Dec. 24, 1963 W. G. ALEXANDER 3,115,075

BRIGHT DISPLAY SYSTEM

Filed Feb. 9, 1960 4 Sheets-Sheet 1

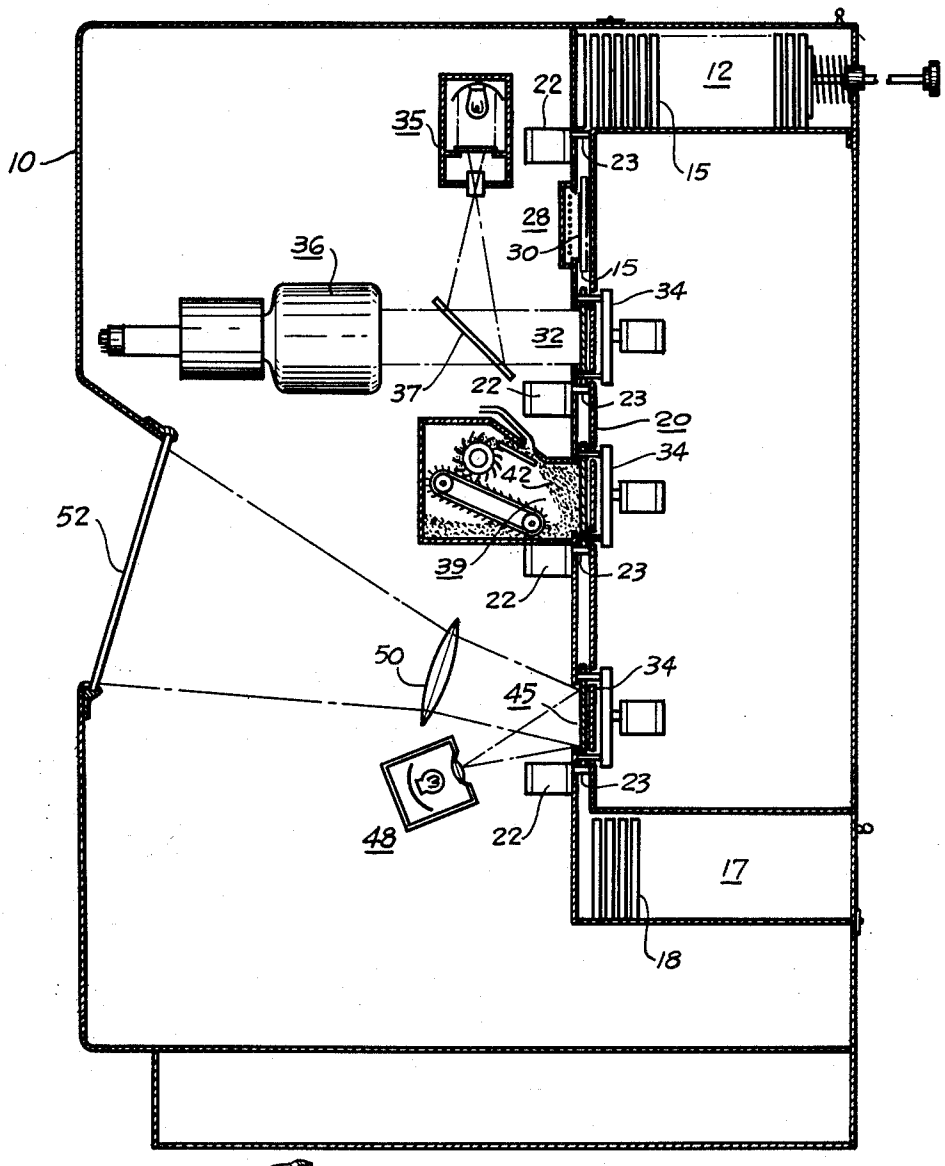


FIG_1

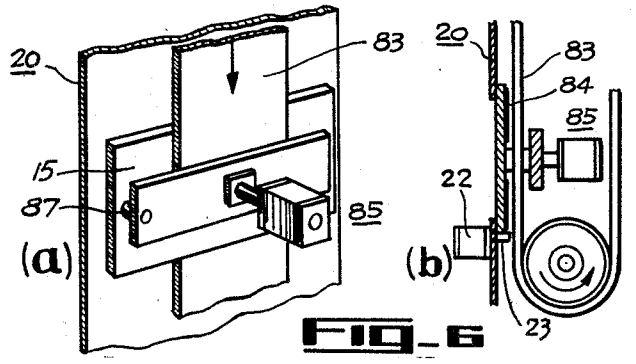


FIG_6

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BRIGHT DISPLAY SYSTEM

