Jan. 6, 1953 E. W. DINGA 2,624,798

PHOTOCOMPOSING MACHINE

Filed March 23, 1948 3 Sheets-Sheet 1

Fig. 1.

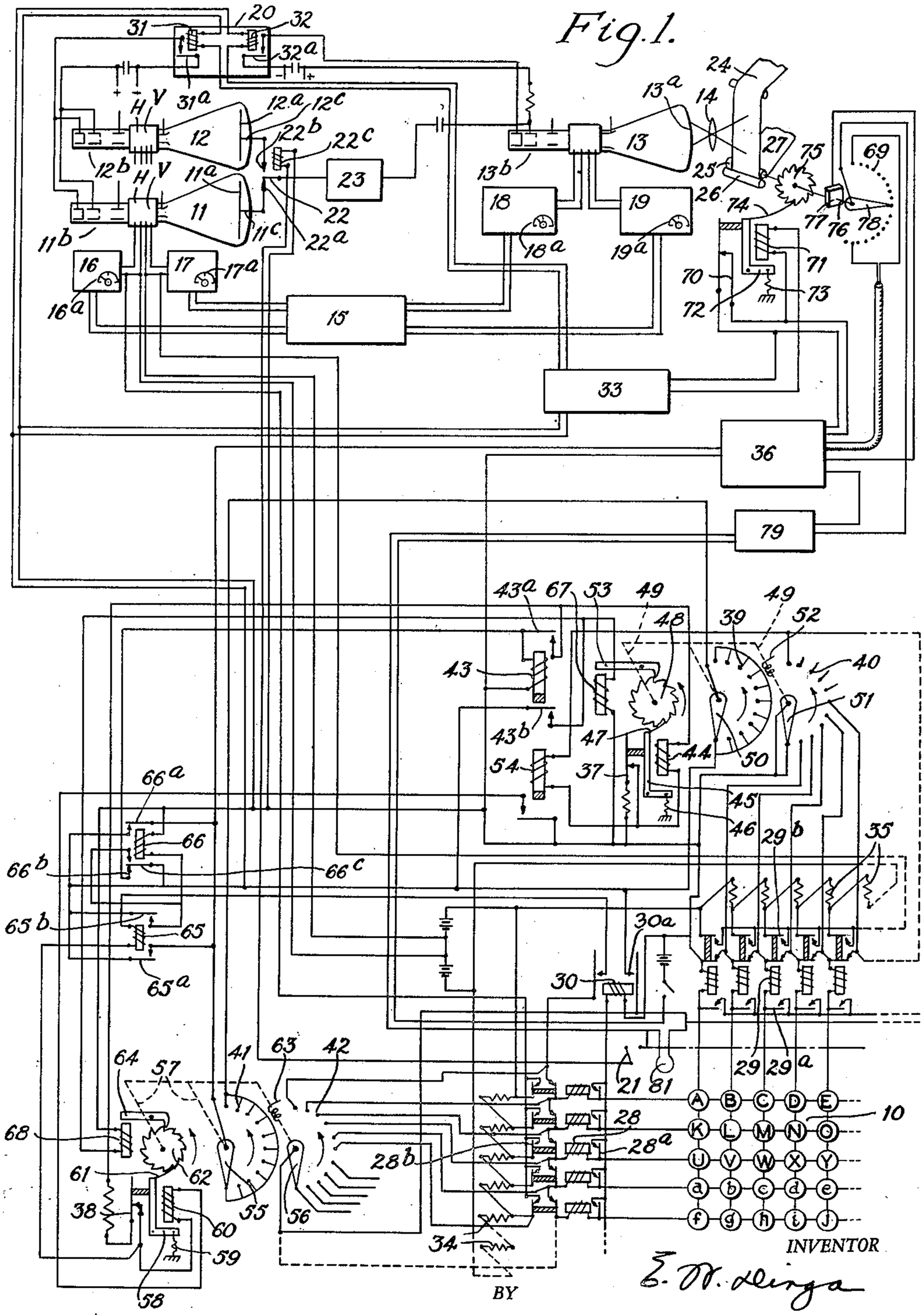

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Fig. 2.

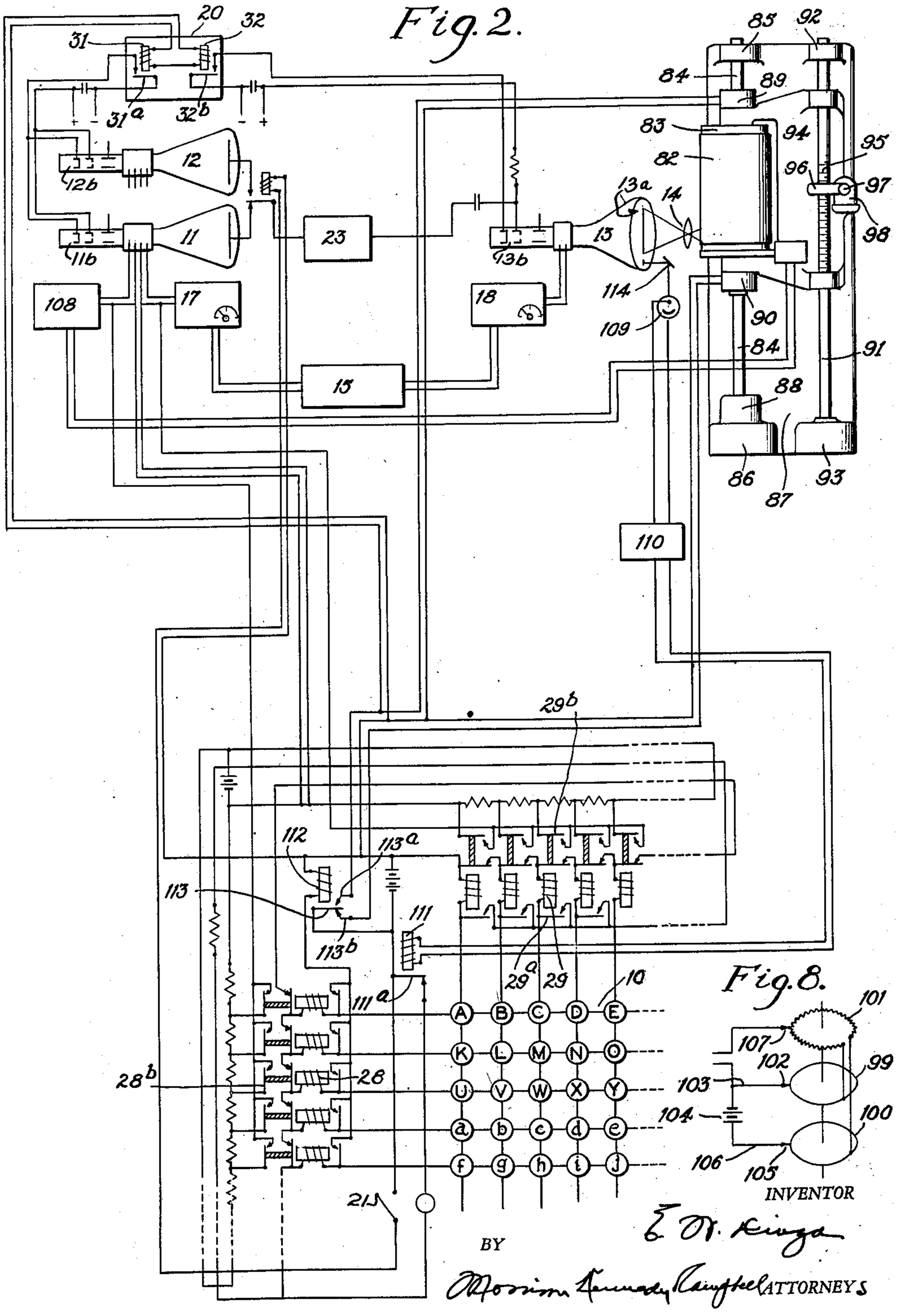

Fig. 8.

