This invention relates to the field of xerography and in particular, to an improved xerographic plate support apparatus.

More specifically, the invention relates to an improved plate support apparatus that is particularly adapted for use in xerographic apparatus where, in order to obtain maximum benefits from the prior improvements in the various processing elements of a xerographic machine, it is required to control the contour of the xerographic plate accurately by means of a plate support apparatus.

The art of xerography, for example, as disclosed in Carlson Patent 2,297,691, a xerographic plate, comprising a photoconductive insulating material on a conductive backing, is given a uniform electric charge over its surface and is then exposed to the subject matter to be reproduced, usually by conventional projection techniques. This exposure discharges the plate areas in accordance with the light intensity which reaches them and thereby creates an electrostatic latent image on the surface of the plate coating which may then be developed with an electrostatic material which clings to the plate electrostatically in a pattern corresponding to the electrostatic image.

Therefore, the developed xerographic image is usually transferred to a support material to which it may be fixed by any suitable means.

In the field of xerography, the xerographic plate is usually comprised of a metallic backing plate, such as a sheet of aluminum or another metal having on one face thereof a coating or layer of selenium in its vitreous or photoconductive insulating form.

To a certain extent the metallic plate and the vitreous selenium are physically incompatible. For example, a metal sheet is generally characterized by being relatively flexible, whereas the vitreous selenium coating is very much like glass, which it resembles in appearance and is characterized by being quite brittle and inflexible. Thus, extreme care must be taken to prevent the metal sheet from absorbing bending and buckling in use and operation, since such bending will cause the selenium coating to crack and chip off.

This incompatibility of plate and coating becomes even more vexing because of seemingly minor characteristics of preferred xerographic processes and equipment. For example, a xerographic plate having a smooth contour is often required to permit even charging of the plate, to permit proper registration of an image on the plate during exposure, to permit uniform spacing of all areas of the plate with respect to a development electrode during the developing process, or to permit uniform contact with a pressure transfer apparatus during the transferring process, to thereby achieve optimum results from the various processing mechanisms described above.

Xerographic plates having a smooth contour, of the desired shape, may be made by fabricating the plate as an integral part of a rigid plate support element. However, even though a xerographic plate may be used thousands of times for reproduction, they eventually wear out and are discarded. If, as suggested above, the xerographic plate was made integral with a plate support element, the cost of such a plate and plate element, especially in the larger sizes, would be prohibitive in many applications of xerography.

It is therefore an object of the invention to improve xerographic plate support apparatus to permit a disposable xerographic plate to be detachably secured to the plate support apparatus for movement through the processing stations of a xerographic machine.

Another object of the invention is to make it possible to support a xerographic plate member on a plate support apparatus by atmospheric pressure and thereby eliminate the need for mechanical holding means.

Thus, and other objects of the invention are attained by means of a plate support apparatus which is comprised of a hollow platen having a smooth contoured external surface portion on which a xerographic plate may be detachably supported, the plate being held in place as a result of a pressure differential produced on opposite sides of the plate, that is, the side of the plate in contact with the plate support apparatus being affected by a partial vacuum controlled by a vacuum conduit means in the plate support apparatus, while the other side of the plate is affected by atmospheric pressure.

For a better understanding of the invention as well as other objects and further features thereof, reference is had to the following detailed description of the invention to be read in connection with the accompanying drawings, wherein:

FIG. 1 illustrates schematically an embodiment of a xerographic apparatus adapted for flat xerographic plate operation, and incorporating a xerographic plate support apparatus in accordance with the invention.

FIG. 2 is a side view partially in section of the xerographic plate support apparatus and a quick disconnect fitting for applying a vacuum to the xerographic support apparatus.

FIG. 3 is a top view of the vacuum backed plate support apparatus of the invention.

FIG. 4 is a detailed sectional view of the vacuum backed plate support apparatus taken along line 4-4 of FIG. 3.

FIG. 5 is an enlarged detailed top view of a section of the vacuum backed plate support apparatus.

FIG. 6 is a detailed sectional view of the vacuum backed plate support apparatus taken along line 6-6 of FIG. 5, and FIG. 7 is an enlarged detailed view of a section of the boss area of the vacuum backed plate carrier.

