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(54) PHOTOCOMPOSING APPARATUS

(71) We, SHAKEN CO., LTD., a Japanese corporate body of 2—26—13, Minamiootsuka, Toshima-ku, Tokyo, Japan, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:—

This invention relates to photocomposing apparatus and more particularly to photocomposing apparatus in which images of characters selected from a character matrix are composed in lines of given lengths on a photosensitive medium.

Known photocomposing apparatus suffers from the disadvantage that it is extremely difficult to correct the characters or to adjust the spacing between the characters after the image of the characters has been imprinted on the photosensitive medium. As a result, when using the known photocomposing apparatus to effect the composition of characters of a non-uniform character spacing in a line of a given length it has been necessary, prior to the selection of the characters, to carry out troublesome calculations involving the arrangement of the characters and the amount by which the photosensitive medium is to be displaced between the imprint of each image.

To enable a great number of characters than is obtainable with normal spacing to be fitted into a given space, the so-called "solid photocomposition" may be relied upon. In this form of composition, characters which are normally arranged in a line with space between adjacent characters, are rearranged so that some characters are arranged in overlapping relation with the characters adjacent thereto. In Figure 1a the characters of the word WATER are shown with a space between each character and in Figure 2a the Japanese Kana (character) "し" (shi) and "う" are shown with a space between them. In the solid photocomposition the character spacing is reduced and a portion of each character projects into the adjacent character region as shown with respect to the letters WA and AT in Figure 1b and the characters of Figure 2b. With the known photocomposing apparatus the use of solid photocomposition has required very careful calculations to be made to bring about the correct positioning of the characters. This takes considerable time and as a result a burden has been imposed on the operator of the apparatus.

With the known photocomposing apparatus the amount of space which results from the use of solid composition in comparison with normal spacing cannot be readily determined unless the adjacent characters are aligned with each other. As a result, it has heretofore been common printing practice for the characters to be solidly printed on translucent material and for the materials to be superimposed one upon another so as to calculate the amount of spacing which can be saved.

As described above the Japanese characters "し" and "う" shown in Figure 2a can be solidly imposed as shown in Figure 2b. Since in order to obtain the composition shown in Figure 2b, the characters "し" and "う" are divided into portions A to J in the X direction and portions a to j in the Y direction. The characters are brought closer together so that intersection of Jf of the character "し" is superimposed upon the intersection of Gf of the character "う". As seen from Figure 2c, if the character space is reduced by 7 portions or steps in comparison with normal spacing, then the picture image of one of the characters is superimposed upon the other character, so that it is preferable to reduce the space

between the two characters by 6 portions or steps as shown in Figure 2b. As a result, if the width of divided units a to j and A to J are made equal to the multiple proportion number of the minimum film feed units of the photocomposing apparatus, a desired solid composition can be effected.

In Japan, about 5,000 characters are used so that it is virtually impossible to take all of the above combinations of these characters into consideration. As a result, these combinations are to be treated by way of a process as explained with reference to Figure 2. Such manual operation becomes very troublesome if a particular line length is given.

In the case of composing European characters whose widths are different from each other on a given length of line, whether or not the characters can be aligned on a given line without hyphenating a word cannot be determined unless the image of the characters has been completed. As a result, initially a trial print is effected in accordance with the formula and finally a real print must be effected. Such steps in the process impose a great burden on an operator of the conventional composing apparatus. Consequently the efficiency of the composition becomes low and errors are found.

Even with photocomposing apparatus which does not require the above-mentioned trial print-out, a careful pre-calculation for determining the amount of film feed for the character spacings has to be performed prior to the printing operation. Furthermore, conditions known as prohibition treatment and flush right, left and centering, as explained hereinafter, have to be taken into account. The prohibition treatment is understood to mean a treatment in which special marks which are called prohibition marks, such as the period "." and parenthesis mark "(" should not be located at the beginning of a line or at the end of a line.