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Fig. 4.

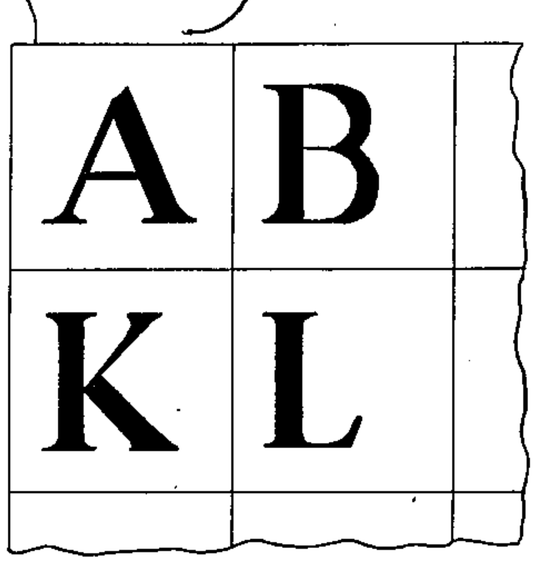


Fig. 6.

EVALUATE TYPE
EVALUATE TYPE
EVALUATE TYPE

Fig. 5.

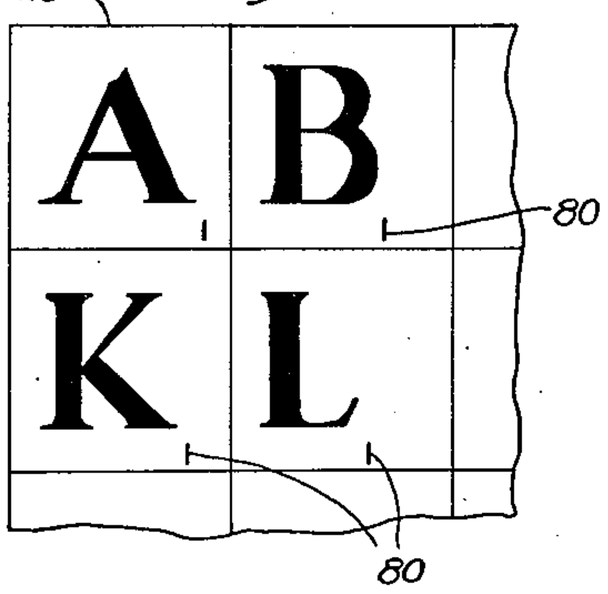


Fig. 7.

K K

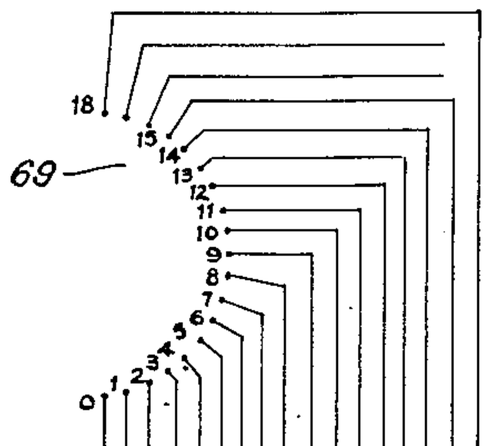
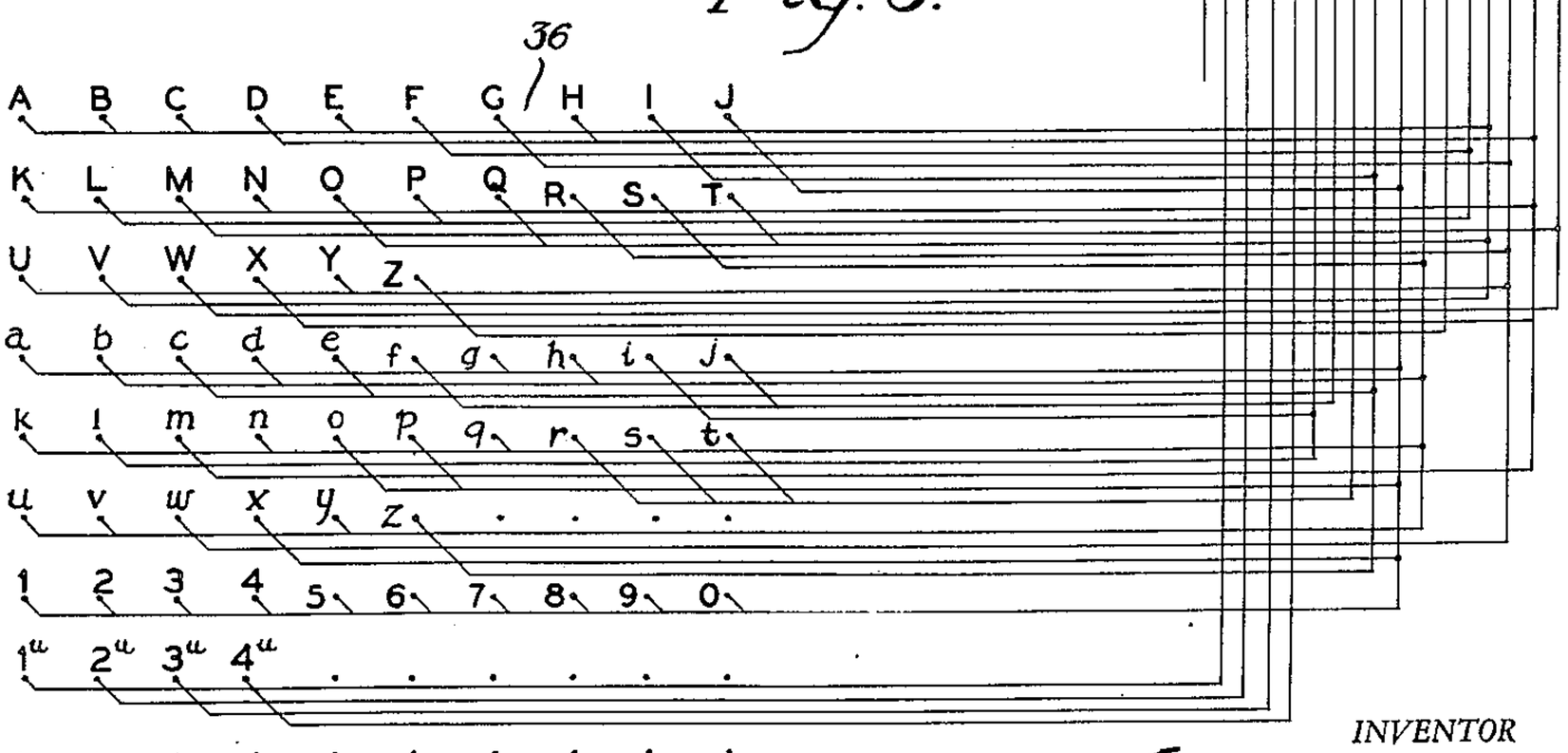


Fig. 3.