Referring now to the drawings, the xerographic apparatus shown in FIG. 1 comprises a frame 10 which structurally supports the various processing elements of the xerographic device in their respective stations. A flat xerographic plate 11, comprising a photoconductive insulating material 12 on a conductive backing 13 is supported on a vacuum backed plate support 14, described in more detail hereinafter, which in turn rests on either drive rolls 15 for longitudinal movement or on drive rolls 16 for lateral movement through the various processing elements of the xerographic machine. The drive rolls 15 and 16 are driven through suitable means, not shown, so that the plate carrier 14 with a xerographic plate 11 thereon, is moved in the direction of the arrows in FIG. 1 starting from stand-by position A.

Positioned at a desired point adjacent to the path of movement of the xerographic plate is a charging station B containing a corona discharge electrode 17 or the like. Next subsequent thereto in the path of motion of the xerographic plate is an exposure station C and a scanning station D. Exposure may be effected by one of a number of types of mechanism or members such, as desirably, an optical projection system 18 whereby an optical image is projected onto the surface of the xerographic plate while the xerographic plate is held stationary in the exposure station C. Although any one of a number of types of optical projection systems may be used, the optical projection system 18, illustrated, includes a copy board 22, having lamps therein (not shown) which project the image
from a copy material 23, such as film, onto mirror 24 from where it is reflected through lens 25 onto mirror 26 which reflects the image onto the xerographic plate 11, the resultant image being inverted longitudinally from right to left as seen by the symbols W, X, Y, and Z. Scanning of the charge remaining on the xerographic plate may be effected by an electrometer probe scanning apparatus 27 described in greater detail in connection with copending Allen et al. application Serial No. 745,957, filed July 1, 1958, A plate 11, previously charged and exposed is shown in the scanning station D in FIG. 1. Adjacent to the scanning station D is a development station E. Positioned at the development station E is a development electrode 31, which may be of the type disclosed in copending Crumrine application Serial No. 723,702, filed April 1, 1958, now Patent 2,942,573, the development electrode being supplied with a powder cloud of developing material from a powder cloud generator 32 to develop the electrostatic latent image formed on the xerographic plate.

At the area generally designated F, transfer of the developed image from the xerographic plate occurs. This transfer of the image to a suitable support material is preferably effected by use of a pressure transfer apparatus 33 described in greater detail in copending Crumrine et al. application Serial No. 742,373, filed June 16, 1958. A supply roller (not shown) supplies a web of support material 34 around the upper roller of the transfer mechanism 33 which forces the support material into contact with the xerographic plate 11 as it moves therethrough, whereby transfer of the powder image is effected. The web of support material, carrying the transferred image, passes an image fixing apparatus 35, for example, a heated platen, whereby the copy is made permanent, and finally the support material is wound on take-up roller 36.

Positioned next adjacent to the transfer area F is a holding station G and next adjacent to this latter station is a plate changing station H where xerographic plates and plate support elements may be removed or added. Rollers 37, which are not power driven, are positioned at the stations G and H to permit the plate support elements to be rolled on or off the xerographic machine.

A clearing station K, having power driven cleaning brushes 38, is positioned adjacent to the second holding station H to clean the xerographic plates of any residual powder particles adhering thereto after the transfer operation.

The next and final station is a floodlight station L, wherein the xerographic plate is flooded with light from lamp 39 to cause dissipation of any residual electrical charge on the xerographic plate.

The xerographic plate 11 is detachably secured to the plate support apparatus 14, as it is transported through the above-described processing stations of the xerographic machine, by means of normal atmospheric pressure acting on one side of the plate while the other side or back of the plate is subjected to a negative pressure. To obtain a negative pressure on the back of the plate, a plate support apparatus 14 may be connected by means of a valved quick disconnect coupling 44 in the plate support apparatus to one of the valved quick disconnect couplings 45 on vacuum lines 46 to an evacuating means, such as ballast tanks 47 maintained at a vacuum of 16 to 24 inches of mercury by vacuum pumps 48.