If the prohibition mark "(" is present at the end of line 1, as shown in Figure 3a, this prohibition mark should be located at the beginning of line 2, as shown in Figure 3b, and as a result, the number of characters in line 1 is reduced. Thus it is necessary to suitably increase the character space so as to make the line length equal to the line length of line 2, as shown in Figure 3b. Such treatment is called line-end prohibition treatment. Similarly, if the prohibition mark is present at the beginning of a line, so-called line-beginning prohibition treatment can be effected. Thus, the operator of the photocomposing apparatus must always pay attention to the position of the prohibition mark. If the prohibition mark is located at a position from which it must be removed by the prohibition treatment or the prohibition mark located at the end of a line is transferred to the beginning of the next line, the remainder of the characters on the preceding line must increase letter spacing there-between and the amount of film feed for the character which is transferred to the beginning of the next line must be distributed over the remainder of the characters.

By flush right, left and centre, is meant the way in which rows of print are aligned. If the first letters of each row are aligned on the left-hand side of the page this is known as flush left and if the last letter in each row is aligned on the right-hand side of the page then this is known as flush right and if the first letters are aligned on the left and the last letters are aligned on the right then it is known as flush right and left. In an alternative arrangement the words in each row may be arranged symmetrically about an imaginary line running down the centre of the page and this is then stated to be flush centered.

It is an object of the present invention to provide a photocomposing apparatus in which the troublesome pre-treatments and calculations which are required with the apparatus of the prior art can be obviated.

According to the present invention a photocomposing apparatus comprises a character matrix, means for selecting characters stored in the matrix, electrical means for producing in turn an electrical representation of each of the selected characters, a memory arranged to store said electrical representations of the characters, means for determining the desired spacing between adjacent characters of a group of characters stored in the memory, display means for displaying the images of the group of characters stored in the memory, print means for printing the images on the display means onto a photosensitive medium and means for causing relative displacement between the photosensitive medium and the print means between successive printing operations by an amount corresponding to the amount determined by said space determining means.

In order that the invention may be more readily understood it will now be described, by way of example, with reference to the accompanying drawings in which:

Figure 1a shows customary European characters;
Figure 1b shows the characters shown in Figure 1a and solidly composed;
Figure 2a shows customary Japanese characters;
Figure 2b shows the characters shown in Figure 2a and solidly composed;
Figure 2c shows the characters shown in Figure 2a and divided into a number of portions for ease of illustration;
Fig. 3a shows Japanese characters having a prohibition mark "(" at the end of one line thereof;
Fig. 3b shows the Japanese characters after a prohibition treatment has been performed;
Fig. 4 is a perspective view of prior art photocomposing apparatus;
Fig. 5 is a schematic perspective view of photocomposing apparatus according to the invention; and
Figure 6 shows the photocomposing apparatus shown in Fig. 5 in greater detail.

In the apparatus shown in Fig. 4, light from a light source 1 illuminates, through a lens system 2, mirror 3 and lens 4, a character matrix 5. Images of characters and marks at the exposure position of the character matrix 5 are incident through a masking-device 6 for permitting light of only one character to reach a lens in a lens barrel 8 mounted on a turret 7. The lens in the lens barrel 8 serves to change the magnification of the images of characters and marks. These images of characters and marks pass through a shutter S and a photograph thereof is taken on a photosensitive medium 11 disposed on a drum 10 in a magazine 9. The lens turret 7 is rotatable about an axis 12 and is provided at its periphery with a desired number of lens barrels 8. As a result, rotation of the turret 7 produces change in the magnification of the characters and marks in the character matrix 5 and printing of these characters and marks on the photosensitive medium 11. The character matrix 5 is mounted on a frame 13 adapted to be moved in directions shown by arrows 17, 19 in a manner such that the characters at any position on the character matrix 5 can be positioned under the marking device 6. In the present example, the character matrix 5 is composed of three small character matrices and one large matrix, each of these character matrices being mounted on the movable frame 13. The frame 13 is provided at its end and side edges with racks 14 which engage with position defining members 15, respectively. When compositing the characters, the operator moves the frame 13 by hand to bring a desired character into composing alignment with the masking device 6 and then the position defining members 15 are operated to cause them to be engaged with the rack 14, thereby holding the movable frame 13 stationary. Subsequently, the shutter S is released to project the light beam passed through the desired character upon the photosensitive medium 11, whereby a photograph of the desired character is taken on the photosensitive medium 11. After the photograph of the desired character has been taken, a given displacement or feed of the medium 11 is effected and the defining members 15 are released so as to be ready for the next character printing operation.

