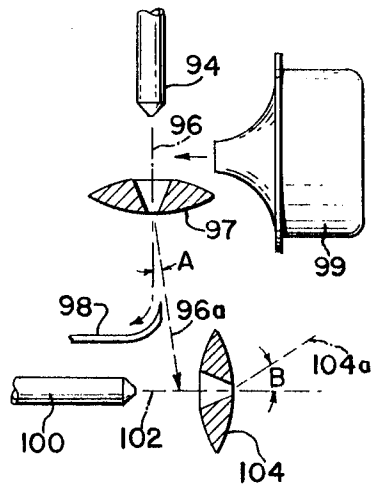


FIG-9



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FACSIMILE PRINTER-ENLARGER UTILIZING A DISPLACEABLE MARKING STREAM

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to method and apparatus for making a record and, more particularly, for making a record which is an enlargement of a graphic original. In addition, the invention relates broadly to fluid-amplification techniques.

2. Description of the Prior Art

One recording system heretofore known is shown in the U.S. Pat. to Ranger No. 1,841,452. In this patent a system is shown whereby a constant blocking fluid intercepts an ink stream that is directed at a moving recording surface. The path of the blocking fluid is altered by electrostatic means generally requiring high-voltage potential, however, the breakdown potential of air is a limiting factor on the magnitude of the voltage.

Another form of device for recording by the use of ink is shown in the U.S. Pat. to Hansell No. 1,941,001. In this patent the individual ink droplets are directly acted on by electrostatic potential to vary their direction and thus their position on the recording surface. Electrical voltage to do this also has been limited to small values. In addition, an undesirable electrical charge or impression is left on the ink particles which limits their value as a recording medium.

Still another form of device is shown in the U.S. Pat. to Kazan No. 3,287,734. In this patent ink containing within it magnetic particles is formed into a fine stream. The stream is deflected by two separate magnetic fields acting on individualized droplets of the stream. The first field magnetically polarizes the droplets and the second field deflects the Droplets. Such a system has several disadvantages. For example, magnetic particles are expensive and may limit the range of coloring available as a marking stream. In addition, the droplets have a magnetic imprint left on them that may limit their usefulness. Still further considerable magnetic energy is believed necessary to produce a substantial deflection of sufficient mass of droplets to be effective as a facsimile enlarger.

SUMMARY OF THE INVENTION

The invention relates to a method and apparatus for recording and particularly for recording an enlarged facsimile. An advantageous feature is that the printout produced is highly responsive to the information signals being recorded. A basic concept is the conversion of intelligence information to motive pulses to provide a modulating force which by acting in conjunction with an amplifying device deflects an energy stream from its target. In the preferred form the energy stream is a marking stream which when deflected effects a selective deposition of marking fluid on the recording surface. The preferred amplifying device employs a fulcrum force having a component perpendicular to the direction or central axis of the marking stream. The direction of the marking stream downstream of the point of contact of the fulcrum force is along the resultant of the original momentum force of the marking stream and the perpendicular component of the fulcrum force. By a slight shift in the upstream direction of the marking stream, the perpendicular component of the fulcrum force will produce a leverage action such that a substantial deflection of the marking stream occurs downstream of the point of contact of the fulcrum force. As may be readily seen the high energy of the marking stream is advantageously employed to assist in the deflection so that a much less powerful deflecting motive force may be used to control the direction of the marking stream.

Preferably the fulcrum force includes two oppositely directed perpendicular components contacting the high-energy marking stream simultaneously.

In the preferred form the leverage action is reinforced by directing a second deflecting motive force against the marking stream at a point downstream of the focusing force and in a direction opposite to the first deflecting motive force. In the preferred form the deflecting motive forces are in the form of fluid pulses the intensities of which are determined by the magnitude of electrical signals. The electrical signals are, in turn, proportional to the graphic information being recorded.

In a modified form the reinforcing movement or downstream deflecting force is caused by a constant motive force. The constant motive force advantageously acts against the stream to reduce dispersion of the marking particles making up the stream, concentrates the marking particles around the central axis of the stream, and also serves as a constant bias against which the marking stream is balanced.