To effect automatic coupling of the quick disconnect couplings to a plate support apparatus, the quick disconnect couplings 45 may be actuated by an air cylinder 49 or by other similar power means, for movement into engagement with the mating coupling 44 on the plate support apparatus.

A quick disconnect coupling 45 and an air cylinder 49 are located at each station A for automatically re-evacuating a plate support apparatus each time it reaches the stand-by station.

Whenever the xerographic machine has been stopped long enough to dissipate the vacuum in a plate support apparatus, for example, when the machine is idle overnight, it may be necessary to re-evacuate each plate support apparatus before it moves through a critical station. For this purpose quick disconnect couplings and air cylinders are also provided at stations D, G, and H. In this respect it is noted that more than one combination may be shown in the scanning station D in FIG. 1, while a second plate and plate support apparatus, partially broken away to show the details of construction, is shown in holding station G.

For momentarily holding the plate support apparatus stationary in stations A, C, and D, stops 50 and anti-rebound latches 51 are positioned at these stations.

The operation of the various elements of the xerographic apparatus is controlled through a suitable circuit (not shown), which synchronizes the sequence of operation of the various elements.

Since xerographic plates are light-sensitive, the entire xerographic machine may be preferably enclosed in a light-tight housing similar to the housing 52 enclosing the optical system, or the machine may be used in a dark room illuminated by an amber light.

Referring now to the subject of the invention, plate support apparatus 14, in the preferred embodiment, as illustrated in FIGS. 3 to 7, inclusive, consists of a platens 60 formed in the shape of a hollow box or box-like air-tight structure with the top wall 61, sides walls 62 and 63, and the opposite wall 64 having a boss 65 formed integrally therewith. Support webs 66 formed integrally with the above-described walls give rigidity to the structure. As actually constructed, the platens 60 is formed as a casting; the core mold having been removed through openings 67 which were then closed by suitable plugs 68, thus forming in the interior of the platens an accumulator chamber or cavity 69.

The top wall 61 of the platens is machined to provide a substantially flat bearing surface 72 for a xerographic plate, which may be held forcibly in place on the bearing surface by air pressure on one side of the xerographic plate, the other side of the xerographic plate being maintained at a negative pressure. A shallow I-shaped groove or recess 73, in the bearing surface 72 of the platens as defined by the top wall 61, is connected by apertures 74 to the accumulator chamber or cavity 69. To seal a xerographic plate against the bearing surface, a continuous gasket 75, made for example of gum rubber, is retained in the stepped groove 76, which encircles the groove 73, by seal retainer plates 77 and 78 secured by screws 79 (see especially FIGURES 3 and 6). Positioning pins or guide pins 80 are used to locate a xerographic plate on the bearing surface so that it will completely overlie the gasket 75.

As seen in detail in FIGURE 7 a connector plug 82 secured in the threaded opening 83, formed in the bottom wall 64 and boss 65 portion of the platens 60, positions a quick disconnect coupling 44 in alignment with the passage 84 communicating with the accumulator chamber 69. The connector plug 82 is sealed by an O-ring 85 positioned in annular groove 86 in the shoulder 87, while the connector plug 82 is sealed with respect to quick disconnect coupling 44 by O-ring 86 positioned in annular groove 89 in the boss 90 of the plate support apparatus.

The quick disconnect couplings 44 and 45 may be any one of a number of well-known types of commercially available, valved pipe connectors or couplings, the one illustrated being similar to the coupling disclosed in Hansen Patent 2,548,528. Although, either a male or female coupling may be used in the plate support apparatus 14, the quick disconnect coupling used in plate support apparatus 14 consists of a male pipe connector 91 having a flanged end 92 which fits into recess 93 formed in the boss 65. The male pipe connector 91 has a conduit 94 formed therein, the tapered wall portion at the end of
the conduit forming a valve seat 95 for tapered valve 96. A valve guide 97 secured in an annular slot 98 in the wall of conduit 94, guides the movement of valve 96 by means of the valve stem 99 secured thereto. The valve is normally maintained in a closed position by spring 81 which exerts valve stem 99.

