Aug. 8, 1961 UB IWERKS 2,995,108

XEROGRAPHIC POWDER IMAGE TRANSFER APPARATUS

Filed June 2, 1958 3 Sheets-Sheet 1

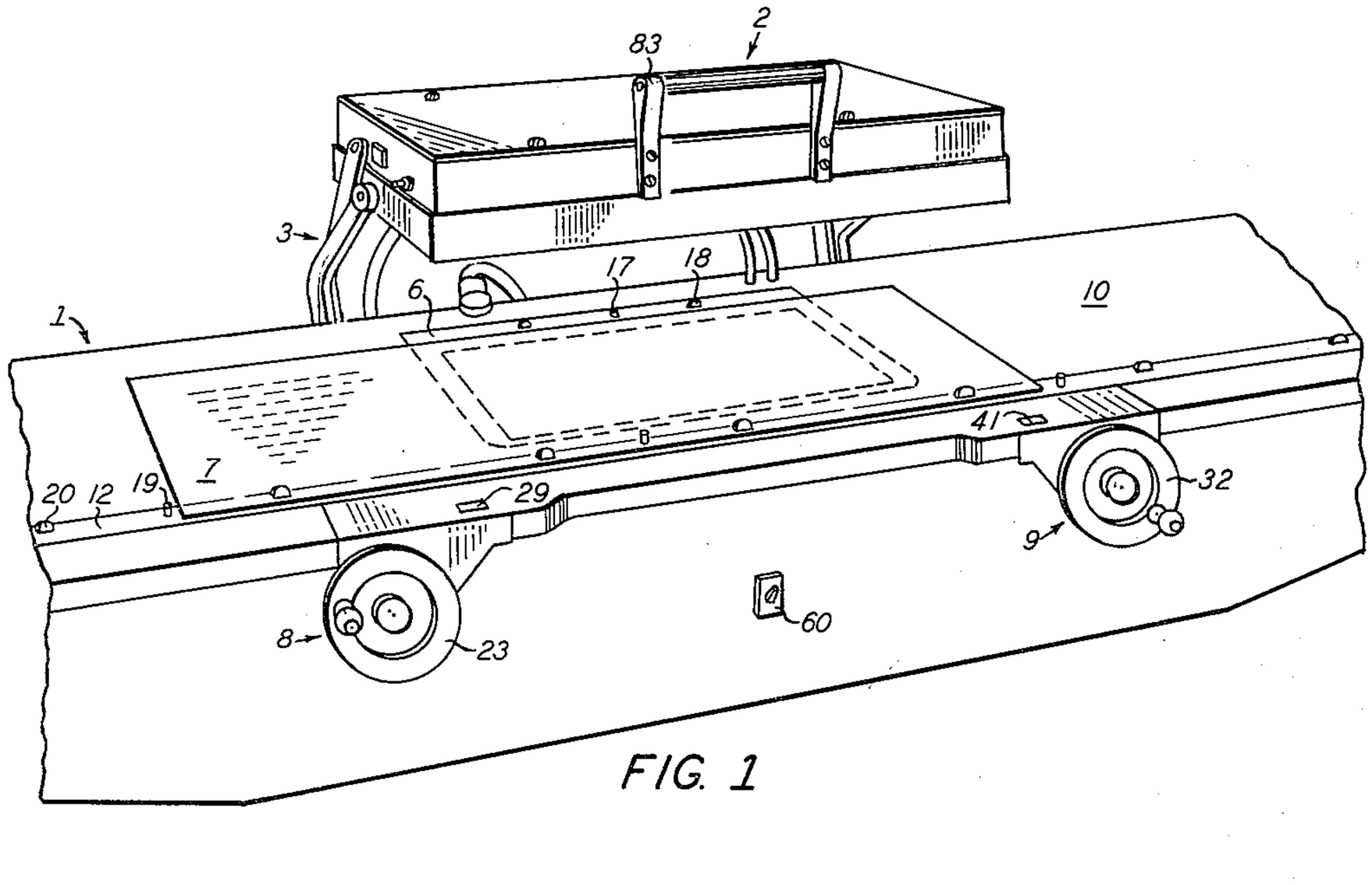

FIG. 1

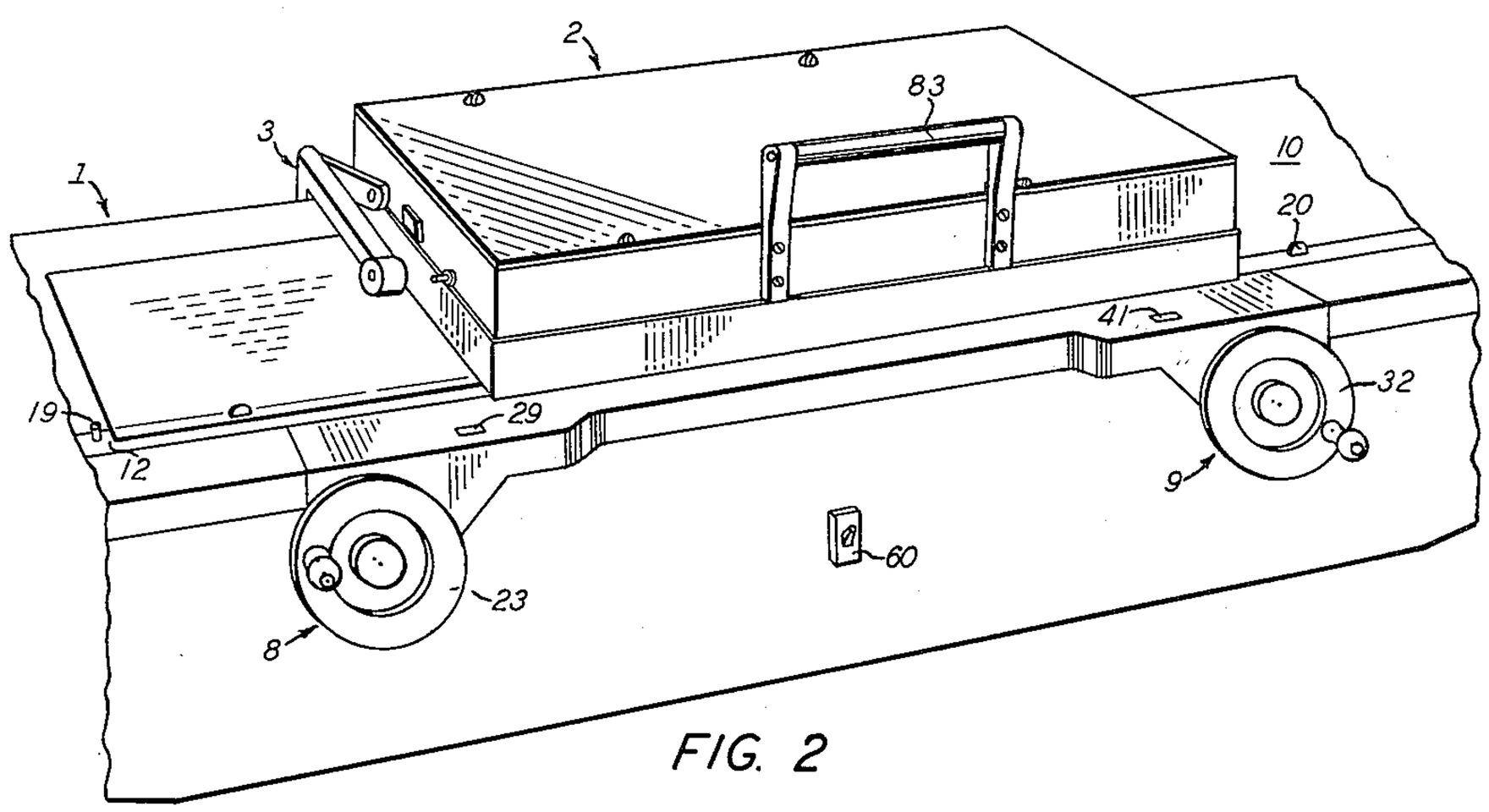

FIG. 2

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XEROGRAPHIC