Oct. 16, 1962 R. C. O'BRIEN 3,059,219

PHOTOGRAPHIC TYPE COMPOSITION

Filed March 12, 1958 4 Sheets-Sheet 1

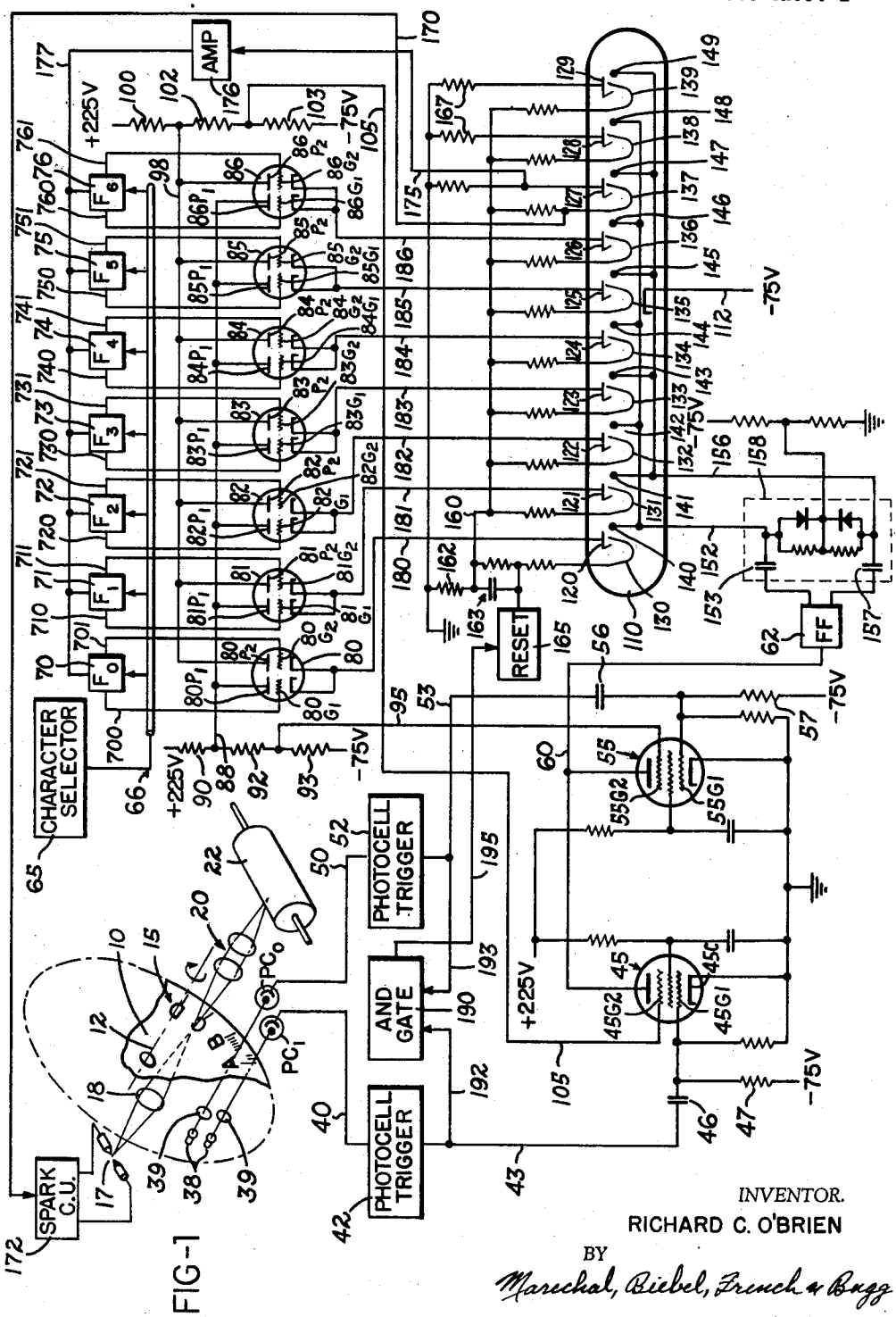


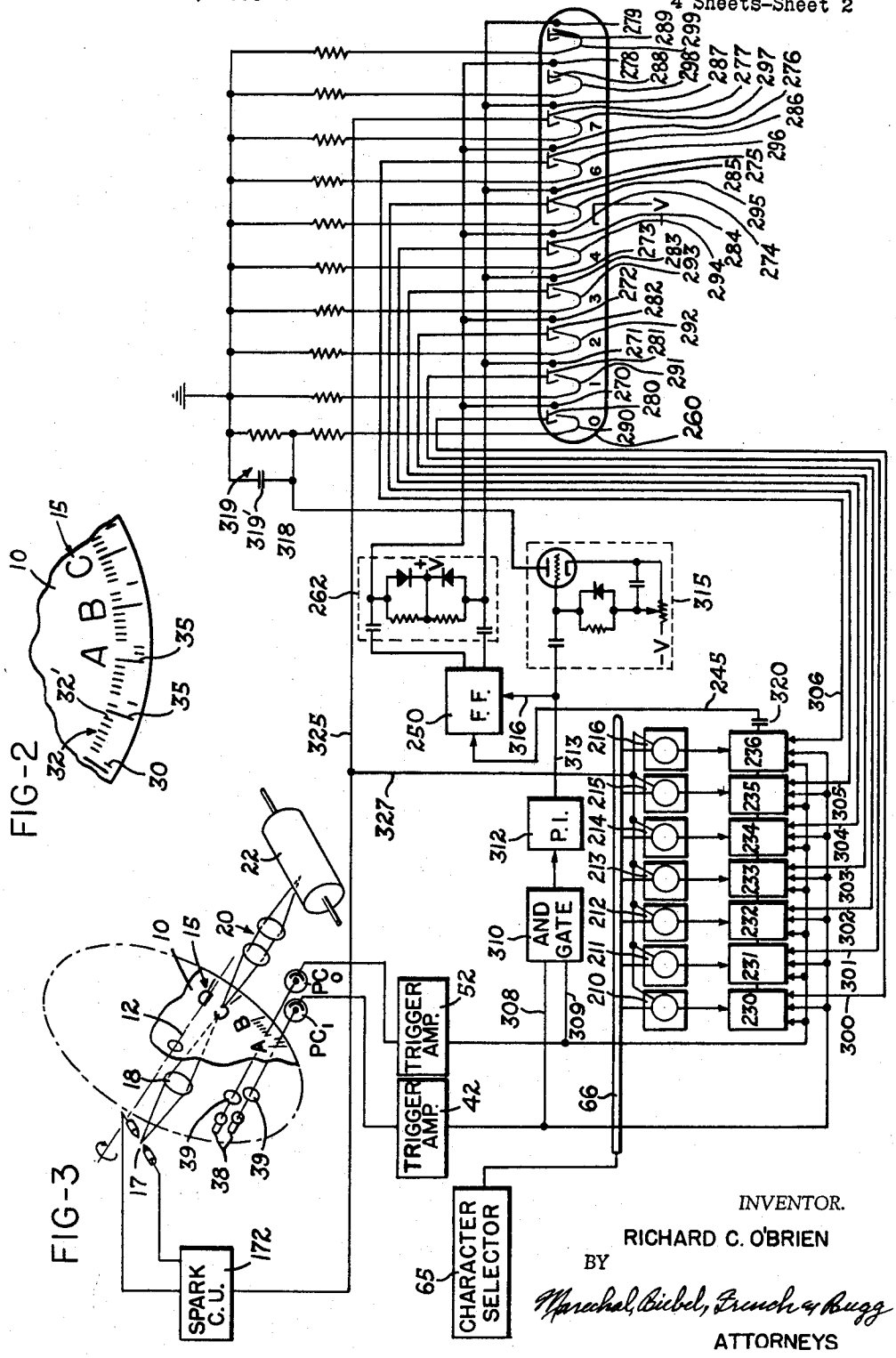
FIG-1

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PHOTOGRAPHIC TYPE COMPOSITION