To clearly illustrate the operation of the plate support apparatus and, in particular, the operation of the quick disconnect couplings, FIG. 2 shows a pair of couplings connected together. Since a male coupling 44 has been used on the plate support apparatus 14 it is apparent that the female couple coupling, and, as shown in FIGURE 2, the female quick disconnect coupling 45 is connected, in the embodiment disclosed, to an air cylinder 49 which is not described in detail since it forms no part of the invention. The female quick disconnect coupling 45 consists of a female pipe connector 53 having an opening 54 which receives the valve end of the male coupling 44, the pipe connectors when engaged being sealed by O-ring 55 positioned in annular slot 56. The internal structure of the female coupling is similar to that of the male coupling, that is, it has a conduit 94, valve seat 95, valve stem 99, valve guide 97 (not shown), and spring 81, all of which have been described in detail in connection with the male coupling 44.

The valves 96, which normally remain seated when the couplings are separated, are unseated when the valves contact each other as the couplings are connected together, thereby permitting fluid flow through the conduits 94.

In operation, a xerographic plate of suitable size is placed on the top of the plate 60, positioning of the xerographic plate being aided by guide pins 80. A vacuum line 46 is then connected by the pair of quick disconnect couplings 44 and 45 to the valves 96, the valves being connected and the lines in the couplings becoming unseated as the couplings are connected. With the couplings connected, the accumulator chamber 69 and its associated passages and grooves and the area in back of the xerographic plate, as encompassed by the seal, is evacuated, the ballast tank 47 being continually maintained during this operation at a vacuum pressure of 16 to 24 inches of mercury by vacuum pump 48. As the plate support apparatus is being evacuated, the xerographic plate is forcibly retained against the bearing surface of the plate because of the difference in pressure acting on the opposite sides of the plate.

After evacuation, the couplings may be disconnected, the valves being reseated by springs 81 upon disengagement of the couplings.

The xerographic plate and the plate support apparatus can now be moved through the xerographic machine, the xerographic plate being unencumbered by any mechanical fasteners while the plate support apparatus is unencumbered by any vacuum lines continually connected to it.

Due to the seal which forms an effective barrier against the flow of air between the back of the plate and the bearing surface of the plate, and to the size of the accumulator chamber, which acts as a ballast tank of relatively large volume, the vacuum will be maintained for a considerable length of time, permitting continuous use of the xerographic plate without short-time periodic re-evacuation of the plate. However, as a practical matter of safety, the plate support apparatus may be periodically re-evacuated, as, for example, in the xerographic machine, illustrated in FIGURE 1, the plate support apparatus is automatically connected to a vacuum line each time it reaches the stand-by station for the purpose of re-evacuating the vacuum and if necessary re-calibrating the plate support apparatus.

A plate support apparatus constructed in accordance with the invention permits the use of separate xerographic plate elements without the use of mechanical fasteners or plate clips, which normally are unsatisfactory on small plates and which are completely inadequate on large plates.

Plate support apparatus constructed according to the present invention provides a vacuum frame which may be loaded with a xerographic plate, sealed, and evacuated with a minimum of delay, the apparatus upon evacuation holding a xerographic plate in intimate contact with the rigid smooth bearing surface of the plate.

Since a xerographic plate is held in place on the plate support apparatus of the invention as a result of a pressure differential produced on opposite sides of the xerographic plate, the xerographic plate is uniformly pressed against the smooth contoured bearing surface of the plate support apparatus, thereby preventing warping or bulging of the xerographic plate. Thus, if the bearing surface of the plate support apparatus is flat, as illustrated in FIGURES 2 and 3, a xerographic plate, secured thereon by pressure acting on the entire surface of the xerographic plate, will be held flat against the flat bearing surface.

Although in the embodiment disclosed the bearing surface is shown as a flat surface, it is apparent that any smooth contoured bearing surface may be used. For example, the plate may be in the shape of a drum or a segment thereof, the bearing surface of which would be a smooth curved surface to receive a correspondingly shaped xerographic plate.