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Patented Jan. 6, 1953 2,624,798

UNITED STATES PATENT OFFICE

2,624,798

PHOTOCOMPOSING MACHINE

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Application March 23, 1948, Serial No. 16,531

17 Claims. (Cl. 178—6.7)

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This invention relates to photo-composing machines, that is to say, machines wherein selected type characters are composed in line photographically.

Heretofore, many machines of this sort have been proposed. However, none of these machines is being used commercially to any great extent, especially in the newspaper and book publishing fields which demand that the printed matter be well defined or sharp in outline and the characters be properly spaced apart. In these branches of the printing industry, it is also important that the composing machine be such that different type faces may be composed in line.

Prior photo-composing machines have either failed to satisfy these requirements or they have been so highly complicated as to be too costly to build or too slow in operation.

The foregoing and other well known objections are overcome by the present invention which provides for the first time a keyboard controlled composing machine embodying the principles of electronics.

In practicing the invention, the individual type characters to be composed in line are selectively scanned from a font or series of type characters associated with the screen in one cathode ray tube, the resultant impulses utilized to create in a second cathode ray tube images of the characters so scanned, and the images then photographed onto a light sensitive member in a predetermined spaced relationship with respect to one another.

In accordance with one embodiment of the invention, the scanning of the selected characters is effected in the conventional manner, that is to say, by a beam of electrons that vibrates in two planes, but the amplitudes of these vibrations are restricted to the extent that the beam scans a substantially square area slightly larger than the area occupied by the largest character in the font. Normally, the vibrating beam of electrons is directed towards the center of the screen. In response to the operation of a key on a keyboard, however, the beam is shifted until it is caused to scan a selected character. As the beam scans this character, impulses are generated on the signal lead or electrode leading from the screen and these impulses are utilized to create in a second tube a full or complete image of the character thus scanned. As the image is so produced, a light sensitive member is exposed thereto for a predetermined length of time to create a photograph of the character,

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after which the member is moved a distance determined by the set width of the character.

In accordance with another embodiment of the invention, the scanning of the selected character is effected in panoramic fashion by a beam of electrons that vibrates in a single plane only. The amplitude of vibration of the beam is made such that it is slightly greater than the height of the tallest character in the font. In response to the operation of a key on a keyboard, this vibrating beam is shifted until it is adjacent one edge of a selected character and then it is moved progressively across this character. As the beam travels across the character, impulses are generated on the electrode leading from the screen. The impulses thus generated are utilized to create on the screen in the second tube an image of the character being scanned in the form of illuminated sections thereof. As the image is so created on the screen in the second tube, a light sensitive member is moved in front of it, with the result that a photograph thereof is progressively created on the light sensitive member. In addition, means are provided for arresting the movement of the light sensitive member after it has traveled a predetermined distance, the arrangement being such that the photographs of characters created on the member will bear spaced relationship determined by the varying set widths of the different characters.

Referring to the drawings—

Fig. 1 is a schematic view of that embodiment of the invention wherein full images of selected characters are created and photographed.

Fig. 2 is a schematic view of that embodiment of the invention wherein images of selected characters are progressively created and photographed.

Fig. 3 is a schematic view of the two motion switch and the electrical connections leading therefrom to control the operation of the rotary switch employed in the first embodiment of the invention for moving the film.

Fig. 4 is an enlarged view of a portion of the screen associated with the transmitting tube employed in the first embodiment of the invention.

Fig. 5 is an enlarged view of a portion of the screen associated with the transmitting tube employed in the second embodiment of the invention.

Fig. 6 is a view showing a composed line of type characters selected from the screen associated with one transmitting tube, a composed line of type characters selected from the screen associated with a second transmitting tube, and a com-

posed line of type characters selected from both screens.

Fig. 7 is a view showing a condensed and an expanded character; and

Fig. 8 is a schematic view of the circuits associated with the drum employed in the second embodiment of the invention for progressively moving the electron beam across a selected character.

In the first embodiment of the invention wherein full or complete images of selected characters are to be created and photographed, the apparatus employed comprises an electrically operated keyboard **10**, a pair of Monoscopes or transmitting tubes **11**, **12**, a Kinescope or receiving tube **13**, and a camera having a lens **14**.

While the keyboard **10** may be of any standard type, the one employed, and a portion of which is shown, comprises ten horizontal and ten vertical rows of keys marked with index characters for a font or series of one hundred different type characters.

As is well known, both types of tubes are somewhat similar in construction, each tube being provided with a screen **11**^{a}, **12**^{a}, **13**^{a}, a gun portion **11**^{b}, **12**^{b}, **13**^{b} for generating and directing a beam of electrons towards the center of the screen, and a pair of plates or yokes H, V which, when energized by alternating current, serve to deflect the beam in two planes. In accordance with the present invention, the energization of the yokes H, V is effected by means of an oscillator **15**, the output of which is fed to the yokes through amplifiers **16** to **19** inclusive.

Also, in accordance with the present invention, the so-called first grids of the gun portions of the tubes are all connected to a brightness control unit **20** by means of which the first grid is normally floating with respect of the cathode under which condition no electron beam is formed.

The two types of tubes, however, differ from one another in that the screen **13**^{a} in the receiving tube **13** is of the fluorescent type which, when bombarded by a beam of electrons, serves as a transducer, absorbing electrical energy and emitting light, whereas the screens **11**^{a}, **12**^{a} in the transmitting tubes **11**, **12** comprise a metal plate having a pattern thereon which, when bombarded by a beam of electrons, generates a potential or impulse on the signal lead or electrode **11**^{c}, **12**^{c} which leads from the plate.

In accordance with the present invention, the patterns on the screen in each of the transmitting tubes **11**, **12** make up a font or series of one hundred different type characters, preferably arranged in ten horizontal and ten vertical rows to accord with the arrangement of like characters on the keys of the keyboard. The type faces of the characters in the two transmitting tubes **11**, **12**, however, may differ from one another. For example, the characters in tube **11** may be "Bodoni" and the characters in tube **12** may be "Caslon."

The two transmitting tubes **11**, **12** are so arranged that in response to the operation of a control switch **21** positioned adjacent the keyboard, one or the other may be operatively connected through an amplifier **23** to the gun portion **13**^{b} of the receiving tube **13**. To this end, the signal leads or electrodes **11**^{c}, **12**^{c} leading from the two tubes **11**, **12** are connected to the two contacts, **22**^{a}, **22**^{b} of a switch **22**. Normally, a contact **22**^{a} serves to operatively connect the electrode leading from tube **11** to the receiving tube **13**. When the control switch **21** is operated, however, a circuit is completed through the winding of a relay **22**^{c} which then functions to open contact **22**^{a} and to close contact **22**^{b} and thus connect the other transmitting tube **12** to the receiving tube **13**.

The camera comprises a light tight compartment (not shown) in which is mounted the Kinescope **13** and the lens **14**, the lens **14** being positioned between the face of the Kinescope **13** and a film **24** which extends downwardly from a spool (not shown) and thence between a pair of friction rollers **25**, **26** one of which is mounted on a shaft **27**.

When it is desired to compose a line of characters of a given type face, the tube containing the screen having the type characters of that face is brought into operative position with respect to the Kinescope **13** in the manner explained above. Thereafter the keys on the keyboard **10** which represent the selected characters it is desired to compose in line are operated one after another. As each key is depressed, it inaugurates a cycle of operations during which the brightness control unit **20** is rendered operative thereby allowing the beam of electrons generated in the tube to travel towards the center of the screen, the beam vibrated in two planes, the vibrating beam shifted until it is caused to scan the character selected, the resultant impulses utilized to create in the Kinescope **13**, a full image of the character being scanned, the image photographed onto the film **24**, and the film **24** moved a distance equal to the set width of the image.