In Fig. 5 is schematically shown an embodiment of a manually operable photocomposing apparatus according to the invention. Reference numeral 40 designates a light source, 41 a condenser lens, 42 a shutter, 43 a character matrix, 44 a lens, 45 a television camera means such as vidicon or image orthicon, 46 a memory means for storing a scanning signal corresponding to selected character such as a video tape recorder, disc storage tube, or semiconductor memory, 47 a display tube composed of a cathode ray tube, 48 a lens, 49 a photosensitive medium, 50 a feed circuit inclusive of a pulse motor and the like for shifting the photosensitive medium or a travelling lens system on a continuously moving line composing carriage (not shown) everytime the photosensitive medium 49 is printed by the selected character and after printing over one line has been completed, 51 a group of instruction buttons (Fig. 6) for delivering instructions for the printing operation and for various kinds of typesetting inclusive of solid composition, prohibition treatment and the like, and 52 a control circuit for calculating the amount of film feed for each character spacing stored in the memory means 46 and controlling circuits of the shutter 42, display tube 47 and feed circuit 50. In Fig. 5, the shutter 42 is disposed between the condenser lens 41 and the character matrix 43. Alternatively, the shutter 42 may be disposed between the character matrix 43 and the lens 44 or between the lens 44 and the camera means 45. In addition, as the light source 40 use may be made of a flash lamp instead of a customary electric bulb shown in Fig. 5. In the case of using the flash

lamp, the shutter 42 may be dispensed with. In addition, in order to omit the lens 48 for projecting the character image on the display means 47 onto the photosensitive medium 49, the display means per se may be composed of, for example, an optical fibre transfer tube which can directly project the character image onto the photosensitive medium 49.

If the operator causes the character matrix 43 to be moved to and fro and to left and right so as to register a desired character into the exposure position and then a character selection 51a of the instruction button group 51 (Fig. 6) is pushed, a signal is delivered from the control circuit 52 to the shutter 42. The shutter 42 is thus opened and closed to project the image of the character on the character matrix 43 through the lens 44 onto the target surface of the camera means 45. At the same time, a signal is delivered from the control circuit 52 to the memory means 46 to store the scanning signal of the character projected onto the camera means 45. All of the characters included in one line are thus projected in turn onto the camera means 45. When the scanning signals of all these characters projected onto the camera means 45 have been stored in the memory means 46, a print button 51b in the instruction button group 51 is pushed by the operator to deliver a signal to the control circuit 52. The control circuit 52 becomes operative to calculate the spacing or amount of film feed for the characters stored in the memory means 46 and delivers a character scanning signal to the display means 47, whereby the character images are displayed in turn on the display means 47 and the character image when so displayed is projected through the lens 48 onto the photosensitive medium 49.

After the character image has been projected on to the photosensitive medium 49, the signal representing the amount of film feed for the character is calculated in the control circuit 52 and is delivered to the feed circuit 50 to shift the photosensitive medium 49 or the travelling lens system (not shown) over a given distance. The above described operations are repeated to print the characters corresponding to one line and then a new line is begun and its beginning is brought into printing alignment with the beginning of the preceding line.

On the display means 47 may be displayed only one character or a plurality of characters at the same time. When a plurality of characters are simultaneously displayed on the display means 47, the amount of film feed calculated by the control circuit 52 is supplied to a deflecting circuit of the display means 47 so as to adjust spacings between the adjacent characters and the plurality of characters are printed on the photosensitive medium so as to be ready to print the next group of characters, the feed circuit 50 is operated so that the corresponding amount of feed is delivered to the photosensitive medium 49.

The invention will now be described in greater detail with reference to Figure 6.