POWDER IMAGE TRANSFER APPARATUS

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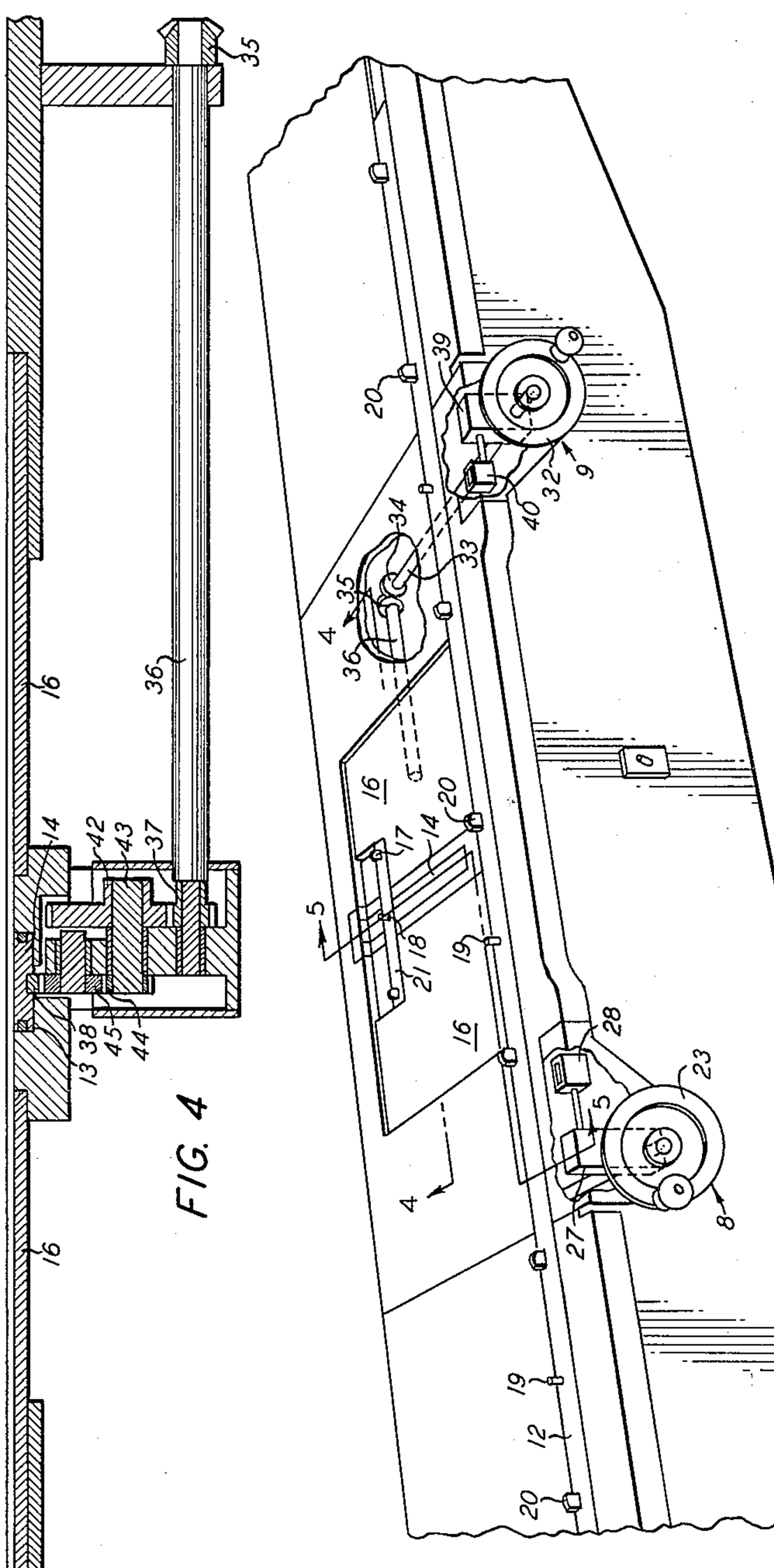