In other forms the deflecting motive forces are constant fluid streams of the intensities of which determine the magnitude of the deflection of the marking stream. These fluid streams are modulated by electrical signals that are converted by a photocell from light signals reflected from an original graphic image to be enlarged. Both mechanical and optical enlargement of the image is obtained or in the alternative the enlargement may be either all optical or all mechanical. The optical enlargement is accomplished by suitable lenses and the mechanical enlargement is obtained by using suitable ratios between the scanning distance of the photocell and the length of the printout.

An advantageous feature is that small signals control the direction of a marking stream of a much larger mass so that a facsimile of greater than 4 by 6 feet, for example, is possible. The facsimile may also be purposely distorted to produce various visual effects merely by changing the mechanical enlargement.

The control principles are also applicable in a broader sense to energy stream deflection in general and to the principle of staging either for facsimile enlargement or for general application. Basically this staging feature employs a first high-energy stream that passes through a nozzle and is deflected by a low-energy pulse. The deflected stream then acts as a deflecting motive force for deflecting a still higher energy stream. The result is greatly increased amplification that is proportional to an original information signal.

The recording apparatus is quite inexpensive to manufacture and is extremely sensitive, that is, responsive to the electrical signals, to enable accurate reproduction of the information being recorded. The device modulates the marking stream without the insertion of moving parts into the stream, provides a self-cleaning design utilizing low voltages, and modulates the marking stream without regard to or alteration of the mechanical, magnetic, chemical, electrical or electrostatic properties of the marking stream. Therefore, there is no change affected on any of the properties of the marking stream to limit their usefulness as a recording medium.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a schematic isometric of a facsimile enlarger embodying the principles of the invention.

FIG. 2 is a schematic isometric of the printing-head components shown in the embodiment of FIG. 1.

FIG. 3 is a schematic illustration of the components of FIG. 1 indicating the mechanical enlargement feature of the invention.

FIG. 4 is a schematic vertical section looking generally in the direction of the arrows 4–4 of FIG. 2.

FIG. 5 is a schematic plan partly in section of the printing head shown in FIG. 2.

FIG. 6A is a diagrammatic illustration of the marking stream in a normal marking position.

FIG. 6B is a schematic illustration similar to FIG. 6A but showing the marking stream in the deflected state and the condition of the forces acting on the marking stream to cause the deflection.

FIG. 7 is a schematic illustration of a slightly modified form of optical-enlarging arrangement but which teaches the principles similarly employed in the preferred form of the invention.

FIG. 8 is a modified form of printing head indicating downstream a constant deflecting motive force and upstream a constant deflecting motive force modulated in accordance with signals received.

FIG. 9 is a schematic illustration of an arrangement of the components when used as a fluidic amplifier staging device.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The apparatus for producing an enlarged facsimile is best illustrated in FIG. 1 and includes an original **10** having a graphic image which reflects light from a bulb **12**. The reflected light passes through a lens **14** thence from a mirror **16** to a photocell **18**. The photocell moves in a manner to scan an entire line of the original. A printer **20** produces a line **19** across a recording sheet **22** and is mechanically linked to the photocell for movement therewith preferably at a 2:1 ratio. Thus an enlargement takes place optically through the lens **14**, or mechanically through the linkage between the photocell and the printer, or both mechanically and optically. As the photocell and printer complete a line the original **10** and recording sheet **22** are indexed to the next line and the printer and photocell move in the reverse directions to record another line. The printout line is produced by a stream of ink emitted from the printer the intensity of which at any instantaneous time depends upon the amount of light reflected from the original **10**.

The original **10** containing graphic information, such as a photograph which is to be enlarged and reproduced, is mounted on a drum **26** that is rotated by a conventional intermittently operated motor **27** to advance the original a predetermined increment. This increment is determined by dividing the height or vertical width of the printout line **19** on the recording sheet **22** by the desired enlargement ratio as established by the optical or mechanical enlargement arrangement. As used hereinafter the width of the printout or graphic original line will mean the vertical height of the line whereas the length of the line will mean its dimension from one end to the other.

The light source or bulb **12** is, in the preferred embodiment, a linear filament bulb covered by a conventional mask having a narrow slit **28**. The bulb thus generates a narrow strip of light that evenly illuminates a line of information on the original parallel to the axis of rotation of the drum. A narrow strip of light generated is used primarily to reduce heating effects on the original and not to establish a scan line width. Consequently, other forms of illuminating devices may be employed with the scanning width determined at a later stage (e.g. at the photocell) rather than by the light source. The overall dimensions of the strip of light reaching the photocell are dependent upon the shape of the lens **14** and the distance between the original **10** and the lens and the photocell. It should be apparent that an optical enlargement will take place dependent upon this positioning.