To more clearly understand how the cycle of operations is inaugurated and maintained, let it be assumed, for example, that the upper case character "W" of the Bodoni type face is to be composed in line. Under these conditions, the Monoscope **11** containing this character is brought into operative position with respect to the Kinescope **13**, after which the key bearing the index character "W" is depressed. When this key is depressed, it completes a circuit through the winding of two control relays **28**, **29** electrically connected thereto, relay **28** being one of ten electrically connected to the keys in the ten horizontal rows of keys, and relay **29** being one of ten electrically connected to the keys in the ten vertical rows of keys. As soon as this circuit is completed, relays **28**, **29** operate and close switches **28**^{a} and **29**^{a} to establish circuits that maintain them locked in operative position. After these relays are locked, the key may be released.

When switch **28**^{a} closes, it also serves to complete a circuit through the winding of a relay **30**. When relay **30** is thus energized, it closes switch **30**^{a} which then functions to complete two circuits, one being through the windings of two relays **31**, **32** in the brightness control unit **20**, and the other being through the winding of a motor (not shown) in a time delay relay **33**. When the circuit through the windings of relays **31**, **32** in the brightness control unit **20** has been completed, these relays operate to close switches **31**^{a}, **32**^{a}, respectively, and in so doing render the control unit operative.

When the brightness control unit **20** has been rendered operative, the beam of electrons generated in this tube is free to travel towards the center of the screen. As this beam travels through the tube, the deflecting yokes H, V serve to vibrate it in two planes, and the input from the oscillator **15** to the yokes is so regulated by means of the gain control units **16**^{a}, **17**^{a} asso-

ciated with the amplifiers 16, 17 that the amplitudes of vibrations of the beam are such that the beam scans a substantially square area slightly larger than the area occupied by the largest character on the screen.

In addition, when relay 28 operates it closes switch 28b and taps in on a closed direct current circuit having a series of resistances 34 to complete a circuit through the horizontal deflecting yoke H of the Monoscope 11. Where this circuit is tapped in at switch 28b, a positive potential obtains by virtue of the fact that there is less resistance in the positive leg than in the negative leg of the circuit. In consequence, a positive potential is superimposed on the horizontal deflection yoke H of the Monoscope 11, and the unbalance in the circuit is such that the potential thus applied is sufficient to shift the vibrating beam horizontally until it is in alignment with the character selected.

Likewise, when relay 29 operates, it closes switch 29b and taps in on a second closed direct current circuit having a series of resistances 35 to superimpose a positive potential upon the vertical deflection yoke V of the Monoscope 11, and the unbalance in the circuit is such that the potential thus applied is sufficient to shift the vibrating beam vertically until it is in alignment with the character selected. In other words, in response to the operation of a key on the keyboard 10, the vibrating beam in the Monoscope 11 is shifted until it is caused to scan a character that corresponds to the key operated.

As the vibrating beam in the Monoscope 11 scans the selected character, an impulse is generated on the electrode 11c leading from the screen 11a each time the beam traverses the character. These impulses are fed through the amplifier 23 and then delivered to the gun portion 13b of the Kinescope 13. The brightness control unit 20 having been rendered operative, these impulses cause the intermittent release of electrons which are condensed into beams and directed towards the center of the fluorescent screen. As these beams travel through the tube 13, they are vibrated both horizontally and vertically by the yokes H, V with the result that a full or complete illuminated image of the character being scanned is created on the fluorescent screen 13a of the Kinescope 13.

As the image of the selected character is thus created on the fluorescent screen 13a, a photograph thereof is created on the film 24 through the medium of the lens 14 in a manner well understood.

The time of exposure of the film 24 to the image in the receiving tube 13 is controlled by the time delay relay 33 which, as explained heretofore, is set in motion when a key on the keyboard is operated. After the time for which the delay relay 33 was set has elapsed, it operates to break the circuit through the windings of the two relays 31, 32 in the brightness control unit 20 at which time these relays operate to open switches 31a, 32a and so render the control unit 20 inoperative. When the brightness control unit 20 is thus rendered inoperative, it again acts to remove the positive grid voltage to render the tube inoperative, at which time, of course, the fluorescent screen in the receiving tube 13 is dark.

After an image of a selected character has been photographed, the film 24 is advanced a distance equal to the set width of the photographed character. In this embodiment of the invention, the film is advanced in accordance with the well

known system of spacing type characters in a composed line wherein the em measure is divided into eighteen units and the set width of each character in the font is a multiple of one-eighteenth of the em measure. Accordingly, there is provided a so-called two-motion switch 36 of the type commonly used in telehpone exchanges. Since such switches are well known, a description thereof is not deemed necessary other than to say they comprise a semi-cylinder having horizontal and vertical rows of contacts together with means responsive to the opening and closing of two circuits therethrough for moving a contact arm therein vertically from one horizontal row of contacts to the next and thereafter rotating the contact arm from one vertical row of contacts to the next to bring the contact arm therein into engagement with a selected contact.

In accordance with the present invention, the number of contacts in the two-motion switch 36 corresponds to the number of keys on the keyboard and they are arranged in like manner. In other words, the two-motion switch 36 is provided with one hundred contacts arranged in ten vertical and ten horizontal rows (Fig. 3).

When a key on the keyboard 10 is operated, the contact arm in the two motion switch 36 is moved into engagement with the contact therein which corresponds to this key, this being effected in two stages through the medium of a pair of vibrating or self-interrupting switches 37, 38 and a pair of rotary switches, 39 to 42 inclusive, associated with each vibrating switch. The number of contacts on the two rotary switches 39, 40 associated with vibrating switch 37 exceeds by one the number of vertical rows of keys, and the number of contacts on the two rotary switches 41, 42 associated with the vibrating switch 38 exceeds by one the number of horizontal rows of keys, the first contact in each rotary switch being neutral or the starting point of the switch.

When a key on the keyboard is operated, it completes a circuit through the winding of a relay 43 which functions, by closing switch 43a, to complete a circuit through the winding of relay 44 associated with the vibrating switch 37. Thereafter, relay 44 operates and rocks a pivotally mounted bell crank lever 45 in one direction against the action of a spring 46. As the bell crank lever 45 rocks in this direction, it pulls back a pusher arm 47 carried thereby from one to the next of a series of notches formed in the periphery of a disk 48 mounted on a shaft 49. Also, as the bell crank lever 45 rocks in this direction it opens the vibrating switch 37 and thus breaks the circuit through the winding of relay 44, at which time spring 46 acts to rock the lever 45 in the opposite direction to close the vibrating switch 37 by reestablishing the circuit through the winding of relay 44 and to rotate the shaft 49 to carry a pair of contact arms 50, 51 mounted thereon from the first to the second contact on the two rotary switches 39, 40. As soon as the circuit through the winding of relay 44 is reestablished, the above described cycle of operations continues to advance the contact arms 50, 51 step-by-step from contact to contact on the rotary switches 39, 40. The rotation of the shaft 49 is effected against the action of a spring 52, a pawl 53 being provided to hold the shaft 49 and the contact arms 50, 51 in the position to which they were advanced. All the contacts in the rotary switch 39 are electrically connected together, the arrangement being such that a cir-