FIG. 4

FIG. 3

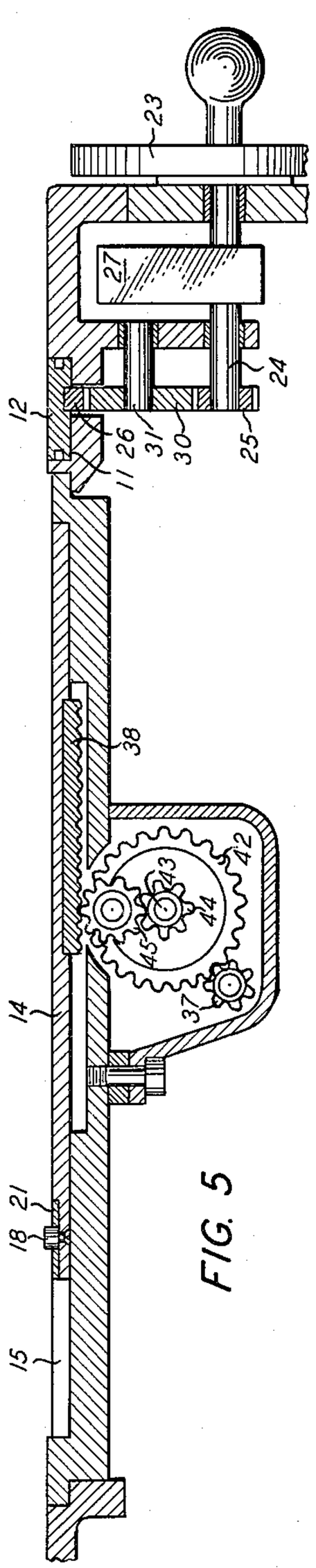

FIG. 5

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XEROGRAPHIC POWDER IMAGE TRANSFER APPARATUS

Filed June 2, 1958 3 Sheets-Sheet 3

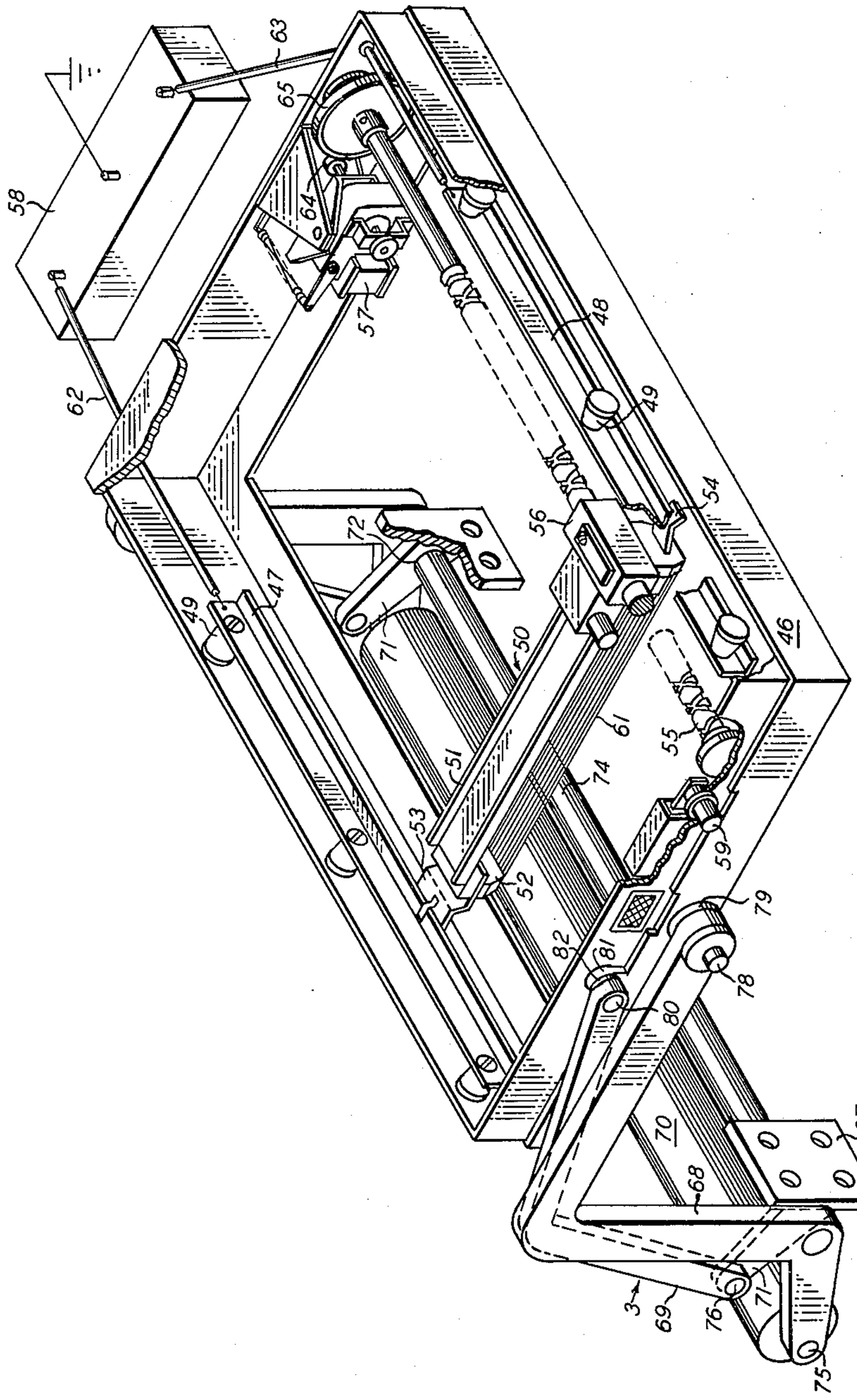

FIG. 6

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United States Patent Office

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2,995,108

XEROGRAPHIC POWDER IMAGE TRANSFER APPARATUS

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Filed June 2, 1958, Ser. No. 739,024

6 Claims. (Cl. 118—637)

This invention relates to the field of xerography and, particularly, to an improved apparatus for transferring a xerographic powder image from a xerographic plate to a support surface.

More specifically, the invention relates to an improved type of apparatus that is particularly adapted for the production of cartoon movies wherein it is required to effect a series of sequential transfers of xerographic powder images from a xerographic plate to successive support surfaces, and whereby, in many instances, the xerographic plate and support surface must be relatively displaced on each succeeding transfer to effect the simulation of motion in the final completed film.

In the process of xerography, for example, as disclosed in Carlson Patent 2,297,691, issued October 6, 1942, a xerographic plate comprising a layer of 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 that reaches them, and thereby creates an electrostatic latent image on or in the photoconductive layer. Development of the latent image is effected with an electrostatically charged, finely divided material such as an electroscopic powder that is brought into surface contact with the photoconductive layer and is held thereon electrostatically in a pattern corresponding to the electrostatic latent image. Thereafter, the developed xerographic powder image is usually transferred to a support surface to which it may be fixed by any suitable means.

Various means are proposed in the Carlson patent for transferring the xerographic powder image onto the support surface dependent upon the type of powder employed and the substance material of the support surface. For example, it is suggested an adhesive surfaced paper may be used as the support surface and that the adhesive side thereof be pressed firmly in contact with the powdered image to effect transfer. Wax or paraffin are typically recommended forms of adhesives. Where the powder or dye is of a soluble composition, a support surface wetted with a suitable solvent may be applied firmly in contact with the powdered image, thereby effecting transfer to the support surface.

