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[54] PHOTOCOMPOSING MACHINE WITH FLEXIBLE FIBER OPTICS SCANNING MEMBER

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[52] **U.S. Cl.** ..... **95/4.5 R**
[51] **Int. Cl.** **B41b 17/10**
[58] **Field of Search** 95/4.5

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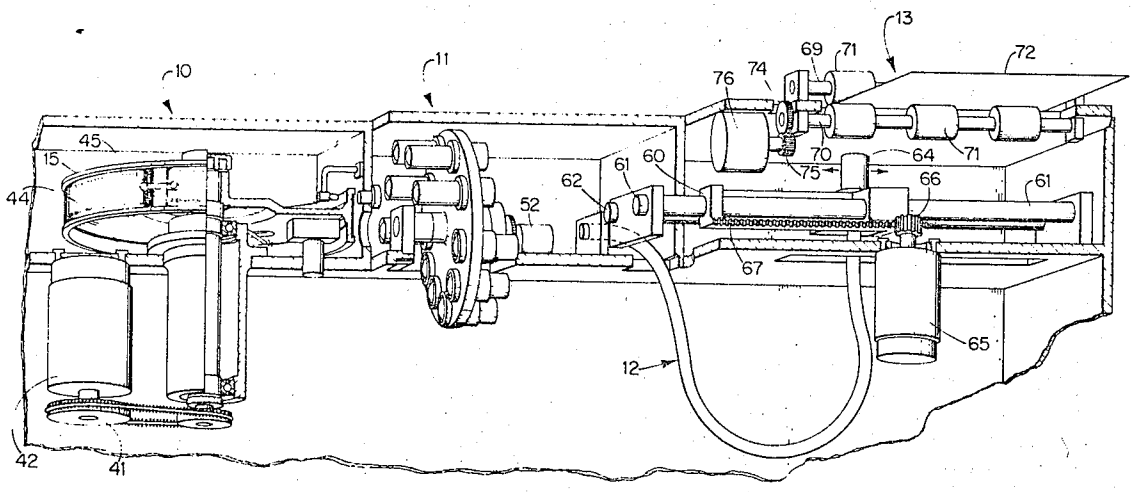
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[57] **ABSTRACT**

A photocomposing machine is described for composing a master useful in the printing industry. A film record, suitably mounted, contains recordings of a type font, including an appropriate selection of alphanumeric characters or type faces which can be selectively employed to compose a printed page. A selected image from the film record is projected through one of the various lenses in a lens turret to project the image on the input end of a fiber optics bundle. The output end is movable in a stepping or scanning mode across a photosensitive recording material. The selected characters are recorded in sequence by selected stroboscopic lighting. An electronic control center receives a coded input signal and appropriately activates the strobe lamp and other components to provide selection of the alphanumeric character as well as timing of the selection to provide justification.