Filed March 12, 1958 4 Sheets-Sheet 2

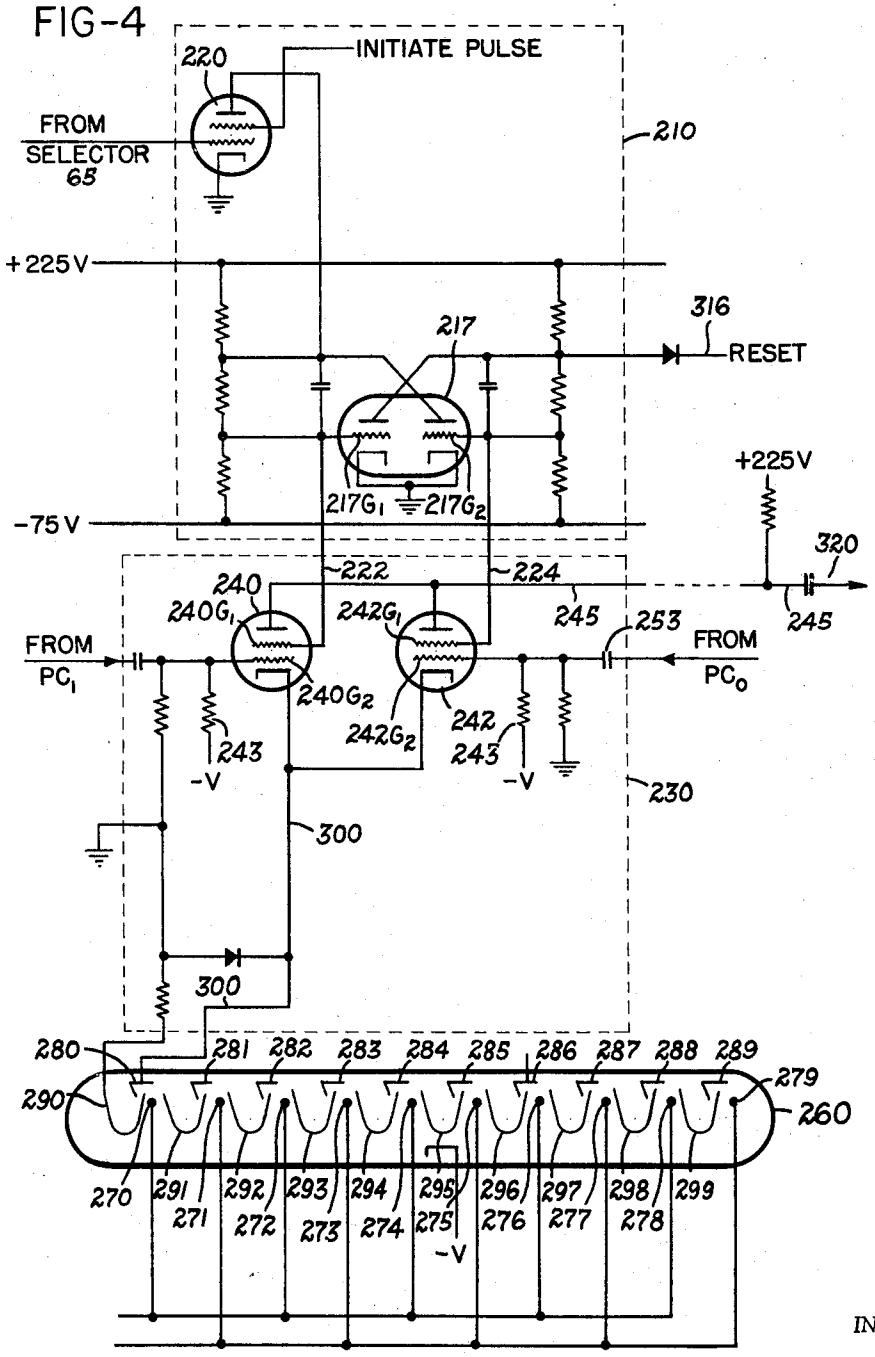


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PHOTOGRAPHIC TYPE COMPOSITION

Filed March 12, 1958 4 Sheets-Sheet 3

FIG-4



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Oct. 16, 1962 R. C. O'BRIEN 3,059,219