Advances in the xerographic art showed a need for increasingly accurate and more positive transfer means. In today's state of the art, transfer of a xerographic powder image from a xerographic plate to a support surface is usually achieved through the use of a corona generating apparatus which is an adaptation of the Image Transfer Device disclosed by Sabel and Mayo Patent 2,684,901, issued July 27, 1954. When placed in transfer relation to a support surface superposed on a xerographic powder image, the corona generating apparatus, by electrostatically charging the support surface, causes the powder image to transfer and adhere to the support surface. The transferred image can then be fused on the support surface by conventional xerographic techniques.

In the above-cited Carlson patent it is noted that a variety of types of finely divided electroscopic powders may be employed for developing electrostatic latent images. However, as the art of xerography has progressed, it has been found preferable to develop line copy images with a powder formed of any of a variety of pigmented

resins that have been specifically developed for the purpose. A number of such developing materials are commercially available and are specifically compounded for producing dense images of high resolution and to have characteristics to permit convenient storage and handling.

Such developing materials are specifically designed to permit them to be electrostatically transferred and then fixed to support surfaces either by conventional heat or vapor fixing techniques, in accordance with the particular application in which they are employed. Where the support surface is composed of a material or substance such that it is impractical or unfeasible to permit fixing the powdered image by conventional applications of these methods, as, for example, in the fixing of a powdered image onto a cellulose acetate support surface or "cel," of the type employed in the preparation of cartoon movies, a method and apparatus disclosed in copending application S.N. 674,777, filed July 29, 1957, in the name of Ub Iwerks, entitled Xerographic Fusing Apparatus, may be preferred.

In general, to prepare a cartoon movie, each frame of the finished film is exposed to a group of four or more cellulose acetate transparencies, upon which are drawn and painted the various figures in the cartoon. Usually, each transparency or "cel" is employed to depict a single character and a progression of cels with minute variances are necessary to portray the successive movements required to simulate motion in the finished film. Sometimes a drawing may appear on only one of the cels that are being photographed, but in all cases in a given film sequence a uniform number of cels are stacked together before exposure in order to maintain consistency of light transmission and reflection. Background scenes are usually painted on one of several types of artist painting boards and may be painted in water color, tempera color, or an oil color, and are positioned behind the cels being photographed.

An illustration of the above application would be a scene portraying an automobile in motion. The automobile must appear continually to advance in its direction of travel relative to its natural surroundings. This effect is attained by slightly displacing the automobile on each succeeding cel, so that when photographed in relation to fixed background scenery, there will result a filmed scene portraying the automobile in continuous movement. The amount of cel displacement required is a function of the rate of motion to be simulated and is determined from calculated or empirically prescribed relationships.

Prior to the application of xerographic techniques to the production of cartoon movies, the preparation of the individual cels required that an artist draw a pencil sketch of the desired figure on heavy white bond paper in exact registration of the scene to be portrayed. The paper employed was specially prepared with a series of holes punched along one edge which were used for alignment and registration purposes. When the drawing was completed, it was passed on to a tracer who placed a cellulose acetate "cel" having similar registration holes over the original drawing and copied all the pencil lines of the original sketch with pen and ink. The inked drawing was then passed to another artist who colored the ink outlines on the reverse side of the cel, according to a predetermined coloring sketch. After the painting was completed, the several cels required to form a particular scene were mounted on a board using the holes to achieve proper registration and were photographed to form a single frame of the movie.