6 Claims, 3 Drawing Figures



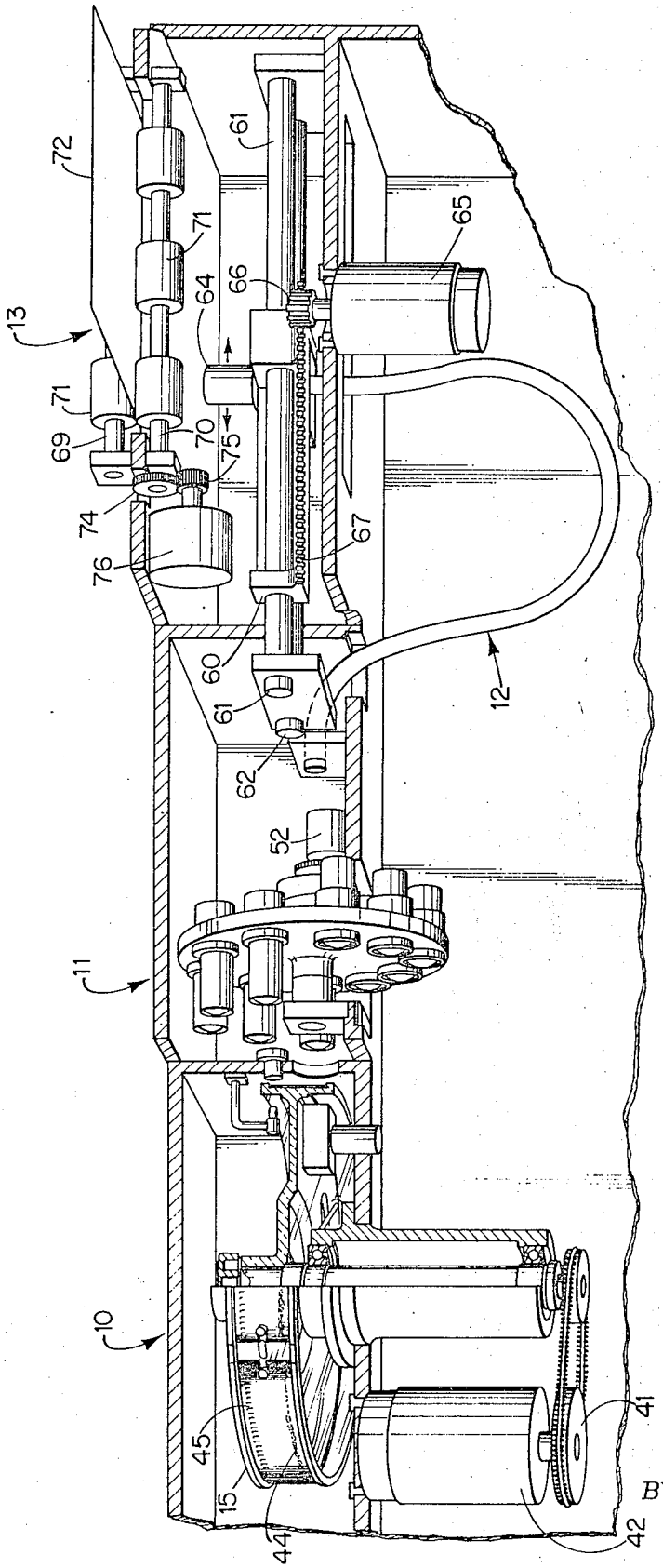


Fig. 1.

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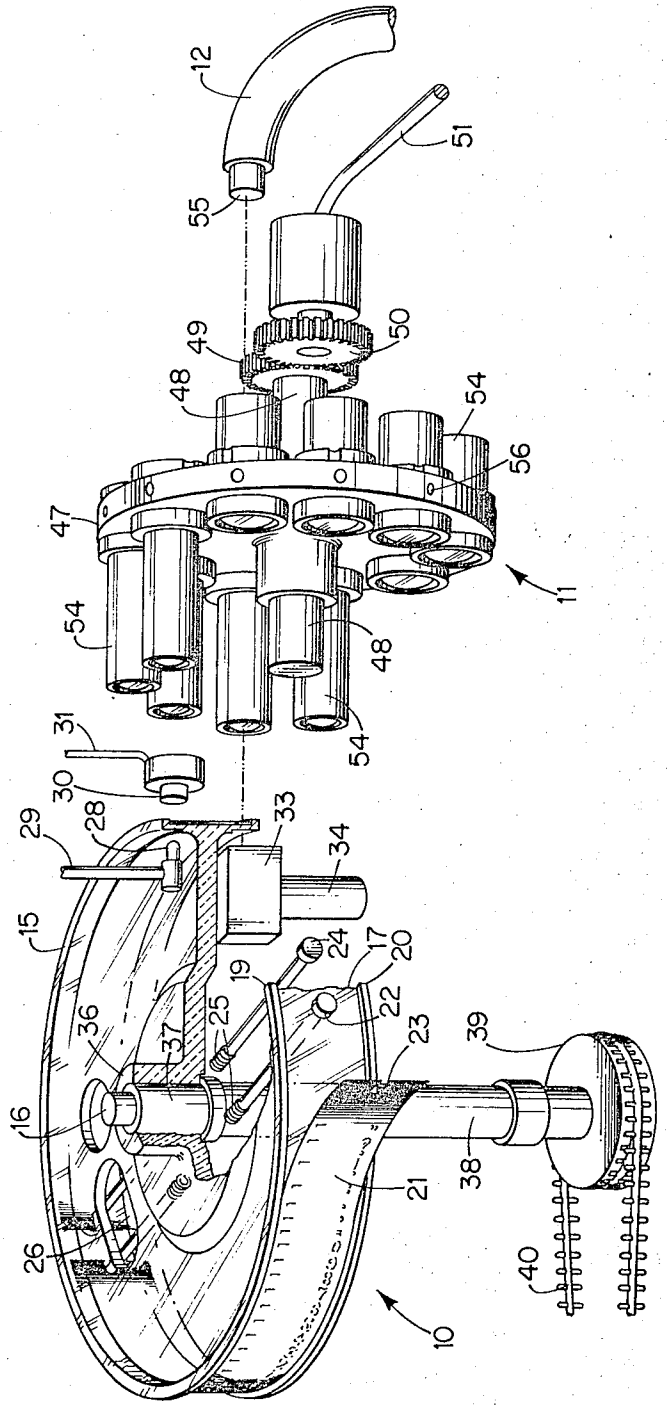