PHOTOGRAPHIC TYPE COMPOSITION

Filed March 12, 1958 4 Sheets-Sheet 4

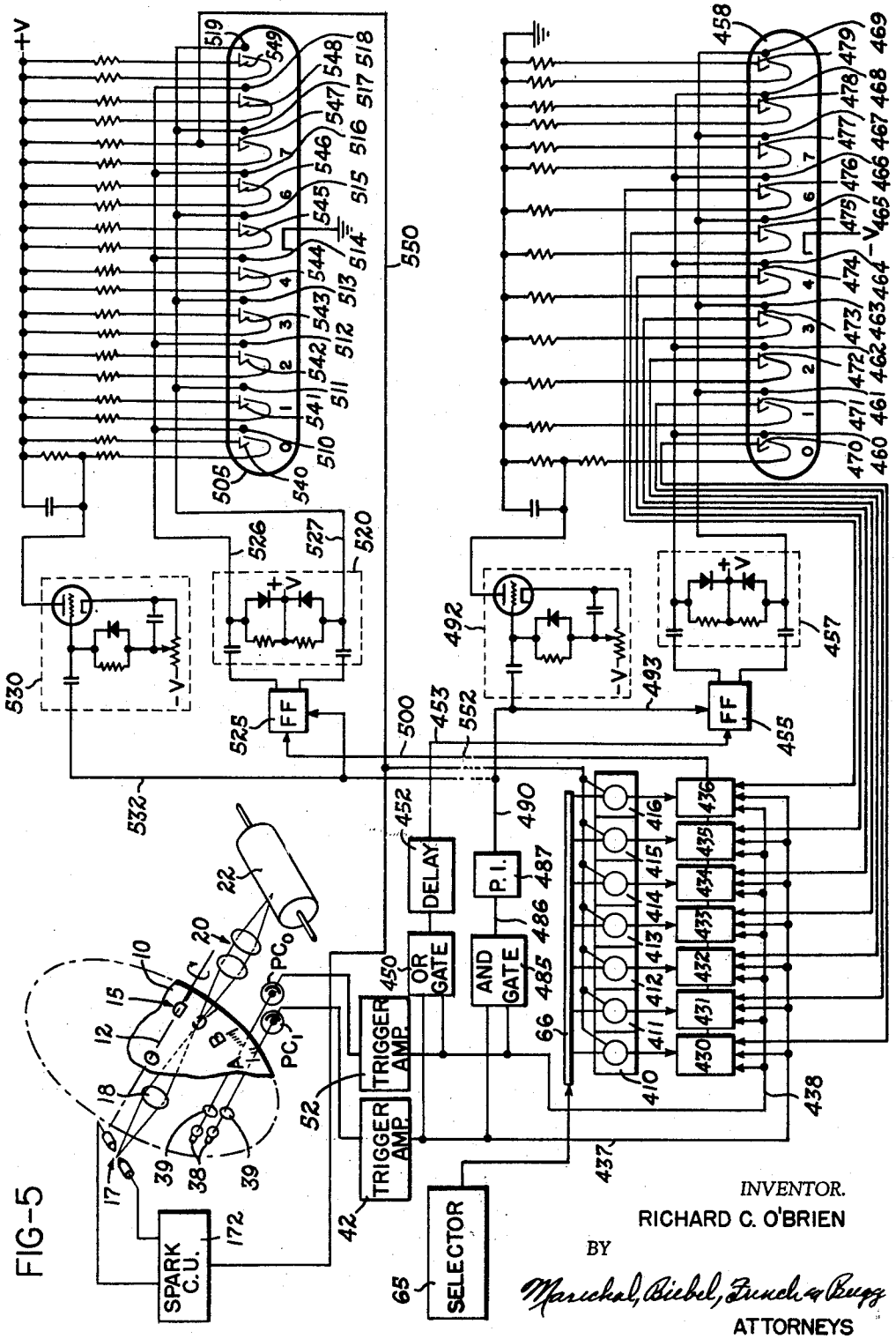


FIG-5

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United States Patent Office 3,059,219 Patented Oct. 16, 1962

3,059,219

PHOTOGRAPHIC TYPE COMPOSITION

Richard C. O'Brien, Cleveland, Ohio, assignor to Harris-Intertype Corporation, Cleveland, Ohio, a corporation of Delaware

Filed Mar. 12, 1958, Ser. No. 720,840
8 Claims. (Cl. 340—146.2)

This application relates to photographic type composition, to phototypesetting machines and the like, especially to apparatus for selecting a desired character on a matrix bearing a plurality of characters as portions of differential light transmitting ability, and to the selection of specific locations on a matrix or the like for similar purposes.

The present invention is particularly suitable for rapid determination of a desired location on a matrix or similar member bearing distinctive code indicia. In accordance with the invention the code indicia characteristic of each possible location is compared with the desired code in a selector system, and when the code indicia corresponding to that in the selector is located, an output signal is immediately provided which may be used, for example, to effect photography of material located on the matrix in predetermined relation to the located code indicia. Thus, there is no need to work from a reference point on the matrix or other code bearing member, and more than one location may be located on the matrix during each cycle of scanning of all the code indicia.

Accordingly, the primary object of this invention is to provide an improved system for scanning a plurality of code indicia on a matrix or like member and for selecting desired locations on the matrix in predetermined succession, as indicated by the location of code indicia on the matrix corresponding to a selected code, by instantaneously indicating a coincidence between the selected code and its corresponding indicia on the matrix.

A further object of this invention is to provide a system for locating a selected binary code indicia on a member bearing a plurality of such indicia, by comparing each of the indicia on the member with the selected code, digit by digit, until the coinciding indicia is located on the member.

Another object of the invention is to provide such a coincidence responsive system wherein the scanning or reading of each indicia on the member is performed independently of the other indicia thereon, providing for a number of possible coincidences during each cycle of scanning all the indicia on the member.

An additional object of the invention is to provide an improved character selecting system for phototypesetting apparatus wherein the character identifying code indicia for each character is independent of other indicia and occupies a zone on the character matrix of minimum radial width.

A further object of this invention is to provide such an improved character selecting system wherein coincidence between the selecting code and the identifying code on the matrix will produce immediately an output signal effective to energize or actuate the associated high speed photographic equipment and record the character identified with such code.

Another object of this invention is to provide a system for locating a selected binary code number on a matrix or similar member having a plurality of different code numbers recorded thereon, in which system all of the code numbers or indicia on the matrix are scanned in cyclic fashion and each compared digit by digit with the selected code number to seek coincidence between each digit of the selected number and each digit of the code indicia on the matrix, and wherein discriminating apparatus receives signals for digit by digit coincidences

such that a noncoincidence between any digit of the selected number and the code indicia being scanned will cause the discriminating apparatus to become out of phase with the scanning cycle, thereby providing that an output indicating the location of the selected number can occur only, and immediately, when complete digit by digit coincidence occurs in the discriminating means.

In the drawings—

FIG. 1 is a schematic diagram of one selector system provided by the invention;

FIG. 2 is a fragmentary view on an enlarged scale of the character bearing matrix shown in FIG. 1;

FIG. 3 is a diagrammatic illustration of another embodiment of the invention;

FIG. 4 is a detail diagram of coincidence circuits employed in the apparatus of FIG. 3; and

FIG. 5 is a diagrammatic illustration of a further embodiment of the invention.

Referring to the drawings, which illustrate preferred embodiments of the invention, and particularly referring to FIG. 1, there is shown a matrix disk **10** which is mounted for rotation about its axis **12**, and which bears characters **15** located at a common radial distance from the axis of rotation **12**. These characters are defined by suitable parts of differential light transmitting ability so that a light beam passing from the spark gap **17** through condensing lens **18** will be formed, on passage through one of such characters, to provide an image bearing light beam which then passes through a suitable focusing and size controlling optical system **20** onto a photosensitive record material which may be carried, for example, upon the drum **22**.

Relative movement between the light beam from spark gap **17**, which is of relatively high intensity and short duration, may be provided by rotating the disk, thus bringing successive characters into alignment with the possible path of the light beam, and by properly controlling the flashing of the light source or spark gap **17** desired character images may be projected onto the light sensitive material for recording in succession thereon. Suitable apparatus for spacing successively projected character images may be provided, for example as described in detail in the copending application of Frederick J. Hooven and Richard C. O'Brien, Serial No. 661,633, filed May 27, 1957, now Patent No. 2,966,835.

The present invention relates particularly to apparatus for determining the instant when a selected character, identified by a suitable binary code number for example, is properly aligned with the optical system for photographing that character. In accordance with the invention each character is identified by a binary code number which is recorded as indicia on matrix disk **10** in predetermined spatial relation with respect to the character which it identifies. For purposes of example the code is illustrated as a seven digit binary code.