When starting the composing operation, the operator pushes those buttons of the intruction button group 51 which correspond to, for example, character size, presence or absence of modification in shape and its degree, amount of film feed, line length, and longitudinal or transverse composition so as to give instructions correspondingly. Then, the character matrix 43 is moved to and fro and left and right to find a desired character and to locate it at the exposure position. When the character selection button 51a is pushed, the control circuit 52 becomes operated to deliver a signal to the shutter 42 so as to make it open and close, and as a result, the desired character on the character matrix 43 is projected through the lens 44 onto the target surface of the camera means 45. Then, the control circuit 52 becomes operative to deliver a signal to the memory means 46 to cause it to store the scanning signal corresponding to the character projected onto the camera means 45 in an image recording device 46a in the memory means 46. At the same time, the number of operations of the shutter 42 is stored in a shutter number counter circuit 46b and stored also in a character and space counter circuit 46c. The scanning signals corresponding thereto are stored in the image recording device 46a, the number of operations of shutter 42 is stored in the shutter number counter circuit 46b, and the sum of the characters and character spaces therebetween is stored in the character and space counter circuit 46c. Then, a print button 51b in the instruction button group 51 is pushed by the operator to deliver a signal to the control circuit 52. Then, a control device 52a in the control circuit 52 becomes operative to calculate the amount of film feed for each character stored in the image recording device 46a based on the signal delivered from the character and space counter circuit 46c and based on the information from the instruction button group 51 such as the character size, its modification in shape, the amount of

film feed and the like and the amount of film feed for each character thus calculated is delivered to a feed amount memory device 46d. In addition, the control device 52a delivers a character scanning signal to the display means 47 so as to display the character image thereon which is projected through the lens 48 onto the photosensitive medium 49 and a photograph of the character image is taken on the photosensitive medium 49. Then, the control device 52a becomes operative to deliver a signal to the feed amount memory device 46d and the feed amount stored therein is transmitted to the feed circuit 50, thereby shifting the photosensitive medium 49 by a necessary amount. The above described successive operations are repeated to print all of the characters belonging to one line and then the line is shifted to a new line and the print for the new line is started.

Each of the European characters is different in width from each other. Strictly speaking, each of the Japanese hiragana and katakana characters is different in width. In the case of Japanese kana characters, the width is different depending upon whether the characters are composed in horizontal rows or vertical columns. Such is also the case with several chinese characters.

In order to print characters which are different in width from each other by distributing the amount of film feed to each in accordance with the character width, the character matrix 43 may be provided with a character width mark for every character. This character width mark is detected when the character is projected onto the camera means 45 so as to give an instruction to the feed circuit 50, thereby feeding the photosensitive medium 49 in response to the character width. A character width detector 53 is shown in Fig. 6. If the line length is given, the control circuit 52 can effect a calculation with justification and correct the character width by taking an accumulated width of all of the widths of the characters belonging to one line, line length and space between the characters, if necessary, into consideration.

The above described manually operable photocomposing apparatus according to the invention may be used to effect the above mentioned various kinds of special composition. In the first place, if a given number of characters are solidly composed within a line having a given length, an amount of film feed reducible in comparison with normal spacing is stored beforehand by the memory device in the control circuit 52. This amount of film feed reducible is integrated every time the character is selected so as to ascertain the number of characters which can be printed on one line. In addition, calculation is effected so as to distribute the remainder of the amount of feed over each of the characters. Then, the character image is reproduced and an instruction is given to the feed circuit 50 such that the photosensitive medium 49 is fed by the calculated amount.

Similarly, in the case of European characters, all of the characters once selected are stored in the memory means 46. The selection of the characters is stopped within a range at which justification is possible. The control circuit 52 is operated to effect calculation in a manner such that the remainder of the line length is distributed over every space between adjacent characters. Then, the character image is produced and the feed of the photosensitive medium 49 is effected. Thus, the European characters can easily be composed with justification without effecting the above described troublesome procedure of double composition. In the case of the prohibition treatment, presence or absence of the prohibition treatment at the beginning of line is discriminated. Thus, several characters at the beginning of next line are selected and if it is required to effect the prohibition treatment, the control circuit 52 is so operated that the character at the end of a line is brought into the beginning of the next line. In addition, in order to make each line length equal to another line length, a calculation is effected such that the space for one character that is brought into the beginning of the next line is suitably distributed over the line to increase the space between the adjacent characters. This calculation is instructed to the feed circuit 50.

Similarly, flush right, flush left, flush right and left, and flush centered, composition of chemical equations, composition of musical notes and the like may be effected. In these cases, in the first place, the required characters, or marks and the like are selected and then the amount of feed relative to the character and mark is determined and subsequently, the photosensitive medium 49 is fed in accordance with such amount of feed.