The strip of light reflected from the original is projected by the lens **14** to the photocell **18** via the mirror **16**. The photocell **18** is provided with a mask having a square masking aperture **30** (FIG. 7) having a vertical dimension equal to some increment of the width of the printout line **19** on the recording sheet **22**. In the preferred embodiment this vertical dimension is equal to one-half the printout line width; however, other multiples may be used as dictated by mechanical enlargement ratio. For example, to produce a printout line width of one-eighth inch the masking aperture is one-sixteenth inch high. As thus far described the reflected light arriving at the photocell is a constant beam varying in intensity along its length in direct relation to the light and dark areas of the graphic original.

In order to convert this constant beam into usable form, such as to produce alternating current signals, an interrupter in the form of a rotating chopping wheel **32** is inserted in the path of the reflected light. The chopping wheel is rotated at a regular frequency in a conventional manner. By controlling the frequency the electrical signals thus generated by the photocell **18** an amplitude modulated audiofrequency signal is produced suitable to control the printer **20**. Other interruption techniques, such as by using a frequency controlled, intermittent light source **12**, may also be employed. The electrical signals generated by the photocell are passed through an amplifier **34** (FIG. 7) which in turn controls two air-pulse or sound-wave generators **36** and **37** to be later described. FIG. 7 shows an enlarging system basically identical to that of FIG. 1. The former varies from that shown in FIG. 1 only in the absence of the mirror **16** from the optical system which is employed primarily to make the apparatus of the preferred embodiment more compact.

As is best shown in FIGS. 1, 3 and 7 the photocell **18** is mounted on a carriage **38** that moves along the focal plane of the lens in a position to receive light from the lens **14**. The carriage moves in a track **39** and is pulled by a pulley-cable system **40** that is connected between the carriage and the printer **20**. A spring **41** biases the carriage in one direction. A second cable and pulley system **42** is connected to the printer **20** and to a reversible electric motor **43**. As is well known in the art, movement of the printer **20** will produce a corresponding movement of the photocell carriage **20** and by proper arrangement any desired ratio of movement between the two can be established. In the preferred embodiment the cable-pulley systems illustrated produce a 1:2 ratio between the photocell carriage **38** and the printer **20** such that the printer will travel twice the distance traveled by the photocell carriage for each scan of the photocell across the focal plane of the lens **14**. With such a mechanical enlargement and with the magnification of the lens **14**, enlargements on the order of 1:24 may be accomplished with apparatus of minimum size and bulk and without requiring a high degree of optical or mechanical precision. In addition, if intentional distortion of the recorded image is desired, such as to produce a wide-angle affect or the like, this may be easily arranged by increasing the mechanical ratio, for example.

After a printout line **19** is completed on the recording sheet **22** the sheet must be indexed to provide the proper spacing for the next printout line. This is accomplished by a conventional intermittently operated motor **44** which is connected to a drum **46** upon which the recording sheet is wound. The motor **44** will be cycled to rotate the drum simultaneously with movement of the drum **10** in a manner well known in the art. The recording sheet **22** may be of any suitable material and may be heat sensitive or of any other medium employed to reproduce an image.

The printer or printing head **20** is best shown in FIG. 2 and includes an ink-aspirator nozzle **48** having an air inlet **49** and a marking medium inlet **50**. The marking medium emitted from the ink aspirator may be any suitable material that will produce a directional stream, such as liquid, heated medium, electrostatically charged particles, etc. For the purpose of the description, however, the preferred medium will be described as a high-energy liquid stream of aspirated ink.

The ink stream emitted from the nozzle **48** is directed through a second stage nozzle or fulcrum device **52**. The purpose of the focusing device is to provide a surface or surfaces against which the ink stream impinges so as to provide a fluid-amplifier type of leverage for obtaining substantial deflections in the direction of the ink stream downstream of the fulcrum device. Thus, although a nozzle is illustrated, other forms of fulcrum devices, such as a single or a pair of converging vertical plates, may also be employed. As best shown in FIGS. 4 and 5 the nozzle **52** has two converging guide surfaces **53** and **54** terminating in a vertical slot **55** that extends downwardly at the downstream side of the nozzle to provide an outlet route for condensed ink droplets that may form on the interior surfaces of the nozzle. It is desirable to avoid such formation of droplets since they may otherwise be carried by the ink stream onto the recording sheet and mar the printout. The guide surfaces of the nozzle are treated to produce a roughened or engraved quality resisting the formation of such droplets and

assisting in guiding them to the drainage area below the slot **55**.