Fig. 2.

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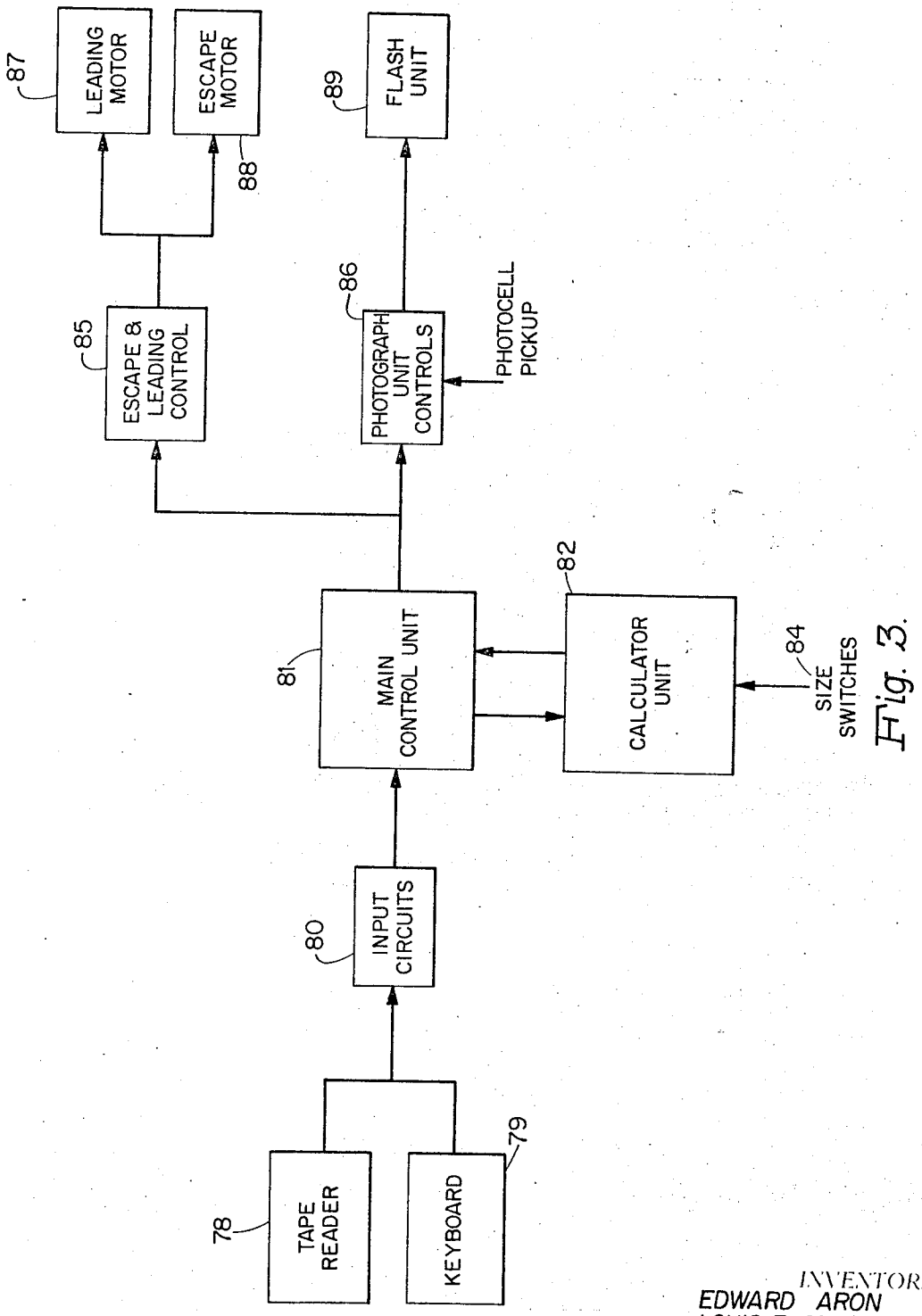