Since normal motion picture projection speeds are twenty-four frames per second and a minimum of four cels are required to be prepared for each frame, it is apparent that a full minute of projection requires the preparation of thousands of cels and that the preparation of

a two-reel "short" requires the expenditure of a tremendous amount of effort. In addition, since highly skilled artists are required for this work, it is apparent that the cost of making cartoon movies is quite high. In order to decrease these costs, it was found that xerographic techniques could be employed to eliminate a substantial portion of the skilled manual craftsmanship that was previously employed. Specifically, it was found that xerocopies of the original artist sketches could be transferred directly to cels and fused thereon, thereby eliminating completely all of the manual tracing previously required. In addition, it was found that certain of the artist's shading effects, that were normally lost in the manual tracing, could be retained by the careful application of xerographic techniques to improve the quality of the finished cartoon.

In practice, in the application of xerographic techniques to the production of cartoon movies, a xerographic plate comprising a photoconductive layer formed on a conductive backing is provided with a uniform electrostatic charge on the photoconductive layer which then is exposed to a light image of the sketch required to be reproduced, usually by conventional projection techniques. This exposure discharges the xerographic plate in the lighted areas thereof retaining a latent electrostatic image of the sketch on the photoconductive layer. This latent image is then developed by cascading a xerographic developing material over the surface of the plate whereby the pigmented resin component of the developing material adheres to the latent image to form a xerographic powder image of the sketch on the plate. Thereafter, the xerographic powder image is transferred to the surface of a cellulose acetate "cel," by conventional electrostatic transfer techniques, and is then fixed on the cel's surface.

The foregoing technique provides an accurate and economical way of forming cels for use in the production of cartoon movies and is presently in commercial use for this purpose. In addition, it has been found that at least portions of the cartoon movie can be simplified in production by a further application of xerographic techniques. For example, in the illustration noted above, namely, the automobile in motion against a background scene, it may be assumed that in at least a portion of a given film sequence, the automobile will retain a given configuration through a succession of at least several frames. To achieve the illusion of motion, the automobile may be advanced on successive frames relative to a fixed background, or it may remain fixed relative to the projection screen while the background is caused to move. In either case, it is apparent that each scene of a series of successive frames can comprise repetitions of the same background configuration and the same automobile outline merely by displacing one relative to the other.

Prior to the application of xerographic techniques to cartoon movie preparation, the above displacement procedure for successive cels was achieved by visual perception. As each successive cel was manually traced from the artist's sketch as hereinbefore described, the tracer would visually and painstakingly reposition the succeeding cel before tracing. It is apparent that these means require employment of skillfully trained personnel and at best provided a limited accuracy for displacement. In the alternative, duplicate cels were traced in exact registration of artists' sketches and successive cels were visually displaced when mounted for photographing the finished scene.

The principal object of this invention is to improve transfer of a xerographic powder image from a xerographic plate to a support surface. A further object of the invention is to effect precise registration between a xerographic powder image and a support surface. A further object of the invention is to effect precise relative positioning between a xerographic plate and a support surface. A further object of the invention is to provide a corona generating apparatus for effecting transfer of

a xerographic powder image from a xerographic plate to a support surface in combination with devices for effecting precise relative positioning of a xerographic plate and a support surface. A further object of the invention is to provide means for positioning a corona generating apparatus from image transferring relation to a parallel ineffective and stable position.

These and other objects of the invention are attained with the apparatus of the invention comprising a work table with lateral and longitudinal slides on the work table surface, an independent means for relatively positioning each of the slides, a means for aligning and securing a xerographic plate on one prepositioned slide, a means for aligning and securing a support surface on the other prepositioned slide, a corona generating apparatus supported on the work table for effecting transfer of a xerographic powder image from a xerographic plate to a support surface and a means for positioning the corona generating apparatus in powder image transferring relation to a xerographic plate and support surface secured on the slides.

A preferred form of the invention is embodied in the accompanying drawings, in which:

FIG. 1 is an isometric view of the apparatus of the invention, showing a xerographic plate and a cel in position for effecting image transfer;

FIG. 2 is an isometric view of the apparatus of FIG. 1 in image transferring position;

FIG. 3 is an isometric cut-away view of the work table;

FIG. 4 is a longitudinal section view through the work table top;

FIG. 5 is a lateral section view through the work table top; and

FIG. 6 is an isometric cut-away view of the corona generating apparatus and the parallel linkage supporting mechanism therefor.