As is best shown in FIG. **5** the central axis of the ink stream is centered in the slot **55**, as is indicated by the dotted line **56**, and passes through a target orifice **58** and thence onto the recording sheet **22**. If the central axis of the stream is completely deflected, as is indicated by the dotted line **60**, the ink stream misses the target orifice **58** and does not reach the recording sheet **22**. The target orifice **58** has upper and lower diverging walls **64** and diverging sidewalls **66** terminating in an orifice opening **67**. The height or vertical width of the opening is determined by the desired printout line width and the length of the orifice opening is determined by the speed with which the printer head moves across the recording sheet and the resolution desired. In practice, the orifice opening is square being selected as a compromise between resolution and the amount of ink striking the paper. For example, if the original **10** has a solid black line the printer **20** moving across the recording sheet **22** in synchronized relation with the photocell carriage **38** will also produce a solid black line the width of which is determined by the height of the orifice opening **67**.

As is best shown in FIGS. **6A** and **6B** the ink stream emitted from the second stage nozzle **52** is fan shaped in horizontal cross section. The concentration of ink particles immediately surrounding the central axis of the ink stream is much greater than the concentration of ink particles at the remote edges of the stream. Consequently, the amount of ink particles striking the recording sheet may be varied. A heavy concentration is produced when the ink stream is centered in the fulcrum device **52** (FIG. **6A**) and a blank space is produced when the ink stream is completely deflected from the target orifice (FIG. **6B**). Varying degrees of ink particle concentrations are produced when the center portion of the stream is deflected from the target orifice but the less concentrated edge of the stream is still passing through the target orifice and thus onto the recording sheet **22**. For example, a deflection somewhere between that shown in FIGS. **6A** and **6B** will produce a light ink (grey if black ink is used) printout with the concentrated ink particles surrounding the central axis of the stream striking outside the opening **67** of the target orifice. The target orifice is of an absorbent material which collects the misaligned ink particles and directs them to a reservoir for further use. It should be noted that in the preferred embodiment the ink stream is deflected only in the horizontal plane, however, other planes of deflection may also be used if desired.

The deflecting means or motive forces for deflecting the ink stream are, in the preferred embodiment, the air-pulse generators **36** and **37**. Air-pulse generator **36** is located upstream of the fulcrum device **52**. The air-pulse generator **37** is located downstream and is directed opposite to that of the upstream generator. In the preferred form the air-pulse generators are identical; therefore only the generator **37** will be described. Each generator includes a coil **69** interconnected to an outwardly converging cone or diaphragm **70** mounted in a nozzle **72**. The electrical signal received from the amplifier **34** produces a suitable magnetic field to cause movement of the diaphragm **70**, thus converting the electrical signal into an air-pulse. The signals received are generally at audiofrequency such that the actuation of the generator is generally analogous to an audio speaker, and the movement and control of the diaphragm **70** parallels the technique common to the present state of the audio art. The diaphragm thus produces an air movement emerging from the nozzle **72** that is proportional both in magnitude and characteristic to the action of the coil **69**. As the diaphragm moves toward the opening of the nozzle **72** it ejects a volume of air which develops sufficient velocity and inertia to exit the nozzle as a distinct pulse. The corresponding reversal of the diaphragm draws in a corresponding volume of air but primarily from the periphery of the nozzle outlet thus allowing the initial pulse to escape and, on the next pulse formation, be reinforced. In this regard the pulse generation deviates from the conventional audio speaker. As a result of the shape of the nozzle and the frequency character of the generated pulses rectification occurs to produce a steady succession of sound wave pulses providing a low-energy stream emerging from the nozzle opening suitable for deflecting the main ink stream.