cuit, which is initially established through the first or neutral contact of this switch and through the two-motion switch **36** when a key is operated, is opened each time the contact arm moves from one contact to the next. Each time this circuit is opened, the contact arm in the two-motion switch **36** moves vertically from one horizontal row of contacts to the next. When the contact arm in the two-motion switch **36** reaches the horizontal row of contacts that corresponds with the horizontal row of keys in which is located the key that is operated further movement thereof is arrested by the contact arm **51** of the second rotary switch **40**. Accordingly, the contacts on the second rotary switch **40** are so arranged that when a key is operated, a potential is applied to the contact that corresopnds with the vertical row in which the key operated is located. For example, when key "W" is operated and which is located in the third vertical row of contacts, a potential is applied to the fourth contact, the first contact being neutral or the starting point of the switch, as explained heretofore. When the contact arm **51** engages this contact it closes a circuit which, in by-passing the self interrupting switch **37**, prevents further movement of contact arms **50**, **51** and thus completes the first stage in the movement of the contact arm in the two motion switch **36**. Also, when contact arm **51** engages this contact it renders operative a slow motion relay **54** to inaugurate the second stage in the movement of the contact arm in the two-motion switch by putting in motion the second vibrating or self interrupting switch **38** to advance step-by-step a pair of contact arms **55**, **56** mounted on a shaft **57**, from one to the next of a series of contacts on the second pair of rotary switches **41**, **42**. The second self interrupting switch **38** operates in the manner heretofore explained, that is to say, a pivotally mounted bell crank lever **58** is rocked back and forth under the influence of a spring **59** and the alternate energization and de-energization of a relay **60** to advance the shaft **57** and the contact arms **55**, **56** through the medium of a pusher arm **61** carried by the lever **58** and a notched disk **62** mounted on the shaft **57**. The rotation of shaft **57** is also effected against the action of a spring **63** and, again, a pawl **64** is provided to hold the shaft **55** and the contact arms **55**, **56** carried thereby in the position to which they are moved.

All the contacts of rotary switch **41** are electrically connected together, the arrangement being such that a circuit which is established through the first contact of this switch and through the two-motion switch **36** when the slow acting relay **54** operates, is opened and closed each time the contact arm **55** moves from one contact to the next. Each time the circuit through the two-motion switch **36** is opened and closed in this manner, the contact arm therein is rotated from one vertical row of contacts to the next. When the contact arm in the two-motion switch **36** has been moved to the contact in the vertical row of contacts that corresponds to the vertical row of keys in which is located the key operated, further movement thereof is arrested through the medium of the contact arm **56** of the rotary switch **42**. In consequence, the contacts on the rotary switch **42** are so arranged that when a key is operated a potential is applied to the contact that corresponds with the horizontal row in which the key operated is located. For example, when key "W" is operated and which is located in the eighth horizontal row of

contacts as counted from the bottom up, a potential is applied to the ninth contact, the first being neutral or the starting point of the switch. When contact arm **56** on the rotary switch **42** engages this contact, it closes a circuit which in by-passing the self interrupting switch **38** completes the second stage in the movement of the contact arm in the two-motion switch **36** to bring it into engagement with the contact therein that accords with the key depressed.

After the contact arm in the two-motion switch **36** has been so located, it is locked in position. To this end, there is provided a relay **65** which is rendered operative when the circuit which halts further movement of the contact arm in the two motion switch has been completed. When relay **65** operates, it closes a switch **65a** and establishes a circuit which serves initially to hold the contact arm in the two-motion switch **36** in engagement with the contact to which it was moved.

Also, when relay **65** operates, it closes a second switch **65b** which then serves to establish a circuit through the winding of another relay **66**. When relay **66** operates it, in turn, closes a switch **66a** and thus completes a circuit that supersedes the initial lock-up circuit established to lock the contact arm in the two-motion switch **36** in its adjusted position.

After the contact arm in the two motion switch **36** has been locked in its adjusted position, the two rotary switches **39** to **41** inclusive are restored to their initial position, this being effected by means of relay **66** which in opening contact **66b** of switch **66c** breaks the circuit through the winding of relay **43**. When relay **43** is thus de-energized, switch **43b** closes and completes a circuit through the windings of two relays **67**, **68**. When relay **67** operates, it pulls the pawl **53** out of engagement with disk **43** at which time spring **52** acts to return contact arms **50**, **51** to their initial positions of engagement with the first contacts on the two rotary switches **39**, **40**. Likewise, when relay **68** operates, it pulls the pawl **64** out of engagement with disk **62** at which time spring **63** acts to return the contact arms **55**, **56** to their initial position of engagement with the first contacts of the two rotary switches **41**, **42**.

As before stated, the two motion switch **36** is provided with ten vertical and ten horizontal rows of contacts which accord with the arrangement of the keys on the keyboard. The contacts which accord with characters of the same set width are connected together and to one of eighteen contacts in still another rotary switch **69** and in proper sequence (Fig. 3). For example, the contacts that accord with the narrowest characters, such as the lower case "i," which have a set width of five units are connected together and to the fifth contact on the rotary switch **69** while the contacts that accord with the widest characters, such as the upper case "W," which have a set width of eighteen units are connected together and to the last or eighteenth contact (Fig. 5).

When the contact arm in the two motion switch **36** comes to rest it applies a potential to that contact on the rotary switch **69** that accords with the set width of the character scanned and reproduced.

Going back for the moment, let it be remembered that the time delay relay **33** served to render the brightness control unit **20** inoperative after the film **24** had been exposed to the reproduction or image on the fluorescent screen **13a**

in the receiving tube 13 for a predetermined length of time. When the time control relay 33 functioned, it also completed a circuit through a third self interrupting switch 70 and through the winding of a relay 71 associated therewith. Thereafter, the switch 70 operates in the manner heretofore explained, with the result that a pivotally mounted bell crank lever 72 associated therewith is rocked back and forth under the influence of a spring 73 and the alternate energization and de-energization of the relay 71. As the lever 72 rocks about its pivotal axis the shaft 27 which carries the friction roller 25 over which the film is threaded, is advanced step-by-step a distance equal to one unit of the em measure, this advance of the shaft 27 being effected through the medium of a pusher arm 74 which is carried by the lever 72 and a notched disk 75 mounted on the shaft 27. As the shaft 27 is so rotated, the film 24 is likewise advanced step-by-step in front of the fluorescent screen 13 in the receiving tube 13 a distance equal to one unit of the em measure. After the film 24 has advanced a distance equal to the set width of the photographed character, the self interrupting switch 70 is rendered inoperative to halt further advance of the film. Accordingly, the shaft 27 is coupled to a second shaft 76 through the medium of a magnetic clutch 77. The second shaft 76 carries a contact arm 78 that is also advanced step-by-step from one to the next of the eighteen contacts on the rotary switch 69 in response to the operation of the self-interrupting switch 70. When contact arm 78 is advanced into engagement with the contact to which potential was applied by the two motion switch 36, a circuit is completed which by-passes relay 71 and hence prevents further rotation of the shaft 27 and the various elements driven thereby. Also, at this time, a circuit is completed through a so-called wipe-out relay 79 which renders the magnetic clutch 77 inoperative and thus allows a spring (not shown) to restore the shaft 76 and the contact arm 78 carried thereby to their initial position. In addition, the wipe-out relay 79 when operated, completes a circuit through the two-motion switch 36 to allow the contact arm therein to return to its initial position. Also, the wipe-out relay 36, when operated, serves to break the lock-up circuits for relays 28, 29 and in this manner restores the circuit through the keys on the keyboard so that another cycle of operations may be inaugurated.

In addition to the above described arrangement for restoring the circuits to their initial condition, the keyboard is provided with a wipe-out key 81 which when depressed also breaks the lock-up circuits through relays 28, 29 to restore the circuits through the keys on the keyboard.