It is also apparent that while the invention has been described as a support apparatus for a xerographic plate, it will be understood that various omissions and substitutions and changes in the form and details of the invention as illustrated and in its operation may be made by those skilled in the art, without departing from the spirit of the invention. It is the intention, therefore, to be limited only as indicated by the scope of the following claims.

What is claimed is:

1. Apparatus for advancing a xerographic plate successively to each of a plurality of processing stations including a platen having wall means forming an accumulator chamber, an exterior portion of said wall means forming a bearing surface, a groove in said bearing surface, at least one aperture in said wall means connecting said groove to said accumulator chamber, said wall means being secured to said wall means positioned to enclose said groove in said bearing surface, said bearing surface being adapted to support a xerographic plate and said gasket means being adapted to seal a xerographic plate to said bearing surface, a valved quick disconnect coupling secured in said wall means in communication at one end with said accumulator chamber and adapted at its other end to be connected to a mating quick disconnect coupling connected to a vacuum line whereby a vacuum may be applied through said accumulator chamber to draw and hold a xerographic plate in contact with said bearing surface, and a conveyor means movable supporting said platen for advancing said platen and a xerographic plate supported thereby successively to each of a plurality of processing stations located adjacent said conveyor.

2. Apparatus for advancing a xerographic plate successively to each of a plurality of processing stations including a platen having wall means forming an accumulator chamber, an exterior portion of said wall means forming a bearing surface, a groove in said bearing surface, at least one aperture in said wall means connecting said groove to said accumulator chamber, said wall means being secured to said wall means positioned to enclose said groove in said bearing surface, said bearing surface being adapted to support a xerographic plate and said gasket means being adapted to seal a xerographic plate to said bearing surface, a valved quick disconnect coupling secured in said wall means in communication at one end with said accumulator chamber and adapted at its other end to be connected to a mating quick disconnect coupling connected to a vacuum line whereby a vacuum may be applied through said accumulator chamber to draw and hold a xerographic plate in contact with said bearing surface, a conveyor means movably supporting said
platen for advancing said platen and a xerographic plate supported thereby successively to each of a plurality of processing stations located adjacent said conveyor, and a mating quick disconnect coupling connected to a vacuum line movably positioned on said conveyor means adjacent a processing station, said mating quick disconnect coupling being adapted to be moved to a first position in which said mating quick disconnect coupling is connected to said quick disconnect coupling, and to a second position in which said mating quick disconnect coupling is uncoupled from said quick disconnect coupling.

3. In a xerographic reproducing apparatus including a plurality of processing stations for charging, exposing and developing a xerographic plate, the improvement including a conveyor means positioned in operative relation to said processing stations, a plate support apparatus movably supported by said conveyor means for advancement through said processing stations; said plate support apparatus including a hollow platen having a smooth contoured surface portion on which a xerographic plate may be detachably supported, a groove in said surface portion, a conduit connecting said groove with the interior of said hollow platen, gasket means connected to said surface portion encompassing said groove, and a valved quick disconnect coupling secured to said hollow platen in communication with the interior of said hollow platen adapted to be connected to a mateable quick disconnect coupling on a vacuum line whereby vacuum may be applied to the back of a xerographic plate positioned on said surface portion of said hollow platen to secure the xerographic plate to said surface portion and whereby said quick disconnect coupling may be disconnected from a mateable quick disconnect coupling to permit said plate support apparatus to be moved on said conveyor means through a plurality of processing stations.

4. A xerographic plate support apparatus including a platen having top wall, bottom wall and side walls forming an accumulator chamber in the interior of the platen, the upper exterior surface of said platen as defined by said top wall being substantially flat to support a xerographic plate, a groove in said upper surface, at least one aperture in said top wall connecting said groove to said accumulator chamber, a valved quick disconnect coupling communicating at one end with said accumulator cham-

References Cited in the file of this patent

UNITED STATES PATENTS
2,078,741 Stenmark Apr. 27, 1937
2,122,474 Karl July 5, 1938
2,672,080 Davidson Mar. 16, 1954
2,814,233 Anander Nov. 26, 1957
2,814,975 Mears Dec. 3, 1957

FOREIGN PATENTS
186,523 Austria Aug. 25, 1956