The action of the fulcrum nozzle **52** on the ink stream may be likened to a fluid amplifier since the air pulses upstream of the fulcrum move the central axis of the ink stream only slightly but as a result cause a substantial deflection of the ink stream downstream of the fulcrum nozzle **52**. The downstream generator **37** supplements or reinforces this deflection but since it lacks the leverage of the fulcrum its primary effect is to provide reinforcement of the deflection action and to focus or concentrate the ink particles in the fan-shaped stream by moving the light, widely dispersed particles around the fringes or edges of the stream toward the central axis thereof.

The dynamics of the "energy stream unbalance" to provide the leverage effect for deflecting the stream is best shown in FIGS. **6A** and **6B**. In FIG. **6A**, the central axis **56** of the undeflected stream is shown centered between the guide surfaces **53** and **54** of the nozzle **52** and balanced reaction force vectors **73** and **74** are produced at each surface. Theoretically only one guide surface is required since the ink stream can operate exclusively in one-half or slightly more than one-half of the fan-shaped stream. That is, since the deflection occurs only in one direction it is not necessary to balance the vector forces **73** and **74** but merely to provide a single guide surface to produce a single vector that has a component perpendicular to the path or central axis of the ink stream. In the preferred embodiment of the ink stream is dynamically centered between the two guide surfaces **53** and **54**.

In FIG. **6B** the ink stream has been deflected by the upstream generator **36** producing new vector forces **75** and **76**. Vector force **76** is substantially greater than **75** and thus its perpendicular component is also substantially greater than the perpendicular component of the vector **75**. This unbalance produces a net deflection of the ink stream downstream of the nozzle **52** as illustrated. The amount of deflection is determined by the amplitude of the signal from the amplifier **34** which in turn depends upon the character of the light reflected from the original **10**. A black area on the original will reflect no light and thus no electrical signal. Grey areas will produce signals of medium amplitudes. A white area will produce a signal of maximum amplitude.

In the modification shown in FIG. **8** an upstream air-pulse generator **80** is supplemented with a constant air supply through an air inlet hose **82**. The air enters the nozzle **83** outside of the cone **84** and is regulated by a valve **85**. The constant air supply provides a net airflow emerging from the nozzle **83** to prevent stray ink droplets from entering the nozzle. The air supply also offers a constant energy stream which can be used as a bias for aligning the ink stream and provides a "-filling" function in the nozzle offering more efficient energy transfer from the moving cone to the emerging sound pulse wave.

FIG. **8** also illustrates another modification in which the downstream air-pulse generator has been replaced by a nozzle **86** that is connected to a constant air supply which is controlled by a valve **90**. The constant air supply provides a constant deflecting or biasing force against which the ink stream may be directed and also tends to "tighten up" the fan-shaped ink stream by moving the dispersed particles near the fringes of the stream towards the central axis thereof.

In the modification shown in FIG. **9** the upstream deflecting force is itself a deflected high-energy stream, such as air, liquid, or any type of marking stream mentioned earlier. A deflection stream nozzle **94** emits a fan-shaped deflecting stream **96**. The stream is directed through a first-stage fulcrum nozzle **97** and is aimed in its undeflected state at a baffle **98** where it is rendered inactive. A first-stage pulse generator **99** acts on the deflecting stream upstream of the first-stage fulcrum nozzle and by leverage thus causes a substantially increased deflection of the deflecting stream at the baffle **98**. Thus, depending on the intensity of the air pulses from the

pulse generator which in turn are proportional to the information signal received, the fan-shaped stream will be deflected to the phantom-line position (shown by the dotted line **96***a*) an amount proportional to the information signal received. A main stream nozzle **100** produces a recording ink stream **102**. The stream also may be any of those mentioned earlier suitable for recording an image or may be used for controlling a fluid for a still further stage. The main stream passes through a second-stage fulcrum nozzle **104** and thus by leverage is deflected downstream a substantial amount when acted upon upstream of the second-stage nozzle **104** by the deflecting stream **96**. The deflected position is indicated by the dotted line central **104***a*.

As is readily apparent substantial "gain" is produced by this staging principle. A small information signal may be used to produce a small air pulse from the generator **99**. This air pulse will act on the deflecting stream to produce a deflection downstream of the first-stage nozzle **97** equal, for example, to the angle A. The deflecting stream will in turn act on the main stream to cause a still further increased deflection, for example, equal to the angle B. An advantage in this staging technique is that the size and force of the main stream may be substantially increased and the deflecting stream may be a high-energy stream itself. Basically the leverage principle using fluidic streams, as exemplified by this modification is, in its broadest aspect, a single fluidic amplifier that is highly responsive to the information signals received.