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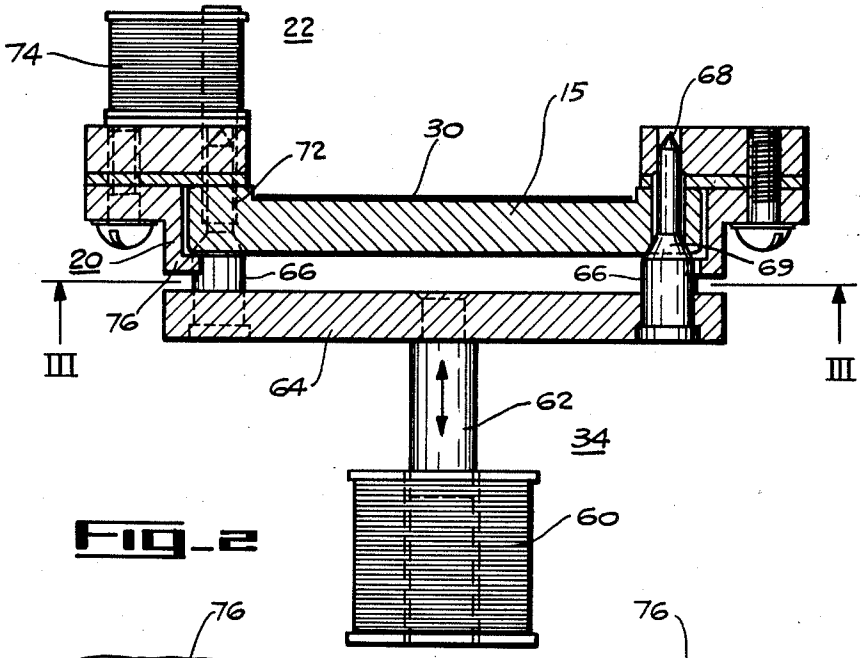


FIG_2

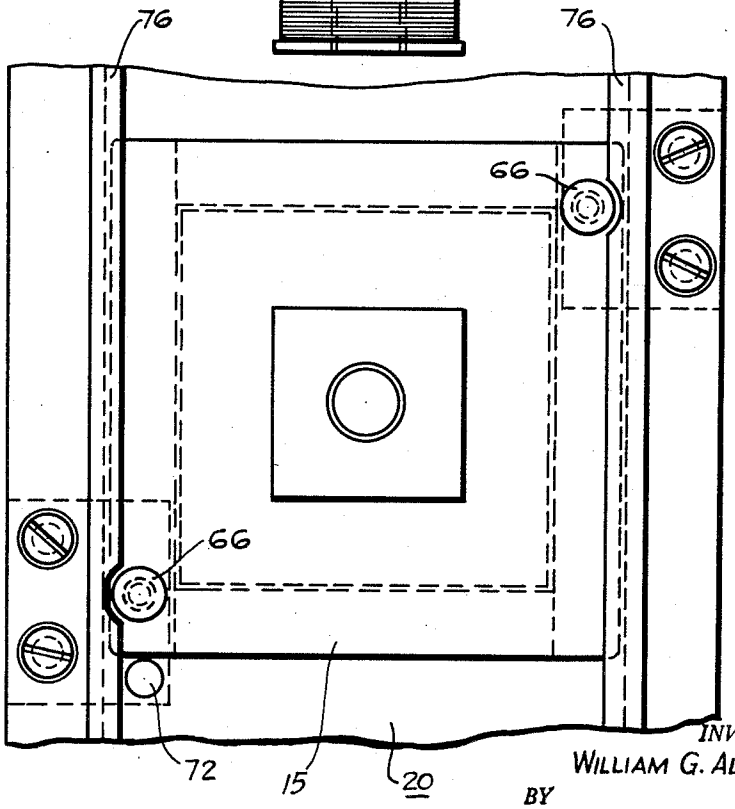


FIG_3

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BRIGHT DISPLAY SYSTEM

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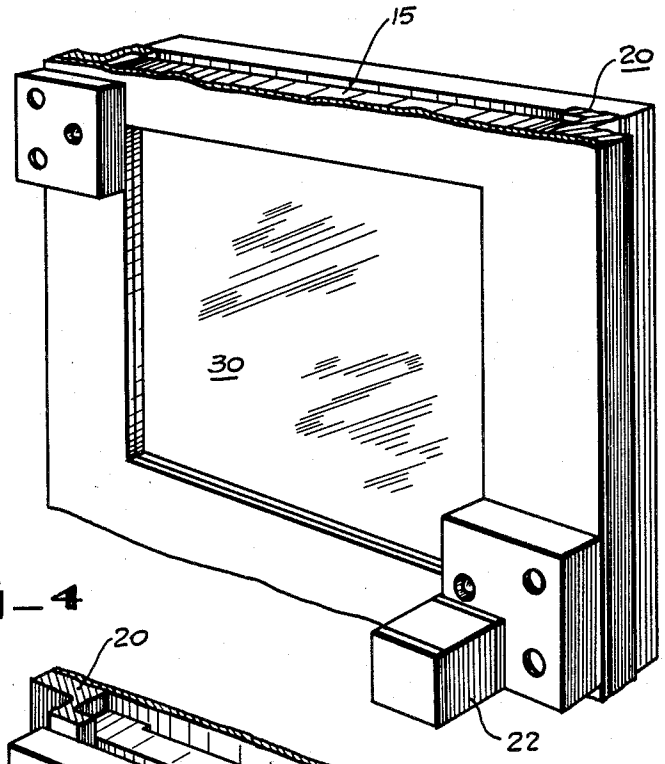