Fig. 3.

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PHOTOCOMPOSING MACHINE WITH FLEXIBLE FIBER OPTICS SCANNING MEMBER

BACKGROUND OF THE INVENTION

In recent years, a new type of composition of printing masters has come into being and it is now possible to produce a master corresponding to a printed page by optical means. In general, these masters have the common characteristic of operating from a record of alphanumeric characters corresponding to a type font and the composition takes place by selectively exposing a photosensitive material to these alphanumeric characters. Usually, the location of the character on the photosensitive material is controlled by moving mirrors which project an image of the character to the desired point on the photosensitive material. The recorded character information is prepared by known methods to form an offset master or other printing plate, usually of quality comparable with good letter press printing. In general, photocomposing machines are operated from a keyboard, but they also can be operated from a coded input signal.

This type of composing machine for the printing industry is finding acceptance because of its convenience of operation and because it is compatible with modern printing techniques. In spite of this growing acceptance, there are several problems associated with photocomposing machines which include the fact that it is difficult to provide proper justification of line width; it is difficult to change type size or font characters; and the machines tend to be either extremely complex or quite limited in scope and flexibility.

SUMMARY OF THE INVENTION

Now, in accordance with the present invention, there is provided a photocomposing machine for the printing industry which is substantially improved in the various problem areas which, heretofore, have plagued the photocomposition art. There is easy change from one type font to another and easy change from one type size to another. The device is well adapted to operation from a keyboard or a coded input signal and the operation of the machine is simple and straightforward.

The machine is generally illustrated in the following drawings in which:

FIG. 1 is a diagrammatic view of a photocomposing machine according to one embodiment of this invention.

FIG. 2 is a diagrammatic view of character display and optical projection means in the device of FIG. 1.

FIG. 3 is a flow diagram of an electronic control center for the machine.

DETAILED DESCRIPTION OF INVENTION

In FIG. 1 is illustrated a photocomposing machine according to one embodiment of the invention, including, generally, a character display device 10, an optical projection system 11, a flexible fiber optics bundle 12 and a recording station 13. These general components are so arranged operatively that a character is flash-illuminated in the character display device 10 and is projected by optical projection system 11 on to a fixed end of fiber optics bundle 12. The other end of the fiber optics bundle is movable in a scanning mode at the recording station 13, whereby a selected character is recorded in its desired position along a line on a photosensitive recording material in the recording station. The mode of motion of the movable terminal of fiber optics bundle 12 is a line-by-line motion across a surface such as a page. Generally speaking, the path projected onto the page is a narrow band desirably corresponding to a line or row of alphanumeric characters. The motion is considered generically a scanning motion, as it progresses line-by-line across the surface, but more specifically, it is a stepping motion consisting of thousands of discrete movements along the line.

The character display device, generally designated 10 and illustrated in FIGS. 1 and 2 comprises a transparent character display drum 15 rotatably mounted on a post or axle 16. The periphery of the drum, which acts as a film strip receiving member 17, is transparent and may be constructed of a material such as glass or a transparent plastic material. According to the preferred embodiment, the entire drum 15 is constructed of an acrylic resin such as, for example, lucite.