Referring to FIG. 2, and using as an example the code number 1000000 as corresponding to the character A, the mark **30** indicative of a "1" in the code number is located at a characteristic radial distance from the center of disk **10**. Immediately following this mark are six further marks **32** which all fall on a common radius from the center of disk **10**, different from the radius upon which mark **30** is located. In other words, all marks representing "1" are at a different distance from the center of rotation from the marks representing "0." The last of these seven marks, identified as **32'**, is located in predetermined spaced relation with respect to the character A, and thus the position of mark **32'** may be used as an indication of the proper alignment of the character A with respect to the optical system.

In similar fashion, the code for character B may be 0100000, and the code for character C may be 1100000,

and so on, as will be apparent from an inspection of FIG. 2. Each set of code marks is set off from adjacent sets by an elongated mark **35** which extends through both of the radial zones occupied by the "1" and "0" marks **30** and **32**. All of these marks preferably are made in such a fashion that they are of differential light transmitting ability with respect to the disk background. For example, the disk may be opaque and the marks translucent, or vice versa.

Again referring to FIG. 1, the areas of the disk in which these two radial zones are located are illuminated by lights **38** from which rays of light pass through suitable lenses **39**, and these light rays are interrupted by the differential light transmitting parts in the two code zones to provide pulse generating means. On the other side of disk **10** there is mounted a first photocell PC_1 which is aligned with the zone on the disk in which the marks **30** appear, and thus pulses sensed by PC_1 are indicative of a "1" in a particular identifying code. In like fashion photocell PC_0 is located opposite the zone bearing the zero marks **32**, and thus pulses sensed by PC_0 are indicative of "0" in the code. The output of PC_1 passes through line **40** to a suitable trigger circuit **42** and the output of the trigger circuit is connected through line **43** to a discriminator pentode **45**, specifically to the first or control grid $45G_1$ thereof through a condenser **46**. This grid is normally biased to cut-off potential through resistor **47** which is connected to a suitable source of negative potential, while the cathode **45C** is connected to ground as shown.

In like manner, the output of photocell PC_0 is connected through line **50** to a trigger circuit **52** and the output of this circuit passes through line **53** to the control grid $55G_1$ of pentode **55** through a condenser **56**. Also in like manner the grid $55G_1$ is biased negative through resistor **57**.

The plate circuits of pentodes **45** and **55** are connected to a common output **60** which provides an input to a bi-stable flip-flop circuit **62**. Thus, a pulse from either of these pentodes, due to momentary conductances thereof, will cause flip-flop **62** to reverse its state.

Referring to the upper right portion of FIG. 1, a suitable selector circuit is designated generally at **65** and may comprise any suitable circuit for retaining temporarily a binary code number which identifies a character to be selected from disk **10**. The selector circuit may include means for receiving an input from any suitable coding device, and thus may operate directly from a keyboard, as in the copending application of Frederick J. Hooven and Richard C. O'Brien, now United States Patent No. 2,846,932, issued August 12, 1958, and assigned to the same assginee as this application, or the selector may operate from any suitable coded record such as a punch tape or magnetic tape.

The output **66** of selector circuit **65** passes to a bank of bi-stable selector flip-flop circuits **70–76** which are independent of each other and are individually under the control of the selector output. Thus each of the flip-flops **70–76** may be set at its "0" or "1" state by the selector circuit independently of the others. Corresponding to the flip-flops **70–76** there is a bank of dual triodes **80–86**, and the first plate of each of these dual triodes, designated $80P_1$, $81P_1$, etc., are connected to a common output line **88** which is in turn tied to a voltage dividing circuit comprising a load resistor **90**, a dividing resistor **92**, and a negative biasing resistor **93**. As shown in the drawing resistor **90** is connected on one side to the plate load line **88** and to dividing resistor **92**, and on its other side to a B+ supply which may conveniently be approximately +225 v. The negative biasing resistor **93** is connected on one side to a negative supply, for example −75 v. as indicated, and at its other side to dividing resistor **92** and to output line **95** which extends to grid $55G_2$ of discriminator pentode **55**.

The other or second plates of the dual triodes **80–86** designated $80P_2$, $81P_2$, etc., are connected through a common plate line **98** to another voltage dividing circuit including resistors **100**, **102**, and **103** which are connected in the same fashion as described above in connection with the voltage divider circuit **90**, **92**, **93**. An output line **105** is connected into this voltage dividing circuit between resistors **102** and **103** and extends to the second control grid $45G_2$ of discriminator pentode **45**.

Each of the flip-flop circuits **70–76** has two output lines which are conducting or nonconducting depending upon the state of the associated flip-flop circuit. For example, the bi-stable flip-flop **70** has an output line **700** which is biased positive if the flip-flop is in its "0" state and a second output **701** which is biased positive if flip-flop **70** is in its "1" state. Line **700** is connected to the first control grid $80G_1$ of tube **80**, and similarly line **701** connects to the second grid $80G_2$.

In like fashion, the output lines **710, 711**; **720, 721**; **730, 731**; **740, 741**; **750, 751**; and **760, 761** are connected to the grids $81G_1$, $81G_2$; $82G_1$, $82G_2$; etc., and thus the grids of the dual triodes will be set up in accordance with the state of the individual bi-stable flip-flops **70–76**. Referring to the lower right portion of FIG. 1, a beam switching tube **110** is illustrated schematically. This tube is of the type manufactured by Burroughs Corporation and as disclosed, for example, in United States Patent 2,721,955. It will be understood that for purposes of illustration the means for creating the magnetic field about this tube has not been shown. Such means is well known in the art and is disclosed in said Patent 2,721,955.

Beam switching tube **110** includes a common cathode **112** which may be connected to a negative source of potential, for example −75 v., and a plurality of target elements **120–129**. For each target there is a corresponding beam deflecting element or spade **130–139**, and corresponding beam switching elements or grids **140–149**. The switching grids **140**, **142**, **144**, **146** and **148** are wired to a common input line **152** and through condenser **153** to one side of the bi-stable flip-flop **62**. The odd numbered switching grids **141**, **143**, **145**, **147** and **149** are carried through a common control line **156** which is connected through condenser **157** to the other side of flip-flop **62**. The remainder of circuit **158** constitutes a conventional switching circuit or network for providing proper bias to the odd or even numbered switching grids.

All of the spade or switching elements with the exception of the first spade **130** are connected to a common load line **160**, through suitable resistors as shown, which is in turn connected through load resistor **162** to ground. Thus, the beam switching tube operates on the relatively low potential difference of less than 75 v. The first spade element **130** is connected to the load line **160** through an additional resistor-capacitor network **163** which receives a resetting impulse from a suitable reset circuit **165**. An impulse from this circuit at any time will cause the beam of electrons to be clamped to the first target element **120**, ignoring the others, by lowering the potential of all spade elements below cut-off potential, after which all of the spades **131–139** will rise to ground potential before spade **130**, due to the network **163**, thereby forming the beam on the first target **120**. The last two target elements **128** and **129** are not used in this circuit, and therefore they are connected directly to ground through suitable biasing resistors **167**.