FIG_4

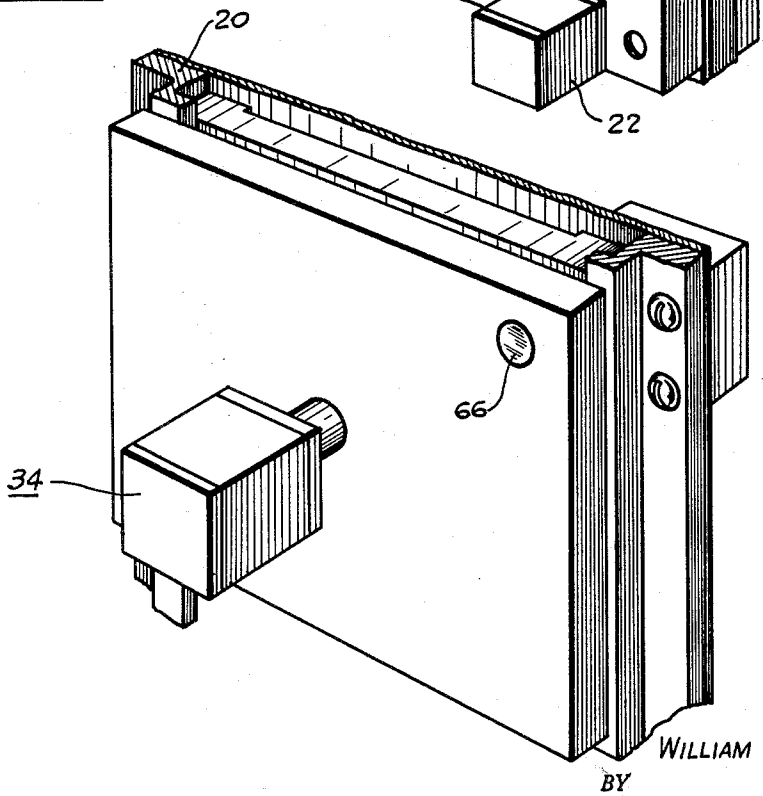


FIG_5

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BRIGHT DISPLAY SYSTEM

Filed Feb. 9, 1960 4 Sheets-Sheet 4

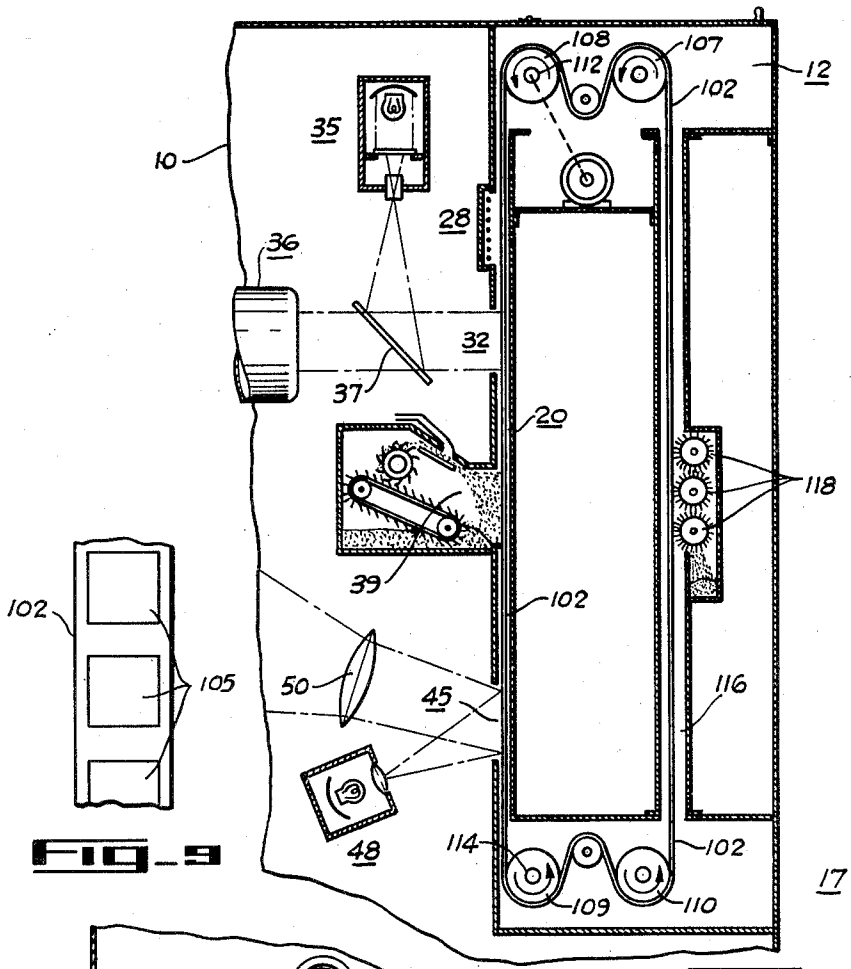


FIG_9

FIG_8

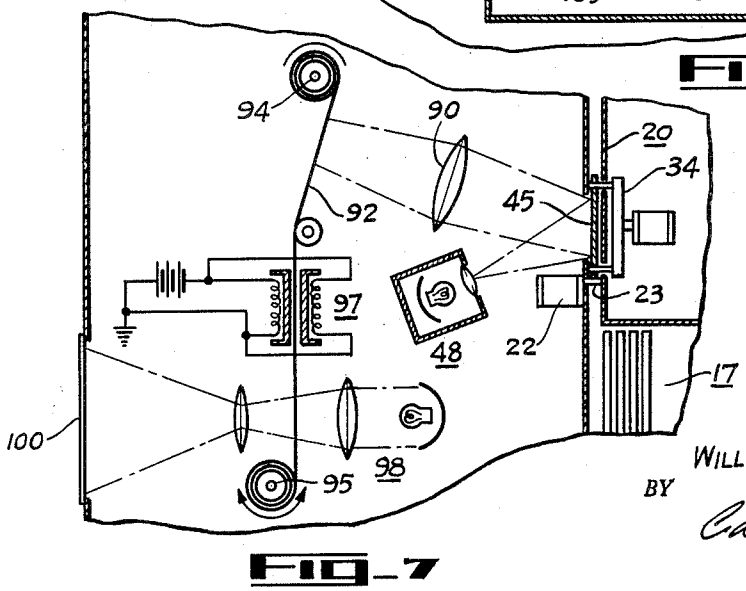


FIG_7

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3,115,075

BRIGHT DISPLAY SYSTEM

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Filed Feb. 9, 1960, Ser. No. 7,635
6 Claims. (Cl. 95—1.7)

The present invention relates generally to a bright display system. More particularly the invention relates to a system and construction utilizing a xerographic member having as its recording surface a photoconductive layer. The photoconductive layer is disposed thereupon for utilization in electrophotography or xerography, in a high speed exposing, developing and projection system and construction.

Xerographic or electrophotographic devices utilizing xerographic members are generally known in the art. However, the expeditious utilization of these members to serially effect recordation of information thereupon, subsequently to develop that information and to cause projection or recordation therefrom is generally unknown. The usual approaches are still generally handled in a rather slow or laborious manner. The present invention seeks to overcome the slow speed and laborious methods of the prior art. It embodies within a single processor construction, serial action upon the xerographic member to effect in order, a removal of the member from the storage chamber, charging the surface of the member, exposing the member to the desired image to be recorded thereupon as latent electrostatic image, transporting the member from the exposing to the developing station, developing the latent image into a visual image, thereafter transporting the member to a projection station for projecting of the visual image from the member surface onto a screen or recording film. Following its utilization at the projection station, the member may be stored for later usage or the member removed and the image erased. The member is thereafter ready for subsequent usage.

The novel xerographic processor construction includes a xerographic member having disposed on one surface a sensitizing layer such as a photoconductive layer. The member is named "xerographic" member to give it a name only. Xerographic member for purposes of this invention is defined to include sensitizing surfaces and referred to hereafter as xerographic plates, as well as xerographic areas upon an elongated belt means, either completely coated with the sensitized layer or only in the discrete areas.