Around the circumference of the drum 15 immediately adjacent to the film strip receiving member 17 are upper and lower flanges 19 and 20. The film strip receiving member 17 and these two flanges 19 and 20 are accurately machined to receive and hold a character storage member 21 in accurate position or register. The machine is as accurate as is consistent with production requirements. In the case of one specific machine, desirably, the upper and lower flanges are machined so that the face of film strip receiving member was 2 inches, with a tolerance of +0.002 inch and minus zero, whereby the character storage member is held in precise register.

At one or more positions around the circumference of the drum 15 and associated with the film strip receiving member 17 is a fastener 22 such as a rod, clamp or the like which is adapted to receive and hold one end of the character storage member 21. Desirably, the character storage member may be a strip of photographic film having characters and other marks recorded thereon and having a hole 23 near one end thereof which is adapted to slip around and be held snugly between fastener 22. A second fastener 24 is also mounted on the character display drum and is positioned to hold the opposite end of the character storage member 21. Either or both of the fasteners 22 or 24 may be spring mounted and held in a retaining position by a spring 25. An insert hole 26 permits finger access to the fasteners 22 and 24 so that the spring 25 may be released, thus releasing one or both ends of the character storage member 21.

The character display drum 15 may be adapted to receive, display and convey one or several film records or character storage members 21. In practice, it has been found desirable and adequate to mount two members 21 on a drum 15, corresponding to two different type fonts such as ordinary light face type and italics. Several may be employed to add the option of bold face or other type styles, if desired. In addition, the effective printing speed of the machine corresponds to one character per drum revolution per character storage member, and machine speed may, if desired, be multiplied by a factor corresponding roughly to the number of character storage members 21 mounted on drum 15. Alternatively, more than one complete set of charac-

ters may be recorded on one character storage member.

Mounted within the character display drum **15** and positioned behind film strip receiving member **17**, is a light **28** mounted for example, on a support member **29** secured to the frame of the machine. Opposite light **28** and with film strip receiving member therebetween, is a photocell **30** suitably mounted on a support **31** adapted to receive and respond to illumination from light **28**.

A lamp **33** is positioned also within the character display drum **15** and mounted on a suitable support **34** also secured to the frame of the machine. Light **28** and lamp **33** are positioned in different locations within the drum and desirably, the light **28** is positioned within the upper half of the drum **15** and lamp **33** is positioned within the lower half of drum **15**. Lamp **33** is capable of being flashed for an extremely short duration, such as, for example a lamp of the type generally known as stroboscopic. This lamp may be an xenon lamp and is triggered for an extremely short duration flash. It has been found satisfactory to trigger this lamp for a flash duration of about three microseconds.

The entire drum assembly, consisting of the character display drum **15** and members mounted thereon is rotatably mounted on axle **16**. This is accomplished for example, by means of a hub **36** mounted on bar **37** which may be connected, for example, with a rotatable sleeve **38**. At the lower end of the sleeve **38** is a pulley **39** operatively driven by a drive member or belt **40** which, in turn, is operatively mounted to be driven by pulley **41** on drive motor **42**.

The character storage member **21** is a suitable permanent storage device having recorded thereon the information which is to be printed ultimately at the recording station **13**. When the character storage member **21** is part of a photocomposing machine, the recorded information generally will be alphanumeric characters, including numbers, letters, punctuation and the like. These alphanumeric characters may be of any form desired, such as standard type face for photocomposition as ordinarily practiced in the printing industry. The character information may be capital letters, lower case letters, bold or light face, italics or whatever form is desired. They may be characters suitable for recording in the English language or in a foreign language and they may be characters for recording for the human eye or for machine reading. According to the preferred embodiment of the invention, the character storage member is easily removable and replaceable so that a series of different character storage members can correspond to a number of different type faces. In this way, the type corresponding to an entire print shop can be represented by a few film strips. Desirably, the character storage member is a strip of high contrast photographic film on which has been recorded a row of alphanumeric characters **44** and a row of character lines or timing lines **45**. As illustrated in the drawings, the alphanumeric characters are recorded in a row near the bottom edge of the character storage member **21**, lying on their sides, and the timing lines are located in a row near the top edge of the member positioned vertically when the character storage member is mounted, on the film strip receiving member. The timing lines are positioned to pass between light **28** and photocell **30**, while the characters pass between lamp **33** and optical projection system **11**. The output of these timing lines is fed as an electric signal (as will hereinafter be described) to control means which identifies character position from character line information.