The spade element **137** is connected directly to an output line **170** which extends to the spark control unit **172** governing the energization of the electrodes **17**. The pulse that appears at spade element **137** is fast rising and thus provides an almost instantaneous signal to spark control circuit **172** when the electron beam is switched for the seventh time, to the target element **127**. This target element is connected directly through output line **175** to an amplifier **176** which in turn supplies a reset pulse through reset line **177** for resetting all of the flip-flop circuits **70–76** to a common state, for example to "0." By providing

such a separate reset output to the selector flip-flops, the reset circuits are isolated from the main output line **170** and therefore do not tend to load and possibly weaken the main output pulses to the spark control unit.

Each of the first seven target elements **120–126** is connected through respective output lines **180–186** to the cathodes of the dual tridoes **80–86**, each of these output lines **180–186** from the beam switching tube **110** thus controlling the operation of a corresponding dual triode **80–86**.

A suitable "and" gate circuit **190** is connected to receive input pulses from both of the photocell trigger circuits **42** and **52** through input lines **102** and **103**. As is characteristic of such "and" gate circuits, when a pulse is received from both of the trigger circuits an output pulse will pass through output line **195** to reset circuit **165**.

The operation of the system is as follows. Assuming for purposes of example that it is desired to select and photograph the character A, and that as described in connection with FIG. 2 the code for A is 1000000. This code is fed to the selector circuit **65** which in turn sets up the flip-flops **70–76** so that the first flip-flop **70** assumes the position corresponding to "1" and the others are in their "0" state. Thus, the grid $80G_2$ is biased positive. Assuming further that the elongated reset mark **35** (FIG. 2) immediately preceding the code indicia identifying character A has just passed the photocells PC_1 and PC_0, then the "and" gate circuit **190** has passed a reset pulse to reset circuit **165** which in turn has caused the electron beam in beam switching tube **110** to reset and be clamped to the first target element **120**, thus in effect connecting the cathodes of dual triode **80** to the −75 v. supply.

The grid $80G_2$ has been biased positive while grid $80G_1$ remains negative, as explained above, and thus the right hand side of tube **80** conducts and an output signal is passed through line **98** to the voltage dividing network including resistor **100**, **102** and **103**, thereby bringing the output line **105** to a higher or more positive potential. At the same time, the relative movement between matrix disk **10** and the reading means (provided by the photocells PC_1 and PC_0) is continued. Preferably, this relative movement is continuous and is provided by rotating the matrix disk relative to the photocells which are supported in a fixed position.

Thus, referring to FIG. 2, the first or "1" mark **30** causes photocell PC_1 to transmit a pulse to its corresponding trigger circuit **42**, and through line **43** and condenser **46** to bias grid $45G_1$ momentarily positive. It will be recalled that there is an output signal in line **105** which is connected to grid $45G_2$, and therefore the discriminator pentode **45** conducts, and an outer pulse is passed through line **60** to the bi-stable controlling flip-flop circuit **62**. The signal through line **60** is in the nature of a pulse only, since although the grid $45G_2$ is biased momentarily positive, the positive bias through condenser **46** from photocell PC_1 is a sharp pulse, and thus grid $45G_1$ is biased positive only for a short duration.

Going on to the next selector flip-flop **71**, its corresponding comparator triode **81**, and the corresponding target element **121**, the pulse to control flip-flop **62** will cause the electron beam in beam switching tube **110** to shift to the second target **121**, due to the change in state of flip-flop **62** which switches the polarity of the switching grids through a conventional switching circuit or network **158**. This causes the even numbered grids to be biased negative and to place a positive bias on the odd numbered grids through line **156**. The cathodes of tube **81** are now connected to the negative potential through the beam switching tube, and since in the example flip-flop **71** has been set to read "0," the grid $81G_1$ will be biased positive causing a signal to pass through line **88** to the voltage divider circuit including resistors **90**, **92** and **93**, and an output signal will be passed through line **95** to the grid $55G_2$ of the discriminator pentode **55**.

Noting from FIG. 2 that the next code mark in the code identifying character A is a "0" mark, then the pulse from photocell PC_0 through its trigger circuit **52**, and through the output line **53** and condenser **56**, will cause grid $55G_1$ to be biased positive for a period sufficient to emit a further pulse through output line **60** to the control flip-flop circuit **62**. Accordingly, the electron beam in the beam switching tube will advance or step to the next target element **122** and the same sequence just described will be repeated.

Thus, the beam switching tube **110** in combination with the following action of the dual triodes **80–86**, provides a means for scanning the code number set up in the flip-flop circuits **70–76** digit by digit, and for providing for each such flip-flop circuit an output signal in either line **95** or line **105**, characteristic of whether the digit in the flip-flop being examined is an "0" or a "1."

At the same time, the photocells PC_1 and PC_0 are scanning or reading the code indicia on the disk to determine, digit by digit, the characteristic code number which is passing these photocells between two consecutive reset marks **35**. These marks index beam switch tube **110** with the photocells or reading means, and thus if there is a coincidence between the first digit of the code number being read and the first digit in the number set up in flip-flops **70–76** by the selector, then an output pulse through line **60** causes the controlling flip-flop **62** to step the electron beam to the next target **121**. If the second mark of the code indicia being read coincides with the set of the second flip-flop **71** again the discriminator circuits (pentodes **45** and **55**) provides a stepping pulse to step the beam to the third target **122**, and so on. Thus, since the pentodes **45** and **55** both have their place circuits connected to the flip-flop **62**, and since the grids $45G_1$ and $55G_2$ are alternately biased positive, this circuit tends to advance or step the beam switching tube **110** in phase with the rate at which the reading means (photocells PC_1 and PC_0) scans or reads the digits of the code data. If at any time during this comparing operation, which occurs over and over for each identified code indicia on the matrix disk, there is a noncoincidence, then the beam switch tube **110** does not advance for that one step and lags behind, or falls out of phase with, the code being read or scanned. In order to have an output through line **170** which will trigger the spark control circuit **172**, the discriminator circuits must find seven coincidences, or in other words it must find the code number set up by the selector by comparing each digit thereof with each digit of the code indicia being scanned.

Assuming that coincidence is found, then the electron beam will switch to the eighth position, target **127**, and the sharp or fast rising pulse referred to above will pass from through line **170** from spade **137** to the spark control circuit **172**. Accordingly, there is no "rough and fine" control as heretofore employed, but instead the present invention provides for comparison of the desired code number with all of the code indicia on the matrix disk, each independently of the other, and once the code on the disk is found that coincides with the code set up in the selector, the light source or spark is fired immediately, or within a very short predetermined interval which is independent of any "fine" control, to photograph the corresponding selected character. At the same time, the slower rising pulse that appears at target **127** will pass through line **175** and amplifier **176** to erase from the flip-flops **70–76** the code number which has just been located, setting these flip-flops to a basic position and preparing them to receive a further code number to select the next desired character. It will be noted that the above described apparatus is independent of any index or basic position on the matrix disk, and thus the system is capable of selecting a number of characters during each cycle of relative movement between the matrix disk and the code reading means and the

optical system, within the limits, of course, of the system to accept new selection code numbers and to reset itself.