For purposes of explanation the invention is described utilizing the preferred embodiment employing the xerographic plate. The belt means and its at least predetermined areas thereon are included as another embodiment of the invention. A further embodiment shows the projection of the light information from the xerographic member to film for subsequent projection. This film is capable of responding to high speed development. The member or plate may be of a plastic or metallic construction that is durable and nonpoisonous with respect to the photoconductor disposed thereof. A light excluding storage chamber is provided at one end of the processor construction and utilized to contain the unexposed plates. A storage bin for containing exposed plates is positioned at another end of the processor construction. In between the storage chamber and the storage bin is a channeling means connecting the chamber to the bin. The channeling means provides a conduit or channel to allow selective movement of the plates serially one after the other from the chamber to the bin. Serially positioned along, adjacent and in cooperative relation with the channeling means is a charging station, an exposing station, a developing station, and a projection station, all for selectively and serially acting upon the plate, in the order named. The plate may be moved along the channeling means by gravity or by positive action such as chain links or belts, exemplified herein as a magnetic belt. The plate may be made of magnetically attractable material or have embodied in its unsensitized surface magnetically attractable material. The plate and the belt may be selectively engaged of disengaged as desired in the travel of the plate and belt through and along the channeling means.

At each of the stations enumerated, there may be disposed means that are selectively actuatable for restraining the movement of the plate into and along the channel. Such means may be a selectively operable solenoid and plunger arrangement. In addition, centering means may also be utilized at predetermined stations to properly center the stopped plate at that station, thereby insuring operation of that station to be conducted upon a properly centered plate.

As can readily be seen, the movement of the plate through the channeling means may be under the influence or gravity or under the positive force of the magnetic belt. Therefore, transfer from one station to the next may be at a relatively high speed if so desired, or may be at a relatively slow speed, if so desired. There is considerable choice of the speeds at which the present apparatus may be operated. The present invention, therefore, is adaptable to various situations which may be demanded of recording and projection equipment, and is flexible in its usage.

The belt means carrying the sensitized layer may be intermittently operated under the influence of a motor and clutch to serially present the predetermined areas thereon at the stated stations. The belt means may be endless, as exemplified herein, or carried on a spool in the storage bin. If the belt means is endless, a cleaning station may be added between the storage bin and the storage chamber.