The optical projection system, generally designated **11**, is illustrated in both FIGS. **1** and **2**, but is perhaps more readily understood in the enlarged simplified presentation in FIG. **2**. This optical projection system includes a plate or disc **47**, which is rotatably mounted on a shaft **48**. A flexible drive **51** may be mounted on shaft **48** to control its rotation and thus to bring a selected lens **54** to the operating position. In actual practice, the flexible drive **51** terminates in a control panel (not shown) at the front of the machine, thus permitting external control of the position of disc **47**. A gear **49** mounted on shaft **48** meshes with and drives a position switch gear **50** on position switch **52**.

A plurality of projection members or lenses **54** is mounted on disc **47**, each lens being of a selected focal length and magnification ratio, so as to project an image of controlled magnification ratio from the face of film strip receiving member **17** to a fixed terminal end **55**, of fiber optics bundle **12**. Detent dimples **56** are adapted to receive a spring mounted detent ball (not shown) to releasably fix a selected one of the lenses **54** in operable position.

The recording station generally designated **13** comprises means to mount the output end of the fiber optics bundle **12** movable in a scanning or stepping mode and means to mount a recording member preferably movable at a 90° angle to the scanning motion of the fiber optics bundle, all as hereinafter described.

A carriage **60** is movably mounted on guide rods **61** and **62** which in turn are mounted to the machine frame. The fiber optics bundle **12** extends in a bend or loop and is mounted with its output terminal **64** on the carriage, whereby the output terminal end **64** of the fiber optics bundle **12** is movable in a scanning mode across the recording station **13**. A stepping motor **65** drives a pinion **66** operably engaging a rack **67** which transports the carriage **60** and thus the output terminal across the recording station.

Positioned on the recording station are upper and lower shafts **69** and **70** which carry sheet feed rollers **71** operable to convey a sheet or web of photosensitive material, such as paper or film **72**, across the recording station in a direction at right angles to the direction of motion of carriage **60**. Drive gear **74** is mounted on lower drive shaft **70** and operatively engaging gear **75**, movable by a sheet member stepping motor **76**. Upper shaft **69** and the upper feed rollers are followers and are not driven.

As desired, the output terminal end of the fiber optics bundle may terminate in virtual contact with the photosensitive paper or film **72** or, preferably, may terminate in a projection lens positioned to focus on to the paper or film the light image carried by the fiber optics bundle **12**.

Optically, as desired for other utilizations, the operation of the drive mechanism, the optical projection system **11** and of the fiber optics bundle **12** may be reversed so that the fiber optics bundle may receive scanning information at its output terminal end and transmit it to its fixed terminal **55** in a device for encoding documentary information.

In FIG. 3 is illustrated a flow diagram of an electronic control center for the control and operation of the machine illustrated in FIGS. 1 and 2. The control center generally comprises a tape reader 78 and a keyboard 79 alternatively or simultaneously operable to supply an input signal into input circuits 80. The input circuits 80, in turn, feed into a main control unit 81. A circulator unit 82 is connected to receive signals from size switches 84 (illustrated for example as position switch 52 in FIG. 2) and to receive a signal from main control unit 81 and to return a signal into main control unit 81. An output signal from main control unit 81 is fed to an escape and leading control 85 which, in turn, feeds an output signal to the leading motor 87 and the escape motor 85. The main control unit 81 also feeds a signal to the photograph unit control 86 which receives a signal from the photocell pick up (illustrated for example as photocell 30 in FIG. 2). The output of the photograph unit control is a signal operating flash unit 89 (to flash lamp 33 in FIG. 1).