Also, to enable the operator to view the character being scanned and reproduced, a second Kinescope 13 or receiving tube (not shown) may be mounted adjacent the keyboard and a reproduction of the character being scanned created thereon in the same manner that a reproduction of this character is created in the Kinescope.

The size of an image thus created depends upon the amplitudes of the vibrations of the beam in the receiving tube 13 and may be varied by regulating the power input to the yokes H, V from the oscillator 15 by means of the gain control units 18ª, 19ª associated with the amplifiers 18, 19. For example, the size of the image may be made the same as the size of the character scanned or it may be enlarged, reduced, or distorted in height and/or width. In consequence,

from type characters of a given point size, images of the same point size or images of larger point sizes may be created on the screen in the receiving tube 13, and these images may be expanded or condensed as desired. In addition, the size of the photographs created from the images may be made the same as the size of the images or they may be enlarged or reduced by regulating the focal point of the lens 14. Hence, by combining the versatility of the image creating means with that of the camera, photographs of a great number of sizes and shapes may be obtained from type characters of a given size and face. For each change thus made in the photographic reproductions of the selected characters, a corresponding change must be made in the film feeding mechanism to insure that the film is advanced after each photographic operation a distance equal to the set width of the photographed character.

There remains to be described the advance of the film for spacing between words. Such advance is effected by means of a special spacer key which, when actuated, will shift the beam in the manner heretofore described until it is caused to scan a specially provided blank space on the pattern and at the same time put in motion the mechanism for advancing the film a given unit distance. This unit distance may be any one of the eighteen units above described but, for practical purposes, would normally be nine units (representing an "en" space) or eighteen units (representing an "em" space). However, to take advantage of word spacing on either unit basis, two blank spaces on the pattern and two separate keys would be provided, one for the "en" space and the other for the "em" space.

While in this embodiment of the invention, the film is advanced according to the unit system wherein the em measure is divided into eighteen units, other unit systems may be employed. For example, the em measure may be divided into thirty-six units. Under these conditions, of course, the number of contacts on rotary switch 69 would have to be changed accordingly and the pusher arm and notched disk arrangement for rotating the shaft 27 would have to be modified to the extent that the advance of the film would be doubled and that contact arm 78 actuated by shaft 27 would be moved from one contact to the next in response to the operation of the self interrupting switch 70.

In the second embodiment of the invention, wherein an image of a selected character is progressively created and photographed, the apparatus employed also comprises a keyboard 10, a plurality of Monoscopes 11, 12, a Kinescope 13, and a camera having a lens 14.

The keyboard employed in this embodiment of the invention is identical with the one heretofore described.

The Monoscopes 11, 12 and the Kinescope 13 employed in this embodiment are similar to those heretofore described save for the fact that the horizontal deflecting yoke on the Kinescope 13 is dispensed with. In addition, a cut-off mark 80 is positioned adjacent and below each character on the screens in the Monoscopes 11, 12.

As in the first embodiment, the gun portions 11ᵇ, 12ᵇ, 13ᵇ of the tubes 11, 12, 13 are connected to a brightness control unit 20 which as stated heretofore, normally serves to prevent the passage of electron beams through the tubes.

Also, as in the first embodiment, the coupling

of one or the other of the Monoscopes 11, 12 to the Kinescope 13 is effected by the operation of a control key 21 positioned adjacent the keyboard 10.

In this second embodiment, however, the output of the oscillator 15 is fed through amplifiers 17, 18 to the vertical deflection yokes V only.

Also in this second embodiment, a film 82 is wrapped around a vertically disposed drum 83 positioned behind the lens 14.

The drum 83 is mounted on a vertically disposed shaft 84 journaled in bearings 85, 86 carried by a frame 87, and it is driven by a motor 88 through the medium of a magnetic clutch 89. The drum 83 is so mounted on the shaft 84 that, while it rotates in unison therewith, it may be moved vertically therealong. In addition, the shaft 84 is provided with a magnetic brake 90 by means of which rotation of the shaft and drum may be arrested.

A second vertically disposed shaft 91, fixedly mounted in brackets 92, 93 carried by the frame 87, is positioned adjacent the drum carrying shaft 84. A U-shaped carriage 94 is slidably mounted on the second shaft 91 with its extending arms in engagement with the drum 83 at its opposite ends. Intermediate its ends, the second shaft 91 is provided with a threaded section 95 which engages a worm wheel 96 adapted to be rotated by a worm 97 driven by a motor 98 mounted on the carriage 94, the arrangement being such that when the worm wheel is turned by the motor driven worm the carriage and the drum are moved upwardly or downwardly depending on the direction of rotation of the motor.

When a selected character is to be composed in line, the Monoscope 11 or 12 containing that character is operatively connected to the Kinescope 13 in the manner heretofore explained. Thereafter, the key on the keyboard 10 corresponding to that character is depressed. As this key is depressed, a cycle of operations is inaugurated during which a beam of electrons that vibrates in one plane only is created in the Monoscope. The beam is then shifted to a fixed position adjacent that edge of the character opposite its associated cut-off mark 80, the distance between the fixed position and the cut-off mark being equal to the actual set width of the character. After the beam has been shifted to its fixed position, it is then drawn across the character, and the resultant impulses are utilized to create on the fluorescent screen 13a in the Kinescope 13, an image of the character in the form of illuminated sections thereof. As the image of the character is so created on the fluorescent screen 13a in the Kinescope 13, the film 82 is progressively exposed there to to create a photograph thereof. And finally, the movement of the film 82 is arrested after it has advanced a distance equal to the actual set width of the character.

To more clearly understand how this cycle of operations is inaugurated and maintained, again let it be assumed that the upper case character "W" of the Bodoni type face is to be composed in line. Under these conditions, Monoscope 11 which contains this character is brought into operative position with respect to the Kinescope 13 and key "W" on the keyboard 10 is depressed. In the manner heretofore explained, when this key is depressed, two control relays 28, 29 operate and then become locked in operative position. During the lock-up of the control relays 28, 29 a third relay 112 is operated to close contact

113a of switch 113. When contact 113a closed, it completed a circuit through the windings of the two relays 31, 32 in the brightness control unit 20, with the result that these two relays operated and rendered the control unit 20 operative by closing switches 31a and 32a. In other words, when key "W" was operated, a positive voltage is applied to the grid of the tubes 11, 13 which are operatively connected together, with the result that the beam of electrons released by the gun portion of the Monoscope 11 is directed towards the screen 11a contained therein. As this beam travels through Monoscope 11, it is vibrated in a vertical plane only, and the input from the oscillator 15 is so controlled by the gain control unit 17a associated with amplifier 17 that the amplitude of the beam's vibration is slightly greater than the height of the tallest character on the screen 11a.

In addition and as explained heretofore, when control relays 28, 29 operated, they closed switches 28b, 29b and thus tapped in on two closed direct current circuits to apply a potential to each of the deflection yokes H, V on the Monoscope 11, and the potentials thus applied are sufficient to shift the vibrating beam to a fixed position adjacent that edge of the selected character opposite the cut-off mark associated therewith.

Also, when the third relay 112 operated, it served to open contact 113b as well as to close contact 113a of switch 113 and thus break a normally closed circuit through magnetic brake 90 and establish a circuit through the magnetic clutch 89 to start rotation of the film carrying drum 83.