In addition to advantages and objects aforesaid, it is an object of the present invention to provide a simple and high speed display system for providing bright displays of light information.

It is another object of the present invention to provide a relatively simple, trouble-free xerographic processor construction utilizing the xerographic member.

It is another object of the present invention to provide a xerographic processor construction in which the xerographic member moves rather simply from storage through its various stations with the rapidity or speed of operation desired of the equipment, all in a single channeling means or chamber, and maintaining relatively accurate alignment throughout its movement so as to provide proper alignment at desired exposer and projection stations.

It is another object of the present invention to provide a xerographic processor construction which serially performs all the operations upon and with the xerographic member with minimal moving parts and minimal complexity.

It is another object of the invention to provide a xerographic processor construction wherein a predetermined time delay between exposing of the member and projection of the image therefrom may be varied as desired within wide limits.

It is another object of the present invention to provide a device for recording light information from a xerographic member on high speed film for later projection as a bright display.

Objects and advantages other than those set forth will become apparent from the following description when

read in connection with the accompanying drawings, in which:

FIGURE 1 is an elevational side view showing schematically an embodiment of the invention;

FIGURE 2 is a cross sectional view of a portion of the channeling means also showing the restraining means and the centering means as utilized in cooperation with the plate at predetermined of the stations;

FIGURE 3 is a partial elevational view along line III—III of FIGURE 2 showing the back side of the channeling means;

FIGURE 4 is a view in perspective of part of the channeling means showing a plate at a predetermined station;

FIGURE 5 is a view in perspective of the back view of the plate at a predetermined station;

FIGURES 6(*a*) and (*b*) show, respectively, a back side perspective view of the channeling means and the belt, and a side view in cross section thereof;

FIGURE 7 is a partial elevational view of another embodiment of the invention;

FIGURE 8 is another embodiment of the invention utilizing a partial elevational view in modified form of FIGURE 1 to exemplify a belt means for the xerographic member; and

FIGURE 9 is a partial view in elevation of a segment of the belt means exemplifying thereupon discrete predetermined areas of sensitized layers.

Referring more particularly to FIGURE 1, an overall exemplary console construction 10 is shown. Within console 10 is disposed a plate storage chamber 12. Storage chamber 12 is so constructed as to be light-tight to contain unexposed xerographic members exemplified as xerographic plates 15. At the opposite extremity of the console 10 is disposed a storage bin 17 capable of receiving and containing exposed xerographic plates 18 and storing them therein. Connecting the storage chamber 12 with the storage bin 17 is a channeling means 20.

Channeling means 20, as shown in cross sectional detail in FIGURE 2, has provided therein a channel, guide, or slide within which the xerographic plates 15 may be caused to move or to be transported from storage chamber 12 to storage bin 17. The xerographic plates 15 may be selectively disposed into the channel 20 through operation of a solenoid 22 actuating its magnetically coupleable restraining plunger 23. The restraining plunger 23 and its winding or solenoid 22, also referred to as means 22, is selectively actuatable for restraining the movement of said plate into and along the channel. This last stated means 22 may be selectively positioned in the channel 20, for example, at the entry thereto, as well as adjacent selected of the stations. The restraining means will cause the plate 15 to stop its travel from the storage chamber 12 to the storage bin 17. Means 22 may be released so that plunger 23 is withdrawn, thereby permitting plate 15 to enter into the channel 20.

The xerographic member, exemplified as the plate 15, carries on its sensitized side a layer of electron responsive material such as a photoconductor layer 30. The overall plate 15 construction may utilize plastic, glass or metal and is herein exemplified as of metal construction. The photoconductors which can be utilized may be chosen from among the following like property materials, including, but not limited to, selenium, cadmium sulfide, silver selenide, germanium, sulphurs, anthracene and anthraquinone.

As the plate 15 moves or is moved into the channel, it first encounters a charging station 28. At charging station 28 the photoconductor layer 30 disposed on plate 15 is presented to the charging means. The charging means produces a surplus of electrons which are disposed upon the photoconductor layer in its dark condition. In the dark condition, of course, the photoconductor is an insulator and latent charges are stored thereon. It should be noted that in the preferred embodiment the xerographic plate 15 is transported past the charging station 28 collecting the electrostatic charges emitted thereupon as the plate travels past the charging station 28.

The plate 15 may next be brought into position at exposing station 32. At station 32, is preferably disposed means 22 to hold the plate 15 for further operation upon the plate by alignment means 34. Means 34 is inserted through the channel 20 and through the xerographic plate 15 aligning the plate at the exposing station 32. At the station 32 the sensitized side or surface of photoconductor layer 30 may be exposed to light radiation from a projector 35 for example, or from a cathode ray tube 36, for example, or from both, through use of a half silvered mirror 37. Mirror 37 permits the projected images to be superimposed on the images of the cathode ray tube 36 and all together to be recorded upon the photoconductor layer 30 of the xerographic plate 15 at the exposing station 32 as latent electrostatic image patterns.