As stated hereinbefore, all of the characters belonging to one line are selected and then the print button 51b of the instruction button group 51 is pushed to effect the printing. Alternatively, the number of characters belonging to one line or the line length may be instructed beforehand to the control means 52. In this case, the

reproduction and feed are automatically effected when the number of characters or the line length is reached. Similarly, the solid composition, European characters prohibition treatment and other various kinds of special compositions may be effected. In addition, the lenses 44, 48 may be changed or the deflecting circuit voltage of the cathode ray tube 47 may be suitably be selected so as to magnify or reduce the characters. Similarly, this measure ensures any modification in shape of the characters.

In Fig. 6, reference numeral 54 designates a monitor display means which is composed of a display television device 54a, a display refresh memory 54b connected to outputs of the image recording device 46a and the feed amount memory device 46d, respectively, and delivering a signal to the display television device 54a, a character position display device 54c, and a character position register 54d connected to an output of the control device 52a of the control circuit 52 and delivering a signal to the character position display device 54C.

The above described monitor display means 54 is capable of displaying the character image which has been stored in the memory means 46 before the character image is printed on the photosensitive medium 49. As a result, the monitor display means 54 serves to display the character image before printing takes place and hence correction by effecting addition or removal of any desired character can be made.

In addition, the monitor display means 54 makes it possible to solidly compose the European characters as shown in Fig. 1b and the Japanese characters as shown in Fig. 2b while directly observing these characters with the operator's eyes, and as a result, the solid composition can be proceeded while confirming the amount of film feed reducible in comparison with normal spacing and position of the characters.

As stated hereinbefore, the manually operating photocomposing apparatus according to the invention makes use of a camera means, memory means and display means and which can store characters to be printed and then determine the amount of feed and subsequently print these characters on a photosensitive medium. Thus, the invention has the advantage that various kinds of workings such as increase and decrease of a character space, modification in shape thereof and the like can be effected during a time from selection of characters to real print, that various kinds of special composition such as a solid composition, European composition, prohibition treatment and the like can be effected in a very simple manner, and that burden imposed on an operator can be relieved.

WHAT WE CLAIM IS:—

1. A photocomposing apparatus comprising a character matrix, means for selecting characters stored in the matrix, electrical means for producing in turn an electrical representation of each of the selected characters, a memory arranged to store said electrical representations of the characters, means for determining the desired spacing between adjacent characters of a group of characters stored in the memory, display means for displaying the images of the group of characters stored in the memory, print means for printing the images on the display means onto a photosensitive medium and means for causing relative displacement between the photosensitive medium and the print means between successive printing operations by an amount corresponding to the amount determined by said space determining means.

2. Photocomposing apparatus as claimed in Claim 1 wherein said memory comprises a video tape recorder.

3. Photocomposing apparatus as claimed in Claim 1 or 2 wherein said means for producing an electrical representation of the characters comprises a television camera and means for directing an image of the selected character onto the television camera.

4. Photocomposing apparatus as claimed in any preceding claim including means for counting the number of characters stored in the memory.

5. Photocomposing apparatus as claimed in any preceding claim including a monitor display means arranged to display the characters stored in the memory.

6. Photocomposing apparatus as claimed in any preceding claim wherein said means for determining the desired spacing between adjacent characters comprises a control circuit programmed to calculate said spacing in dependence upon information and constraints supplied thereto, some of said information and constraints being supplied thereto by way of push button input circuits.

7. Photocomposing apparatus substantially as hereinbefore described with reference to the accompanying drawings.

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As stated hereinbefore, the manually operating photocomposing apparatus according to the invention makes use of a camera means, memory means and display means and which can store characters to be printed and then determine the amount of feed and subsequently print these characters on a photosensitive medium. Thus, the invention has the advantage that various kinds of workings such as increase and decrease of a character space, modification in shape thereof and the like can be effected during a time from selection of characters to real print, that various kinds of special composition such as a solid composition, European composition, prohibition treatment and the like can be effected in a very simple manner, and that burden imposed on an operator can be relieved.

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