At its lower end, the drum 83 is provided with two closed contact rings 99, 100 and an open resistance ring 101, the ends of which are connected to the two contact rings 99, 100 (Fig. 8). A shoe 102 carried by a conductor 103 which leads from one side of a battery 104 is maintained in sliding engagement with contact ring 99, and a similar shoe 105 carried by a like conductor 106 which leads from the other side of the battery 104 is maintained in sliding engagement with the other contact ring 100. Thus, there is formed a closed direct current circuit of fixed potential in which is incorporated the resistance ring or element 101. A circuit which includes a fixed shoe 107 that is maintained in sliding engagement with the resistance element 101, is tapped in on this closed circuit and leads through an amplifier 108 to the horizontal deflection yoke H on the Monoscope 11.

When the magnetic clutch 89 is thus rendered operative and the drum 83 starts to rotate, a gradually increasing potential is fed through the amplifier 108 and superimposed upon the horizontal deflection yoke H of the Monoscope 11, with the result that the vibrating beam is drawn horizontally across the selected character. As the character is thus scanned, an impulse is generated on the electrode 11c leading from the screen 11a in the Monoscope 11 each time the beam traverses the character. These impulses are fed through the amplifier 23 to the gun portion 13b of the Kinescope 13, with the result that intermittent beams of electrons are created and directed towards the center of the screen 13a. Inasmuch, however, as the vertical deflection yoke V on the Kinescope 13 is also connected to the oscillator 15, the beams thus generated in the Kinescope 13 are deflected vertically and in synchronism with the vibrating beam in the Monoscope 11. In consequence, as the selected character is scanned

in the Monoscope 11, there is created on the screen in the Kinescope 13 an image of the character in the form of illuminated sections thereof. As the film 82 travels past these sections a photograph of the character is progressively created thereon.

When the vibrating beam in the Monoscope 11 reached the cut-off mark 80 adjacent the edge of the character being scanned, an impulse will be generated on the electrode 11c leading from the screen 11a and a corresponding light spot will appear on the fluorescent screen 13a in the Kinescope 13 from whence it is directed by a mirror 114 onto a photo-electric cell 109. The impulse thus generated in the cell 109 is fed through an amplifier 110 and thence through the coil of a relay 111. When relay 111 is thus operated, it opens switch 111a and so breaks the circuits set up in response to the operation of the key on the keyboard 10 and hence restores the various parts to inactive position prior to the inauguration of a second cycle of operation.

Since the scanning beam and the film travel at the same speed and since the beam, during its scanning action of each of the selected characters, travels a distance equal to the actual set-width of that character, the photographs of the characters on the film will be created in spaced relationship determined strictly by the actual though varying set widths of the type characters. The height of the photograph depends on the focal point of lens 14 and on the amplitude of vibration of the beams in the receiving tube and since the focal point of the lens 14 may be varied and since the amplitude of vibration of the beams may be varied by regulating the power input from the oscillator 15 to the deflection yoke by means of the gain control unit associated with the amplifier 18, the height of the photographs may be changed to obtain photographs of any desired height within the limits of the size of the receiving tube.

Furthermore, by using other means for moving the vibrating beam across the characters but one which would start simultaneously with the rotation of the film carrying drum 83, and by changing the relative speeds of travel between the two, it would thus be possible to expand or condense the photographs.

In consequence, by controlling the amplitude of vibration of the beams in the receiving tube 13 and by controlling the relative speeds of travel between the film and the movement of the beam across the character, photographs of a great number of sizes and shapes may be obtained from type characters of a given size and shape. Once the machine is set, however, the photographs regardless of their size and shape will be created in spaced relationship determined strictly by the actual though varying set-widths of the type characters from which they are produced since the cut-off marks positioned adjacent these characters determine the advance of the film in all cases. For like reasons, it is also possible in this embodiment of the invention to compose in line characters selected from both transmitting tubes.

After a line of characters has been composed on the film 82, the motor 98 may be started to slide the drum 83 upwardly and then stopped to arrest further movement of the drum after it has been moved the distance it is desired to maintain between lines. The starting and stopping of the motor 98 may be controlled in any suitable manner as, for example, by means of a time delay

relay (not shown) that is set in motion by means of a line spacing key on the keyboard.

In addition to the above described arrangement for restoring the circuits to their initial condition, they may also be restored by means of a wipe out key 31 which when operated breaks the circuits through the control relays 28, 29.

Reference has yet to be made to the advance of the film for spacing between words. Here, again, such advance is effected by means of a spacer key or keys, representing "en" and "em" spaces, which, when actuated, will shift the beam to scan specially provided blank spaces on the pattern and at the same time put into motion the mechanism for rotating the drum the equivalent distance. In this instance, however, the extent of movement of the drum or film will be controlled by the cut-off marks 80 which will be located in the blank spaces so as to stop the rotation of the drum after the film has been advanced the required distance, that is to say, for an en space or an em space, as the case may be.

The panoramic scanning of a pattern or a selected part thereof, in addition to the advantage it presents in photo-composition, avoids the necessity of reproducing all details of the pattern or selected part at the same time as is the case when scanning with a beam of electrons that vibrates in two planes. Also, panoramic scanning results in simplification of frequency band requirements even to the extent that it makes possible the recording of a pattern or a selected part thereof on magnetic wire, tape or phonograph records for storage for retransmission over radio or wire communication systems.

In both embodiments of the invention, the font or series of type characters is shown and described as being applied directly on the screens in the Monoscopes. It is to be understood, however, that equally favorable results may be obtained by using Iconoscopes and projecting the fonts or series of type characters onto the screens through the medium of a lens from a card or the like positioned outside the tube.

While in both embodiments of the invention a complete font of type characters is associated with the screen contained within the transmitting tube, it is to be understood that other arrangements may be used. For example, the font of characters may be divided between two or more tubes and even to the extent of providing an individual transmitting tube for each character.

Also, while in both embodiments of the invention the impulses generated at the transmitting station are conveyed by wires to the receiving or composing station, it is to be understood that the present invention contemplates the transmission of these impulses by radio.

Furthermore, while in both embodiments of the invention, a single composing station is described, it is to be understood that a plurality of such stations may be employed. For example, one or more stations may be installed in one composing room and others in other composing rooms, and, if desired, these composing rooms may be located in different sections of the country. Under these conditions, the same type matter may be composed simultaneously at these different stations from a single transmitting station.

Having thus described my invention, I claim:

1. In or for a typographical photo-composing machine, the combination of a cathode ray transmitting tube having a screen provided with a series of type characters, means for causing the electron beam in said tube to vibrate in a single

plane and with an amplitude of vibration slightly greater than the height of the tallest character in said series, a keyboard, keyboard controlled means for shifting said beam until it is adjacent one edge of a selected character, means for moving said beam across said character, a single cathode ray receiving tube independent of said transmitting for creating an image of said character in the form of illuminated sections thereof, and means for progressively exposing a light sensitive member to said image to create a photograph thereof.

2. In or for a typographical photo-composing machine, the combination of a cathode ray transmitting tube having a screen provided with a series of type characters, means for causing the electron beam in said tube to vibrate in a single plane and with an amplitude of vibration slightly greater than the height of the tallest character in said series, a keyboard, keyboard controlled means for shifting said beam until it is adjacent one edge of a selected character, means for moving said beam across said character, a single cathode ray receiving tube independent of said transmitting tube for creating an image of said character in the form of illuminated sections thereof, means for progressively exposing a light sensitive member to said image to create a photograph thereof, and means for arresting the movement of said beam and the movement of said light sensitive member simultaneously after the beam has moved a distance equal to the set-width of said character.