When exposing is completed, the plunger 23 of the restraining means 22 is withdrawn, as is also the aligning means 34, so that the xerographic plate 15 is then ready to be moved or to drop into the next position, namely the developing station 39. At developing station 39 electrostatically charged or attractable particles 42 are cascaded against and upon the latent image patterns on the photoconductor layer 30 of the plate 15. The particles 42 will, of course, adhere to charged portions on layer 30 forming a negative image pattern thereby developing the latent image into visual image. Here again at the developing station 39, it may be desirable to use the restraining means 22 and the alignment means 34 to properly align the xerographic plates 15 at that station.

Upon completion of developing, the restraining means 22 is again retracted as is the alignment means 34, and the plate 15 is free to move, be moved or drop to the next station, namely the projection station 45. At the projection station 45 the plate 15 may again be restrained against further movement along the channel 20 by the restraining means 22 and aligned by the alignment means 34, aligning the plate to the predetermined position. Here, then, at the projection station 45, a light source 48 may be directed against the photoconductor layer 30 carrying the visual images. The light from source 48 projected thereupon may be reflected therefrom with a light and shadow modulated likeness of the visual images through a lens 50 for example, onto a screen 52 for viewing of the visual images thereupon. When viewing of the visual images upon the screen 52 has been completed, the restraining means 22 is again retracted as is the alignment means 34 and the plate 15 may then move, be moved or dropped into position as one of stored plates 18 carrying the visual image in the storage bin 17.

As shown in FIGURE 1, the plate 15 may travel by gravity from its chamber 12 to and past the various stations, each station sequentially acting upon the plate 15 to aid its recordation thereupon of the light, and projecting the visual image therefrom, and depositing the plate 15 in the storage bin. If greater speed of plate 15 in channel 20 is desired, transporting of the plate 15 through the cycle from the storage chamber 12 to the storage bin 17 may be accomplished by positive action between plate 15 and a motive means such as a chain, belt, gears, magnetic belts or the like may be used. The magnetic belt arrangement may be preferably utilized as exemplified subsequently herein. To utilize such a belt, magnetic material may be embedded in the back or non-sensitized side of the xerographic plate 15 and so disposed with relation to plate 15 and the belt as to have magnetic coupling therebetween, thus providing positive carriage or movement of the plate 15 under the positive influence of the belt from one station to the next station.

In greater detail there is shown, the cross section of the plate 15 carrying the photoconductor surface 30 in FIGURE 2. FIGURE 2 also shows in greater detail con-

struction of the alignment means 34 and the restraining means 22. The alignment means 34 comprises a solenoid 60 having a plunger 62 in electromagnetic coupling therewith. Upon actuation of the means 34, solenoid 60 will cause movement of plunger 62 carrying with it its frame 64 having thereon aligning pins 66. Pins 66 first move into engagement with the plate and then into the channel. This coordinated action aligns the plate with the channel. Aligning pins 66 have two sections, a first pin section 68 and a second beveled pin section 69. In the engaged position, the first pin section 68 protrudes through the mating holes in the xerographic plate 15 for rough alignment; and second pin section 69, with its beveled edges, engages mating beveled edges within the plate 15, thus causing more exacting alignment of the plate 15 with respect to the channel 20. Alignment means 34 operates serially or sequentially after the restraining means 22. Means 22 is operated through magnetic coupling of its plunger 72 with its solenoid 74 and first operates to restrain the further motion of the xerographic plate 15 along the channel 20. Following such restraining of the plate 15, the alignment means 34 is sequentially operated to engage the plate 15 effecting its proper alignment.

FIGURE 3 shows a plan view of a section along line III—III of FIGURE 2 showing the plan or elevational alignment of the xerographic plate 15 by pins 66 and that of the restraining means through pin 72 carrying plate 15 thereagainst.

FIGURE 3 also shows a preferred construction wherein plate 15 is carried in channel 20. Plate 15 is in sliding engagement with and guided by guides or guide surfaces 76 of channel 20. Guides 76 restrain plate 15 against sideway or lateral motion and permit only up on down motion as shown in FIGURE 1, or motion in the direction of the extension of the channel 20. To further exemplify FIGURES 2 and 3, FIGURES 4 and 5 are presented to show, in perspective, the restraining means 22 and alignment means 34, both holding plate 15 in the channeling means 20 at one of the stations disposed along the channeling means. Thus, the photoconductive surface 30 as is shown in FIGURE 4 is placed in predetermined exacting alignment with the station disposed thereat. The alignment of the plate 15 is shown in the back view of FIGURE 4 as FIGURE 5 and is exercised by the aligning or alignment means 34 with its pins 66 holding plate 15 in position with respect to the channel.