The photocomposing machine illustrated in FIGS. 1 and 2 may be used for manually controlled or keyboard controlled recording of alphanumeric information onto a photosensitive material such as photographic paper or film 72. If desired, other photo recording means may be used without departing from the scope of this invention. When used in manually controlled recording, the character display device is moved so that a selected alphanumeric character is positioned directly between lamp 33 and a lens 54. The lamp is then flashed, causing the projected image of the character to be received on the fixed terminal end 55 of the fiber optics bundle 12 and to be carried through the fiber optics bundle 12 and projected from its output terminal end 64 onto the photosensitive paper or film 72. Stepping motor 65 is then advanced one character width along the line of type or printing and the next selected character on the character storage member 21 is brought into operating position. Lamp 33 is again flashed, causing this second character to be similarly recorded on the photosensitive paper or film. In a sequence of such steps, a line of alphanumeric characters is recorded on the paper or film. At the end of the recording of a line of characters, stepping motor 76 is advanced one step or a desired number of steps (or the paper feed mechanism is advanced manually or mechanically), causing the paper or film to be advanced to the next line position, whereupon, the linear recording is again repeated. In this manner, an entire page of type can be recorded on the photosensitive paper or film which is then used as a master for the production of a printing plate according to conventional techniques and procedures,

In printing a page of type according to this invention, whether it be by manual means or electronically controlled means, the selection of the style of type or font is made by placing on the character display device 10 the desired character storage member 21 or desired film strip containing the recorded type font. The size of the type face is controlled by rotating plate 47 to select the appropriate lens 54 to achieve the desired magnification or reduction in size of the recorded character. In the presently preferred embodiment of the invention, there are ten lenses, representing a realistic selection of sizes of type face, although a wider or more restricted selection may be employed if desired. The printing or composing process is then begun.

In automatic operation of the machine, the control of the operation is achieved by the automatic electronic control center illustrated in FIG. 3. The character display drum 15 is constantly rotated at a desired speed such as, for example, about 2,000 revolutions per minute. The electronic control center keeps track of the character which is in the operable position and its precise location thereon by counting the timing lines 45 by means of lamp 28 and photocell 30. A coded input signal is introduced into the electronic control center which translates this signal into a character designation which is represented by the count and position of timing lines 45. Simultaneously, stepping motor 65 advances the output terminal 64 in scanning mode across the face of the recording medium. When the output terminal 64 is at the desired printing position, the electronic control then triggers lamp 33 to flash the character onto the recording medium at the precise position desired.

While the size of steps taken by stepping motor 65 is not limited to a specific number, nor are sizes of other factors in operation, some general guide lines have been found useful in building a practical machine. For example, the character drum 15 can rotate at many hundreds of revolutions per minute, and a rotation of 2,000 r.p.m. has given good machine speed coupled with good quality character recording. In one embodiment of the machine, stepping motor 65 moves at 0.0025 inch per step, moving 800 steps per revolution.

To view the automatic operation of the photocomposing machine more specifically, a coded input signal such as may be received from a tape reader 78, a keyboard 79 or directly from the transmission wire is received and fed into the input circuits 80. The input circuits appropriately receive the signal and operate shift register memories, gates and the like, to translate the input signal into character information as needed. This character information is then fed to the main control unit 81 which receives, simultaneously, size information from the calculator unit and the input character information. This main control unit decides when it has received character information corresponding to a full line and sends this information to the calculator unit 82. The calculator unit thereupon evaluates the length of the alphanumeric character line corresponding to the information transmitted to it from the main control unit, and calculates the number and size of spaces needed to complete the justified line. It sends this information back to the control unit 81 so that the control unit has now received information defining sequence of characters and spaces equivalent to a complete justified line of alphanumeric information. This information is then translated into time pulses corresponding to character and to line position. The information regarding character identification is fed to the photograph unit control 86 which receives also the count of character position from the photocell pick up. When the character identification coincides with this count of character position, the photograph unit controls trigger the flash unit. In this manner, the flash unit is triggered when the identified character on the character storage member 21 is operatively positioned between lamp 33 and lens 54.

The main control unit also feeds the signal corresponding to character information and position to the escape and leading control. The information regarding

escape control is then fed to the leading motor 87 which operates stepping motor 65 to move the output terminal of the fiber optics bundle 12 horizontally across the line of alphanumeric character information.