Another form of apparatus in accordance with the invention is shown in FIGS. 3 and 4. Since the matrix disk, optical and recording system, the reading means, and the character selector are all the same as in FIG. 1, like reference numerals have been applied to these parts. The character selector circuit **65** is connected through its output **66** to set up in the bi-stable flip-flop circuits **210–216** the binary code number which it is desired to locate on the matrix. Each of these flip-flop circuits may include the conventional Eccles-Jordan circuit details of which are shown for flip-flop **210** of FIG. 4.

This circuit includes the dual triode **217** of which one side or the other may be conducting, depending upon the state in which the circuit is set. Accordingly, as is well known in the art, grid $217G_1$ may be biased positive when the left side of the tube is conducting, indicating a state of "1" for the flip-flop, and conversely grid $217G_2$ will be biased positive when the flip-flop is in its "0" state. The flip-flop circuit may be set up by a pulse from control tube **220** which may in turn be controlled from the selector circuit **65** (for example as disclosed in copending application Serial No. 640,741, filed February 18, 1957).

The controlling outputs of the flip-flop **210** (and likewise similarly for the flip-flops **211–216**) are through lines **222** and **224** which are tied directly to the two grids of tube **217** and are biased accordingly. The comparing circuits are designated generally in FIG. 3 by the reference numerals **230–236**, and each of these is coupled to a corresponding flip-flop **210–216** respectively in the same manner as shown in FIG. 4. Accordingly, the comparing or discriminating circuit **230** includes a pair of pentodes **240** and **242**. For purposes of illustration the screen grids have not been shown in the drawings, since they form no part of the control of these tubes. A common plate output line **245** is connected to all of the plates of these discriminating pentodes in each of the discriminating circuits **230–236**, and this line leads to the regulating or beam switching bi-stable flip-flop circuit **250** (FIG. 3).

Line **222** is connected to one control grid $240G_1$ of tube **240**, and similarly line **224** is connected to grid $242G_1$ of tube **242**. The other control grids $240G_2$ and $242G_2$ are similarly biased negative through biasing resistors **243**, and grid $240G_2$ is connected to receive a pulse through condenser **252** from the photocell trigger amplifier **42** which in turn receives pulses from photocell PC_1. In a similar manner grid $242G_2$ is connected to receive pulses from PC_0 through trigger amplifier **52** and coupling condenser **253**.

A beam switching tube **260** is provided, having its beam switching circuit **262** under the control of flip-flop **250**, as shown in FIG. 1, so that every pulse fed through line **245** results in a switching action within flip-flop **250**, which in turn changes the bias on the grid elements **270–279** to step the electron beam successively to the target elements **280–289**. Each of the beam deflecting spade elements **290–299** is connected through a corresponding resistor to ground. The first seven target elements **280–286** are connected to the seven comparing outputs **300–306** which in turn lead to the respective comparing or discriminating circuits **230–236**, and in each instance the corresponding line from the beam switching tube **260** is connected to the cathodes of both the discriminating pentodes within that discriminating circuit, as shown in FIG. 4.

Referring to FIG. 3 the outputs of both trigger amplifiers **42** and **52** are connected through lines **308** and **309** to a conventional "and" gate circuit **310**, the output of which is fed into a suitable phase inverter **312**, and the output **313** of the phase inverter leads to a typical reset circuit **315** for the beam switching tube, and through branch line **316** the output of the phase inverter operates to reset flip-flop **250** to a desired state. The output **313** of reset circuit **315** is connected through the condenser resistor network **319** to the spade elements of the beam switching tube for resetting the electron beam to the first target element **280**, and operates by lowering all spades to below a predetermined cutoff potential. The spade element **280** is slower to return to B+ potential, due to the capacitance **319'** in its B+ connection, and this causes the electron beam to form on the first target **280**.

The operation of this embodiment of the invention is generally similar to that of the system previously described. A desired code number is set into the flip-flops **210–216** by the character selected, and the connections between these flip-flops and the discriminating circuits **230–236** operate to bias positive one or the other of the control grids $240G_1$ or $242G_1$ in the corresponding discriminating circuit, thus preparing one or the other of the discriminating tubes **240** or **242** for conducting. With the beam switching tube in its first position the cathodes of the discriminating tubes in circuit **230** are connected to a negative voltage, and a pulse is received from one or the other of the photocells PC_0 or PC_1 in scanning the first digit of a complete code indicia on the disk.

Assuming the same example as used before, 1000000 identifying character A, then the pulse through condenser **252** would momentarily bias grid $240G_2$ positive, and since flip-flop **210** was set up to its "1" state, grids $217G_1$ and $240G_1$ would be biased positive and an output pulse would appear in line **245**, passing through the coupling condenser **320** to flip-flop **250**. This in turn would cause the advance of the electron beam in beam switching tube **260** to the next target element **281**, and the same comparison would be made between the second digit of the code and the code digit in flip-flop **211**. If a coincidence is found then a further pulse will pass through output line **245** to flip-flop **250**, and so on.

However, if in any one of the discriminating circuits **230–236** a pulse from the photocell reading means enters from one photocell while the opposite discriminating pentode is set up to conduct by the corresponding selector flip-flop, or in other words if there is a noncoincidence, then the beam switching tube **260** will fall behind or out of phase with the matrix, and the required seven output pulses through line **245** will not be obtained. Accordingly, the electron beam will not reach the eighth target element **287**. If, however, there is a complete digit by digit coincidence then the beam will clamp to this target and a pulse will pass through output line **325** to the spark control circuit **172**, causing a spark between the electrodes **17** which will illuminate the desired selected character. At the same time a pulse will be passed through line **327** to clear the selector flip-flops **210–216** preparatory to setting up a new code number therein by the selector circuits.

A further modified form of apparatus is illustrated in FIG. 5, where again the same reference numerals as in FIG. 1 have been applied to the common parts such as the matrix disk, optical and recording systems, the code reading means, and the character selector. The output of selector **65** is connected through line **66** to control individually the setting of seven bi-stable flip-flop circuits **410–416**, and each of these flip-flops is tied to a corresponding discriminator circuit **430–436** which is of the same type, and is connected to its corresponding flip-flop, in the same manner as shown in FIG. 4 and disclosed in the accompanying description above.

In similar fashion the outputs of trigger amplifiers **42** and **52** are connected through lines **437** and **438** to each of the discriminator circuits. An "or" gate circuit **450** is connected to receive pulses from either of the trigger amplifiers **42** or **52**, and as its name implies, this circuit passes a pulse from either of the photocells PC_1 or PC_0 through a delay circuit **452** to its output line **453** which feeds the pulses to a regulating bi-stable flip-flop circuit **455**. Opposite sides of this regulating flip-flop are tied through a conventional switching network **457** to the odd and even

numbered switching grid elements **460–469** of a beam switching tube **458**. The target elements **470–476** of tube **458** are connected to the discriminating circuits **430–436**, to provide for sequential activation of these discriminator circuits to compare the code set up in the selector circuits with the code indicia read from the matrix disk **10**.