In FIGURE 6, the utilization of the electromagnet belt 83 together with a magnetic backing 84 (or use of a magnetic material plate) on the xerographic plate 15 is shown and exemplified. Belt 83 may be of a type known by the trademark "Koroseal" which is a magnetic neoprene that is made by B. F. Goodrich Rubber Company. Greater speed may be allowed if desired by using the belt to move the plate in positive action, transporting the plate 15 from one station to the next, or in its complete travel between the storage chamber 12 and the storage bin 17 under power at predetermined speed. Motion of belt 83 could be continuous if desired. Plate 15 traveling with and magnetically coupled to belt 83 may be disengaged in a parallel slippage from belt 83 upon restraint against further travel of plate 15 in channel 20 by restraining means 22. The plate 15 so restrained by means 22 may be fully disengaged from its magnetic coupling with belt 83 upon action of disengaging means 85. Means 85 may be solenoid operated and straddle belt 83 having a pair of magnetic members 87. Thus, upon actuation of means 85 in one direction, members 87 force plate 15 from belt 83. Upon actuation of means 85 in the other direction, the magnetic coupling between members 87 and backing 84 will draw the plate into engagement with belt 83.

Of course, many well-known switching mechanisms and programing devices may be utilized to perform sequential operation of the solenoids herein exemplified to produce the desired operations.

It should be noted that in the last stated embodiment, the breaking of magnetic coupling at right angles to the field is difficult. Therefore, in the exemplified embodiment the fields are preferably broken or decoupled in a path parallel to each other so that a slippage therebetween may easily be effected as the plate 15 is restrained from further travel in the channeling means 20 at the desired stations. The continuously moving belt will therefore merely have slippage of the magnetic coupling with the plate, neither impairing the action of the belt nor the further magnetic interaction between the belt 83 and the plate 15.

In the embodiment of FIGURE 7, the visual image projected from the xerographic member, as for example plate 15, at projection station 45, may be imaged by a convergent lens 90 onto a light recording means 92. The light recording means 92 may be disposed in the path of the visual images projected from the xerographic member at station 45. Light recording means 92 utilizes preferably diazo light sensitive material that responds to the light images, upon application of heat to the exposed film. The images thereupon are thus developed into a permanent record. Such film is made by Eastman Kodak Company of Rochester, New York, and by the Kalvar Corporation of San Jose, California, the latter selling such film under its trademark "Kalvar."

Following recordation of the projected light images upon the recording material 92, the exposed film is transported by exemplary powered spindles 94, 95 to a subsequent position intermediate heating means 97. Heating means 97 may include a pair of heating platens intermediate which film 92 passes, developing the images thereupon as it so passes. Subsequent to development, the film is carried to projection means 98 that illuminates and projects the developed image on material 92 onto viewing screen 100.

Of course, material 92 may also be used as a memory or storage of the visual images. To facilitate projection of stored images, spindles 94, 95 may be used to move the material 92 forward or backward as desired to select for projection the desired recorded information.

The light images projected on the diazo light sensitive material 92 are instantly developed into visible images immediately upon its passage through heating member 97. This immediate development permits immediate projection of the light images upon screen 100. The light intensity of the display received from the xerographic member at project station 45 is sufficient to expose the material 92 while the light from the screen of cathode ray tube 36 is not. FIGURE 7 shows the material 92 being exposed by light images received from plate 15, but, of course, the material 92 may be exposed from light images projected as shown in FIGURE 8.

Another embodiment of the invention is shown in FIGURE 8 wherein the xerographic member is exemplified as a xerographic belt means 102. Belt 102 may be an endless belt or an ended belt, it being exemplified herein as an endless belt. The belt may be made of a plastic translucent material sold under the trademark "Mylar" by Minnesota Mining and Manufacturing Company of Minneapolis, Minnesota. The belt may have on its entire surface a sensitized layer such as a photoconductor surface, or the same may be coated only upon discrete predetermined areas 105 (see FIGURE 9) of belt 102.

The belt 102 is transported through storage chamber 12 on spools 108 and 109. Spool 108 may have its spindle 112 driven by a motor (not shown) for intermittent motion of belt 102. The belt may then be transported with the visual images recorded thereon through storage bin 17 on spools 109, 110. Belt 102, exemplified as endless, may then be wound from spool 110 through conduit 116 past rotary brushes 118 which remove the visual images therefrom. Thereafter, endless belt 102 moves past spool 107 in chamber 12 to be ready for use again.

The particular embodiments of the invention illustrated

and described herein are illustrative only and the invention includes such other modifications and equivalents as may readily appear to those skilled in the art and within the scope of the appended claims.

I claim:

1. A xerographic processor including at least one xerographic member having a photoconductive layer disposed thereupon, said member having alignment apertures therein, a light impervious storage chamber for containing said member in substantially unexposed condition, a storage receptacle for containing said member in exposed condition, a conduit interconnecting said chamber and said receptacle for channeling said member therein, said conduit having disposed therealong in the order named a charging station for charging said member with electrostatic charges, an exposing station for selectively altering the charges upon said member to record predetermined images as latent images, a developing station for developing the latent images on said member into visual images and a projecting station for projecting said visual images, restraining means at each station selectively actuated for restraining the movement of said member along said conduit, said restraining means in response to actuation thereof causing insertion of a blocking element into said conduit to prevent further progress of said member, and alignment means at each station including alignment pins, said alignment means being actuated subsequent to actuation of said restraining means for moving said alignment pins into the alignment apertures in said member.