3. In or for a typographical photo-composing machine, the combination of a keyboard, a cathode ray transmitting tube having a screen provided with a series of type characters arranged in predetermined positions and occupying predetermined areas, a cathode ray receiving tube, means responsive to the operation of a keyboard for automatically shifting the electron beam in said transmitting tube to selected areas, means for scanning the characters occupying the selected areas, means for transmitting resultant impulses to create images of the selected characters in the receiving tube, and means for photographing said images as they are successively created.

4. In or for a typographical photo-composing machine, the combination of a cathode ray transmitting tube having associated with the screen contained therein a series of type characters and a cut-off mark positioned adjacent one edge of each character, a cathode ray receiving tube having a fluorescent screen, a light sensitive member positioned in front of said receiving tube, means for moving said member past said tube, means for vibrating the electron beam in said transmitting tube in a single plane, selectively controlled means for shifting said beam adjacent that edge of an individual character of said series opposite its associated cut-off mark and for rendering said member moving means operable, means responsive to the operation of said member moving means for moving said beam across said selected character and to the cut-off mark associated therewith, means responsive to the resultant impulses generated in said transmitting tube for creating on said fluorescent screen an image of the selected character in the form of illuminated sections thereof, and means responsive to the movement of said beam to said cut-off mark for simultaneously arresting the movement of said beam and said member.

5. In or for a typographical photo-composing machine, the combination of a cathode ray transmitting tube having associated with the screen contained therein a series of type characters and a cut-off mark positioned adjacent one edge of each character, a cathode ray receiving tube having a fluorescent screen, a rotatable drum positioned in front of said receiving tube, a light sensitive member mounted on said drum, means for rotating said drum to carry said member past said receiving tube, means for vibrating the electron beam in said transmitting tube in a single plane, selectively controlled means for shifting said beam adjacent that edge of an individual character of said series opposite its associated cut-off mark and for starting the rotation of said drum, means responsive to the rotation of said drum for moving said beam across said character to the cut-off mark associated therewith, means responsive to the resultant impulses generated in said transmitting tube during the movement of said beam across said character for creating on said fluorescent screen an image of said character in the form of illuminated sections thereof, and means responsive to the impulse generated in said transmitting tube when said beam reaches said cut-off mark for simultaneously arresting the movement of said beam and said drum.

6. In or for a typographical photocomposing machine, the combination of a cathode ray transmitting tube, a screen associated therewith having a series of type characters arranged in predetermined positions and occupying predetermined areas, a keyboard, means controlled by said keyboard for directing a vibrating beam of electrons at said screen, a plurality of beam deflecting circuits, and means controlled by said keyboard for rendering one of said deflecting circuits operative to scan a selected character on the screen.

7. In or for a typographical photocomposing machine, the combination of a cathode ray transmitting tube, a screen associated therewith having a series of type characters arranged in predetermined positions and occupying predetermined areas, selectively controlled means for automatically shifting the electron beam in said tube to one of said areas, means for vibrating said beam of electrons in a single plane, means for moving said vibrating beam of electrons across the selected character to progressively scan the character, a second cathode ray tube, means for moving a light sensitive member in front of said image to progressively create a photograph thereof, and means for arresting the travel of said member after it has moved a predetermined distance.

8. In or for a typographical photocomposing machine, the combination of an individual cathode ray transmitting tube having a screen therein provided with a series of type characters, selectively controlled means for automatically producing and deflecting an electron beam in said tube to a predetermined character on the screen, means for scanning said character with the electron beam, means for transmitting the impulses generated in scanning, a cathode ray receiving tube independent of and spacially separated from said trasmitting tube adapted to receive and utilize the transmitted impulses to create images of the selected characters scanned, and means for photographing said images.

9. In or for a typographical photocomposing machine, the combination of a cathode ray tube, a screen associated with said tube having a series of type characters arranged in predetermined positions and occupying predetermined areas, means for directing an electron beam at said screen, a

plurality of normally inoperative beam deflecting circuits, each associated with a different character of the screen, and a plurality of electrical switches for selectively rendering one of said beam deflecting circuits operative to scan the character associated therewith.

10. A combination as set forth in claim 9, including a single cathode ray receiving tube ror creating images of the characters scanned in the aforementioned tube, and means for transmitting the impulses generated in the aforementioned tube to the receiving tube.

11. A combination as set forth in claim 9, wherein the electron beam is normally inoperative, and including means for rendering said beam operative after being deflected to the area occupied by the desired character, and means to cut the beam off after the character is scanned.

12. In or for a typographical photocomposing machine, the combination of an individual cathode ray transmitting tube having a screen therein provided with a series of type characters, some of different widths, selectively controlled means for automatically deflecting the electron beam in said tube to predetermined positions to scan individual characters on the screen, means for transmitting the impulses generated in scanning to a cathode ray receiving tube independent of said transmitting tube, said receiving tube creating images of the selected characters scanned, and means for photographing said images on a film in spaced relationship determined by the set widths of the selected type characters.

13. In or for a typographical photocomposing machine, the combination of an individual cathode ray transmitting tube having a screen therein provided with a series of type characters, some of different widths, selectively controlled means for automatically deflecting the electron beam in said tube to scan a selected character occupying a predetermined position on the screen, means for transmitting the impulses generated in scanning to a single cathode ray receiving tube independent of said transmitting tube, said receiving tube utilizing said impulses to create images of the selected characters scanned, a photographic film, means for projecting said images onto said film, and means for intermittently moving said film after each exposure a distance determined by the set width of the character whose image is photographed.

14. In or for a typographical photocomposing machine, the combination of an individual cathode ray transmitting tube having a screen therein provided with a series of type characters, selectively controlled means for automatically producing and deflecting an electron beam in said tube to a particular character, means for progressively scanning the selected character from beginning to end in the form of a plurality of strips or lines, means for transmitting the impulses generated in scanning, a single cathode ray receiving tube adapted to receive said transmitted impulses and to create reproductions of the strips scanned, a photographic film for recording the reproduced strips, and means for progressively moving said film so that the strips will be photographed successively in very close relation to form a composite of the selected character.

15. A combination as set forth in claim 14 including means for cutting off said electron beam after the character has been scanned.

16. A combination as set forth in claim 14 including means for arresting the film after the character has been reproduced thereon.

17. In or for a typographical photocomposing machine, the combination of a plurality of cathode ray transmitting tubes each having a screen therein provided with a series of type characters, a cathode ray receiving tube, means for operatively connecting one or the other of said transmitting tubes to said receiving tube, selectively controlled means for automatically producing and deflecting an electron beam in said operative transmitting tube to a predetermined character on the screen, means for scanning said character with the electron beam, means for transmitting the impulses generated in scanning from the operative transmitting tube to the receiving tube, means for utilizing said transmitted impulses to create images of the selected characters scanned, and means for photographing said images.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,634,390	Zworkykin	July 5, 1927
1,978,684	McCreary	Oct. 30, 1934
2,073,370	Goldsmith	Mar. 9, 1937
2,098,390	Iams	Nov. 9, 1937
2,148,166	Kucher	Feb. 16, 1939
2,207,716	Bumstead	July 16, 1940
2,264,615	Bryce	Dec. 2, 1941
2,275,017	McNaney	Mar. 3, 1942
2,275,898	Goldsmith	Mar. 10, 1942
2,283,383	McNaney	May 19, 1942
2,379,880	Burgess	July 10, 1945
2,406,311	Deloraine et al.	Sept. 3, 1946
2,420,029	Brady	May 6, 1947
2,429,787	Young	Oct. 28, 1947
2,433,340	Burgess	Dec. 30, 1947
2,435,840	Morton	Feb. 10, 1948

FOREIGN PATENTS

Number	Country	Date
454,588	Great Britain	Oct. 5, 1936