An "and" gate circuit **485** receives pulses from both the photocells PC_1 and PC_0, but of course passes a pulse through its output **486** only when the elongated or reset marks **35** (FIG. 2) pass both of the photocells. Such an output pulse passes through a phase inverter **487** into an output line **490** which is tied to the reset circuit **492** for beam switching tube **458**, as well as to a reset line **493** for regulating flip-flop **455**. Thus, a pulse from "and" gate **485** resets the regulator flip-flop **455** to a predetermined state, and also resets beam switching tube **458** to direct the electron beam to the first target element **470**.

The output of the discriminator circuits **430–436** is a common plate line **500** which is connected in parallel to all the plate circuits of all of the pentodes in the discriminator circuits, in the same manner as line **245** in FIGS. 3 and 4. A further beam switching tube **505** is provided, operating between ground and B+ voltage, and the switching grid elements **510–519** of this tube are connected to a conventional switching circuit **520** under the control of a further regulating flip-flop **525**, which in turn receives the output pulses from discriminator output line **500**. The switching grid elements **510–519** are connected in the usual manner through lines **526** and **527** so that the odd and even numbered switching grids are connected to lines **526** and **527**, respectively.

A reset circuit **530** is connected to the beam deflecting spade elements of tube **505** in the usual manner and receives an actuating pulse through line **532** from the phase inverter output **490** for the purpose of resetting beam switching tube **505** and directing the electron beam in that tube to the first target element **540**. All of the target elements **540–549** are tied through load resistors to the positive or B+ high voltage supply. The target element **547** is also connected to the output line **550** which extends to spark control unit **172**, and thus after beam switching tube **505** has been reset a total of seven pulses must be received to regulating flip-flop **525** to advance the electron beam in tube **505** to the target element **547**, resulting in an output to the spark control unit **172** effective to photograph the selected character. A reset pulse is also directed from output line **550** through line **552** to reset the flip-flop circuits **410–416** to a desired state.

The operation of the system shown in FIG. 5 will be understood from the description of the previous embodiment, and therefore will not be discussed in detail. It is understood that the discriminator circuits **430–436** are activated in sequence by the beam switching tube **458** and operate to compare the binary code set up therein, digit by digit, from the photocells PC_0 and PC_1, with the code set up in the selector flip-flops **410–416** by the selector circuits **65**. If the code indicia read coincides, digit by digit, with the code in the selector flip-flops, then a total of seven output pulses will pass to the regulating flip-flop **525**, and beam switching tube **505** will advance step by step until the electron beam strikes the target element **547**, resulting in a spark initiating pulse through output line **550**. If at any time during the reading of code indicia between successive reset marks **35** there is a non-coincidence, then beam switching tube **505** will fall behind or out of phase with the system. There will be less than seven pulses fed to regulating flip-flop **525** before the next following reset mark **35** causes a pulse to pass through "and" gate **485**, with resultant resetting of both beam switching tubes **458** and **505** and also resetting of both regulating flip-flops **455** and **525** without an output to the spark control circuits.

Thus, the operation of each of the above described systems is such that a code number set into the selector bank of flip-flop circuits is compared, digit by digit, with each of the code indicia on the disk identifying each of the characters, the disk being passed by the photocell reading means to scan each code indicia or number on the matrix disk in sequence. This comparison may, especially in the case of binary code systems, be direct, i.e., "1" for "1," or it may be a comparison of complements, i.e., the output signal may be given when the reading means locates the complement of the code number set into the selector. Such a result may be obtained, as well known in the art, by causing the discriminator circuits to produce beam switching signals only when the complementary digits are sensed in the selector flip-flop and in the reading means.

In the above sense, therefore, the term "coincidence" as used herein may mean locating of like digits and code data or complementary digits and code data. If there is a non-coincidence between any digit the system falls out of phase with the disk, for lack of a coincidence pulse, and no output to the spark control unit will be provided for that indicia. The system will be reset to scan the next indicia, and so on, and when a complete digit by digit coincidence occurs, then an output pulse will pass immediately to the spark control unit to actuate the same and photograph the character selected. These systems, therefore, can operate at a relatively high rate and are capable of photographing more than one character for each cycle or revolution of the disk past the photocell reading means.

The present system is, of course, applicable to different types of code comparing or coincidence seeking uses and is not confined to use in phototypesetting apparatus. The above described systems may, therefore, be considered as exemplary for the purpose of disclosing typical practical applications of the principles of the present invention.

While the forms of apparatus herein described constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to these precise forms of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. A character selection system for phototypesetting apparatus, comprising a matrix having a plurality of characters defined thereon by parts of differential light transmitting ability, a controllable flashing light source of relatively high intensity and short duration, means mounting said matrix and said light source providing for relative movement therebetween to align said light source with individual characters in predetermined succession, multi-digit code means on said matrix provided by a plurality of impulse generated means representing individual digits and associated with and identifying each of said characters, means for reading the code means for each said character in digit-by-digit fashion during relative movement between said matrix and said light source, a selector including means for retaining temporarily code data corresponding to a selected character, comparing means having inputs from said reading means and said selector, means controlled by said comparing means for providing an output for every coincidence between digits of the retained code data and said code means, stepping means having a plurality of stages at least equal in number to the number of digits in said code means, said stepping means being connected to said output and being responsive thereto for advancing one step for each digit coincidence output, circuit means between said reading means and said stepping means tending to advance said stepping means in phase with the rate of digit-by-digit reading of the code means by said reading means, and a connection between the last stage of said stepping means and said flashing light source for energization thereof when said stepping means is advanced through a complete cycle indicative of coincidence between the

retained code data and the code means for the selected character.

2. A character selection system for phototypesetting apparatus, comprising a matrix having a plurality of characters defined thereon by parts of differential light transmitting ability, a controllable flashing light source of relatively high intensity and short duration, means mounting said matrix and said light source providing for continuous relative movement therebetween to align said light source with individual characters in predetermined succession, multi-digit code means on said matrix associated with and identifying each of said characters, means for reading the code means for each said character during relative movement between said matrix and said light source, a selector including means for retaining temporarily code data corresponding to a selected character, digit comparing means having inputs from said reading means and said selector, means controlled by said comparing means for providing an output for every coincidence between digits of the retained code data and said code means, stepping means having a plurality of stages at least equal in number to the number of units in said code means, said stepping means being connected to said output and being responsive thereto for advancing one step for each coincidence output, means tending to advance said stepping means in phase with the rate at which said reading means scans the code means in digit-by-digit fashion, a connection between the last stage of said stepping means and said flashing light source for energization thereof when said stepping means is advanced through a complete cycle indicative of coincidence between the retained code data and the code means for the selected character, and reset means connected to said stepping means for resetting thereof to the first stage upon reading of each code means for each character.