2. A xerographic processor including at least one xerographic member having a photoconductive layer disposed thereupon, said member having alignment apertures therein, a light impervious storage chamber for containing said member in substantially unexposed condition, a storage receptacle for containing said member in exposed condition, a conduit interconnecting said chamber and said receptacle for channeling said member therein, said conduit having disposed therealong in the order named a charging station for charging said member with electrostatic charges, an exposing station for selectively altering the charges upon said member to record predetermined images as latent images, a developing station for developing the latent images on said member into visual images and projecting station for projecting said visual images, initial restraining means adjacent said storage chamber normally blocking movement of said member into said conduit, said restraining means being actuated to permit said member to drop from said storage chamber into said conduit, station restraining means at each station selectively actuated for restraining the movement of said member along said conduit, said restraining means at each station in response to actuation thereof causing insertion of a blocking element into said conduit to prevent further progress of said member, and alignment means at each station including alignment pins, said alignment means being actuated subsequent to actuation of said restraining means for moving said alignment pins into the alignment apertures in said member.

3. A xerographic processor including at least one xerographic member having a photoconductive layer disposed thereupon, said member having alignment apertures therein, a light impervious storage chamber for containing said member in substantially unexposed condition, a storage receptacle for containing said member in exposed condition, a conduit interconnecting said chamber and said receptacle for channeling said member therein, said conduit being partially bounded by channel means for restraining said member against lateral motion, said channel means having alignment apertures therein, said conduit having disposed therealong in the order named a charging station for charging said member with electrostatic charges, an exposing station for selectively altering the charges upon said member to record predetermined images as latent images, a developing station for developing the latent images on said member into visual images and a projecting station for projecting said visual images, restraining means at each station selectively actuated for restraining the movement of said member along said conduit, said restraining means in response to actuation thereof causing insertion of a blocking element into said conduit to prevent further progress of said member, and alignment means at each station including alignment pins, said alignment means being actuated subsequent to actuation of said restraining means for moving said alignment pins into the alignment apertures in said member and said channel means.

4. A xerographic processor including at least one xerographic member having a photoconductive layer disposed thereupon, said member having alignment apertures therein, a light impervious storage chamber for containing said member in substantially unexposed condition, a storage receptacle for containing said member in exposed condition, a conduit interconnecting said chamber and said receptacle for channeling said member therein, said conduit being partially bounded by channel means for restraining said member against lateral motion, said channel means having alignment apertures therein, said conduit having disposed therealong in the order named a charging station for charging said member with electrostatic charges, an exposing station for selectively altering the charges upon said member to record predetermined images as latent images, a developing station for developing the latent images on said member into visual images and a projecting station for projecitng said visual images, initial restraining means adjacent said storage chamber normally blocking movement of said member into said conduit, said restraining means being actuated to permit said member to drop from said storage chamber into conduit, restraining means at each station selectively actuated for restraining the movement of said member along said conduit, said restraining means at each station including a solenoid mounted to said channel means and including a plunger, said plunger extending into said conduit in response to actuation of the restraining means at said station to prevent further progress of said member, and alignment means at each station including alignment pins, said alignment means being actuated subsequent to actuation of the restraining means at said station for moving said alignment pins into the alignment apertures in said member and said channel means.

5. A xerographic processor including at least one xerographic member having a photoconductive layer disposed thereupon, said member having alignment apertures therein, a light impervious storage chamber for containing said member in substantially unexposed condition, a storage receptacle for containing said member in exposed condition, a conduit interconnecting said chamber and said receptacle for channeling said member therein, said conduit being partially bounded by channel means for restraining said member against lateral motion, said channel means having alignment apertures therein terminating in beveled edges, said conduit having disposed therealong in the order named a charging station for charging said member with electrostatic charges, an exposing station for selectively altering the charges upon said member to record predetermined images as latent images, a developing station for developing the latent images on said member into visual images and a projecting station for projecting said visual images, and alignment means at each station including alignment pins movable into the alignment apertures in said member and said channel means in response to actuation of said alignment means, said alignment pins having a first section adapted to pass into said apertures in said channel means and a second section including beveled edges mating with the beveled edges of said member.

6. A xerographic processor including at least one xerographic member having a photoconductive layer disposed thereupon, said member having alignment apertures therein, a light impervious storage chamber for

containing said member in substantially unexposed condition, a storage receptacle for containing said member in exposed condition, a conduit interconnecting said chamber and said receptacle for channeling said member therein, said conduit being partially bounded by channel means for restraining said member against lateral motion, said channel means having alignment apertures therein, said conduit having disposed therealong in the order named a charging station for charging said member with electrostatic charges, an exposing station for selectively altering the charges upon said member to record predetermined images as latent images, a developing station for developing the latent images on said member into visual images and a projecting station for projecting said visual images, initial restraining means adjacent said storage chamber normally blocking movement of said member into said conduit, said restraining means being actuated to permit said member to drop from said storage chamber into said conduit, station restraining means at each station selectively actuated for restraining the movement of said member into and along said conduit, said

restraining means at each station including a solenoid mounted to said channel means and including a plunger, said plunger extending into said conduit in response to actuation of said restraining means to prevent further progress of said member, and alignment means at each station including alignment pins, said alignment means being actuated subsequent to actuation of said restraining means for moving said alignment pins into the alignment apertures in said member and said channel means.

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