For each character input from the keyboard or tape reader, the control unit causes the output terminal 66 of the fiber optics bundle to be stepped across the line to the desired position for recording the appropriate character. When it reaches this position, it momentarily stops to await the flash as controlled by flash unit 89 so that the appropriate character from character storage member 21 is flashed onto the photosensitive paper or film. The escapement motor then moves the output terminal 66 to the next recording position where flash unit 89 again operates the flash to record the next character. At the end of the line, the signal from escape and leading control 85 operates the leading motor to move the paper or strip in the vertical direction for the recording of the next line.

In the manner described an automatic, semi-automatic or manual machine can produce a typed tape or long distance signal controlled master which is or can be converted by known methods into a high quality printing master or plate easily, efficiently and effectively.

We claim:

1. A photocomposing machine comprising a character storage and display member movable to present sequentially an optical record of selected alphanumeric characters at a display position, optical projection means to project sequentially each of a succession of character images from said display position to a fixed optical transmission station, at predetermined times capable of being compared with times measuring the selection of the characters being displayed, a flexible fiber optics bundle having an input terminal mounted at said fixed optical transmission station and an output terminal mounted on a carriage movable along a line, means to move said carriage along said line, recording means comprising means to mount a photosensitive recording member adjacent to the carriage and to move the photosensitive member at an angle to the line of motion of the carriage, and timed means to illuminate said selected alphanumeric characters at said display position, said timed means simultaneously selecting predetermined characters in sequence and selecting predetermine positions of said carriage along said line, whereby an optical image of each selected character is projected at a predetermined location on the recording means.

2. The photocomposing machine of claim 1, wherein the means to illuminate the selected alphanumeric character comprises a short duration flash lamp, sensing means to sense the presence of a desired selected character in a predetermined location adjacent said lamp, and means responsive to said sensing means to trigger said lamp for a short duration flash.

3. A photocomposing machine comprising a character storage and display member movable to present sequentially an optical record of selected alphanumeric characters at a display position, optical projection means to project sequentially each of a succession of character images from said display position to a fixed optical transmission station at predetermined times capable of being compared with times measuring the selection of the characters being displayed, said projection means comprising a lens turret including a plurality of different lenses of different focal lengths selectively movable into operative position, a flexible fiber optics bundle having an input terminal mounted at said fixed optical transmission station and an output terminal mounted on a carriage movable along a line, means to move said carriage along said line, recording means comprising means to mount a photosensitive recording member adjacent to the carriage and to move the photosensitive member at an angle to the line of motion of the carriage, and timed means to illuminate said selected alphanumeric character at said display position, said timed means simultaneously selecting predetermined characters in sequence and selecting predetermined positions of said carriage along said line, whereby an optical image of each selected character is projected at a predetermined location on the recording means.

4. The photocomposing machine of claim 3, wherein said lenses are mounted on a lens turret, and including externally operable means to rotate said turret to select a lens positionable in an operating position to project a selected character from said display position to said input terminal.

5. Optical scanning means for a phototypesetter comprising a rotatable type font record having a visible record of alphanumeric characters adapted to be recorded to form a printing master, means to rotate said type font record to bring the characters sequentially and repetitively in timed sequence to an imaging position, a flexible fiber optics bundle having an input terminal and an output terminal, mounted with its input terminal at a fixed position adjacent to said imaging position, optical means to project an image from said imaging position onto said input terminal, a line recording position, means to move a photorecording member at said line recording position and at an angle thereto, means to mount the output terminal of the fiber optics bundle adjacent to the line recording position and to scan said terminal along said line recording position, flash illuminating means mounted to illuminate a selected character of said type font at said imaging position for projection onto the input terminal, and means to flash selected characters of said font in predetermined time relationship with respect both to the position of the output terminal along said line recording position and to the position of a selected character at the imaging position, whereby a preselected character image is flashed onto the input terminal simultaneously with the positioning of the output terminal at a preselected position along the line recording position.

6. Optical scanning means according to claim 5 wherein the output terminal is movable stepwise along the line recording position.

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