3. A character selection system for phototypesetting apparatus comprising a matrix having a plurality of characters defined thereon by parts of differential light transmitting ability, a controllable flashing light source of relatively high intensity and short duration, means mounting said matrix and said light source providing for continuous relative movement therebetween to align said light source with individual characters in predetermined succession, binary number code means on said matrix associated with and identifying each of said characters, each number of said code means being characterized by a succession of pulse generating means arranged for scanning in sequence along with said relative movement between said light source and said matrix, each pulse generating means being located in one of two characteristic positions indicative of whether the digit it represents is a "1" or a "0," selector means for retaining binary code data identifying a particular character on said matrix, reading means for scanning each of the two possible positions for each digit of each number on said matrix, means mounting said reading means for relative movement with respect to said matrix for scanning the code numbers carried on said matrix along with relative movement between said light source and said matrix, comparing means connected between said reading means and said selector means for comparing digit by digit the number of said selector means with the numbers on said matrix, stepping means in said comparing means and receiving a pulse for each digit in either position scanned by said reading means tending to advance said stepping means in phase with said reading means, and means connected to said comparing means and to said light source producing an output signal to flash said light source only upon sensing of complete coincidence between all of the digits in the number retained in said selector means and a number on said matrix.

4. A character selection system for phototypesetting apparatus including in combination a matrix bearing a plurality of characters, a controllable flashing light source for illuminating chosen ones of said characters in succession, and means mounting said matrix and said light source for relative movement to project said characters in succession along a common optical path, said system comprising binary code indicia on said matrix in predetermined relation to and identifying each of said characters, said code indicia including a plurality of pulse generating means located in one or the other of two paths adapted to be scanned during said relative movement to generate in succession for each code indicia digit pulses corresponding to a "1" or "0", reading means mounted to scan said pulse generating means and to transmit separate outputs for said "1" pulses and said "0" pulses, discriminator means connected to receive said outputs from said reading means, a bank of bi-stable flip-flop circuits corresponding in number to the number of digits in the code indicia, selector means connected to said flip-flop for setting the same individually to states corresponding to the digits in a selected code number, normally inactive circuit means between each of said flip-flops and said discriminator means for conveying thereto the state of the individual flip-flops, switching means operatively associated with said normally inactive circuit means for activating the same individually in sequence to compare the state of each said flip-flop with a corresponding digit pulse, circuit means responsive to the rate of operation of said reading means and connected to said switching means tending to advance said switching means in phase with the rate of operation of said reading means, an output signal connection from said discriminator means to said switching means advancing the same from one normally inactive circuit means to the next in response to a coincidence between a digit pulse and the state of the corresponding flip-flop, and means responsive to successive activation of all said normally inactive circuit means for flashing said light source.

5. Apparatus for determining the location of a selected binary number on a member having a plurality of such numbers arranged in succession thereon, each number being characterized by a succession of pulse generating means arranged for scanning in sequence, each pulse generating means being located in one of two characteristic positions indicative of whether the digit it represents is a "1" or a "0," selector means for retaining a binary number to be located on said member, reading means for scanning each number on said member digit by digit, means mounting said reading means and said member for scanning the numbers carried on said member, comparing means connected between said reading means and said selector means for comparing digit by digit the number in said selector means with the numbers on said member, said comparing means producing an output signal for each coincidence between a digit of the number in said selector means and a digit of the number being scanned, stepping means having a plurality of stages at least equal in number to the number of digits in the binary numbers on said member, means connecting said stepping means to said comparing means advancing said stepping means one step for each digit coincidence signal from said comparing means, circuit means connected between said reading means and said stepping means tending to advance said stepping means one step for each digit read by said reading means, output means connected to said stepping means for transmitting an output signal therefrom indicative of a complete coincidence between all of the digits of the number in said selector means with all of the digits of a number on said member, and means for resetting said comparing means after scanning all digits of a number without a complete coincidence.

6. Apparatus for determining the location of a selected binary number on a member having a plurality of such numbers arranged in succession thereon, each number being characterized by a succession of pulse generating means arranged for scanning in sequence, each pulse generating means being located in one of two characteristic positions indicative of whether the digit it represents is a

"1" or a "0," selector means for retaining a binary number to be located on said member, reading means for scanning each number on said member digit by digit, means mounting said reading means and said member for scanning the numbers carried on said member, comparing means connected between said reading means and said selector means for comparing digit by digit the number in said selector means with the numbers on said member, said comparing means producing an output signal for each coincidence between a digit of the number in said selector means and a digit of the number being scanned, stepping means having a plurality of stages at least equal in number to the number of digits in the binary numbers on said member, means connecting said stepping means to said comparing means advancing said stepping means one step for each digit coincidence signal from said comparing means, circuit means connected between said reading means and said stepping means tending to advance said stepping means one step for each digit read by said reading means, output means connected to said stepping means for transmitting an output signal therefrom indicative of a complete coincidence between all of the digits of the number in said selector means with all of the digits of a number on said member, and reset means connected between said stepping means and said selector means for erasing the number retained in said selector means once the number has been located on said member.

7. Apparatus for determining the location of a selected binary number on a member having a plurality of such numbers arranged in succession thereon, each number being characterized by a succession of pulse generating means arranged for scanning in sequence, each pulse generating means being located in one of two characteristic positions indicative of whether the digit it represents is a "1" or a "0," selector means for retaining a binary number to be located on said member, reading means for scanning each number on said member digit by digit, means mounting said reading means and said member for continuously scanning the numbers carried on said member, comparing means connected between said reading means and said selector means for comparing digit by digit the number in said selector means with the numbers on said member, said comparing means producing an output signal for each coincidence between a digit of the number in said selector means and a digit of the number being scanned, stepping means having a plurality of stages at least equal in number to the number of digits in the binary numbers on said member, means connecting said stepping means to said comparing means advancing said stepping means one step for each digit coincidence signal from said comparing means, circuit means connected between said reading means and said stepping means tending to advance said stepping means one step for each digit read by said reading means, output means connected to said stepping means for transmitting an output signal therefrom indicative of a complete coincidence between all of the digits of the number in said selector means with all of the digits of a number on said member, means for resetting said comparing means after scanning all digits of a number without a complete coincidence, and reset means connected between said stepping means and said selector means for erasing the number retained in said selector means once the number has been located on said member.

8. Apparatus for locating a selected binary number on a member bearing a plurality of different binary code indicia, said code indicia including a plurality of pulse generating means located in one or the other of two paths on said member, said pulse generating means being adapted to generate in succession for each code indicia digit pulses corresponding to a "1" or a "0," reading means mounted to scan said pulse generating means and to transmit separate outputs for said "1" pulses and said "0" pulses, discriminator means connected to receive said outputs from said reading means, a bank of bi-stable flip-flop circuits corresponding in number to the number of digits in the code indicia, selector means connected to said flip-flops for setting the same individually to states corresponding to the digits in a selected binary code number, normally inactive circuit means between each of said flip-flops and said discriminator means for conveying thereto the state of the individual flip-flops, switching means operatively associated with said normally inactive circuit means for activating the same individually in sequence to compare the state of each said flip-flop with a corresponding digit pulse, circuit means connected between said reading means and said switching means tending to advance said switching means once for each scanning of a single digit by said reading means, an output signal connection from said discriminator means to said switching means for advancing the same from one normally inactive circuit means to the next in response to a coincidence between a digit pulse and the state of the corresponding flip-flop, and means responsive to successive activation of all said normally inactive circuit means providing an output signal indicative of complete coincidence between the selected code number and code indicia on said member.

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