While the invention has been described and illustrated with a limited number of embodiments, it will be clear that further variation in the details of construction and configuration illustrated may be resorted to without departing from the true spirit and scope of the invention. Accordingly, it is to be understood that the invention is to be limited only by proper interpretation of the appended claims.

What I claim is:

1. A method of recording with a marking fluid comprising the steps of:

forming a marking stream having a central axis;

applying a fulcrum force on the marking stream with a component of said force acting perpendicular to said central axis and directing said marking stream at a recording surface; and

altering the direction of said marking stream upstream of said fulcrum force in response to information signals to increase the magnitude of said perpendicular component whereby deflecting said marking stream an increased amount downstream of said fulcrum force.

2. The method defined by claim **1**, further including applying a second fulcrum force on said marking stream with a component of said force acting perpendicular to said central axis and in a direction opposite to said perpendicular component of said first fulcrum force.

3. The method defined by claim **2**, wherein the resultant of said fulcrum forces on said marking stream is balanced by a constant air pulse on said marking stream downstream of said fulcrum forces.

4. The method defined by claim **2**, wherein said fulcrum forces form said marking stream into a fan shape having a higher concentration of marking particles around said central axis of the stream than at its edges;

intercepting at least a portion of said marking stream prior to reaching said recording surface when the marking stream is deflected; and

altering the direction of said marking stream upstream of said fulcrum by an amount proportional to the magnitude of said information signals and whereby the concentration of the marking particles striking the recording surface varies depending upon the amount of deflection of the marking stream downstream of said fulcrum forces.

5. The method defined by claim **2**, wherein said marking stream includes ink and further including the steps of intercepting at least a portion of said marking stream when the marking stream is undeflected and intercepting a larger portion when the marking stream is deflected and generating said information signals by converting light reflected from graphic images into electrical signals.

6. The method defined by claim **5**, wherein said method produces an enlarged facsimile of said graphic image.

7. The method defined by claim **2**, wherein the direction of said marking stream is altered by displacing the marking stream with a signal-controlled fluid pulse upstream of said fulcrum forces.

8. The method defined by claim **7**, wherein the signal to said signal controlled air pulse is at a frequency of about 200 cycles per second.

9. The method defined by claim **7**, further including the step of reinforcing said stream deflection by displacing the marking stream with a signal-controlled fluid pulse downstream of said fulcrum forces.

10. The method defined by claim **7**, further including the step of reinforcing said stream deflection by displacing the marking stream with a constant airstream downstream of said fulcrum forces.

11. A system for recording signals comprising:

means for projecting a marking stream along a path toward a recording surface;

fluid-dynamic means for creating a force having a component acting on said marking stream in a direction perpendicular to said path;

means upstream of said fluid-dynamic means for altering the path of said stream so as to change the magnitude of said perpendicular force component whereby deflecting said marking stream a greater amount downstream of said fluid-dynamic means; and

means responsive to information signals for energizing said path altering means.

12. The system defined by claim **11**, wherein said fluid-dynamic means includes a nozzle having guide surfaces converging in the direction of said path.

13. The system defined by claim **12**; further including constant stream generator means downstream of said nozzle.

14. The system defined by claim **12**, wherein said means for altering said path includes means for generating intermittent pulses of air the intensity of which are responsive to said information signals.

15. The system defined by claim **14**, wherein said marking stream includes atomized ink and further including a second air-pulse generator downstream of said fluid-dynamic means for generating intermittent pulses of air the intensity of which are responsive to said information signals; and means adjacent said recording surface for intercepting at least a portion of said marking stream when in a deflected condition.

16. The system defined by claim **14**, wherein said generating means includes means for supplementing said air pulses with constant air stream.

17. The system defined by claim **11**, wherein said system is a facsimile enlarger and further includes

means for reflecting light from a graphic image;

means for converting the reflected light into information signals; and

means adjacent said recording surface for intercepting all or a portion of said marking stream when deflected.

18. The system defined by claim **17**, further including means for optically enlarging said reflected light.

19. The system defined by claim **17**, wherein said recording surface is substantially larger than said graphic image and further including means for moving said graphic image and further including means for moving said converting means across said recording surface in timed relation to said means for moving said converting means whereby a mechanical enlargement occurs.