In the form of apparatus shown on the drawings the invention includes a rectangular work table **1**, a corona generating apparatus **2** which in transfer relation serves to provide a uniform electrostatic charge to a support surface thereby effecting transfer of the powdered image from a xerographic plate to the support surface; a parallel linkage mechanism **3** for raising and lowering the corona generating apparatus **2** from the work table surface, a longitudinal positioning mechanism **8** and lateral positioning mechanism **9** for prepositioning a xerographic plate and support surface, respectively.

For positioning xerographic plates and cels support surfaces the horizontal top surface **10** of work table **1** is provided with a longitudinal groove **11** (FIG. 5) for insertion therein of longitudinal slide **12** and a lateral groove **13** (FIG. 4) for insertion therein of lateral slide **14**. In approximate center of table surface **10**, is a depressed rectangular area **15** in which is inserted lateral slide **14** extending laterally through the center of **15** and filler plate **16** which in cooperation with lateral slide **14** forms a substantially flat horizontal surface to accommodate xerographic plate **6** (shown in FIG. 1). When set on top of lateral slide **14** and filler plate **16**, the top surface of xerographic plate **6** forms a substantially continuous horizontal surface with work table top surface **10** for superposing thereon of transfer support surface **7**.

Secured to the top of lateral slide **14** and perpendicular to its main axis is cross member **21**. On the top surface of cross member **21** and upwardly protruding therefrom are rectangular shaped pins **17** and cylindrically shaped pin **18** which serve to secure a xerographic plate **6** to the work table surface and effect alignment thereof with corresponding similarly shaped holes in said xerographic plate **6**. Similarly, on the top surface of longitudinal slide **12** are upwardly protruding cylindrical pins **19** and substantially oblong shaped pins **20** which serve to secure a support surface **7** to the work table surface and

effect alignment thereof with corresponding similarly shaped holes in said transfer support surface 7.

Assembled below the top surface of table top 10 are longitudinal positioning mechanism 8 and lateral positioning mechanism 9 which serve to position longitudinal slide 12 and lateral slide 14, respectively. Turning of handwheel 23 secured on laterally extended shaft 24 effects a longitudinal movement of slide 12 by transmitting the angular movement of 23 through shaft 24 to pinion 25 also secured on shaft 24 thence to gear 30 secured on rotatable shaft 31 and thence to rack 26 which is integrally attached to the underside of slide 12 and is in continuous engagement with gear 30. Coincident with the turning of handwheel 23, counting mechanism 27 secured on shaft 24 and engaged with counting indicator 28, transmits the measured position of slide 12 to a visually legible indicator dial at window 29. Similarly, turning of handwheel 32 secured on laterally extended shaft 33, effects a lateral movement of slide 14 by transmitting the angular movement of handwheel 32 through shaft 33 to bevel gear 34 secured thereon, thence to bevel gear 35 secured on longitudinally extended shaft 36 to pinion 37 also secured on shaft 36, thence to gears 42 and 44 each secured on rotatable shaft 43, thence to gear 45 engaged with rack 38 which is integrally attached to the underside of slide 14. Coincident with the turning of handwheel 32, counting mechanism 39 secured on shaft 33 and engaged with counting indicator 40 transmits the measured position of slide 14 to a visually legible dial at window 41. It is apparent from the foregoing that, by manipulation of either or both handwheels 23 and/or 32, accurate positioning of either slide 12 or 14 may be effected independently and thereby effect a prepositioned relationship between a xerographic plate and a support surface subsequently secured to their respective slides.

Corona geenrating apparatus 2, in transfer relation, functions to generate a uniform electrostatic charge over the transfer support surface 7 thereby effecting transfer of the powdered image from the xerographic plate 6 onto the transfer support surface 7 by electrostatic attraction. Referring to FIG. 6, the corona generating apparatus is comprised of supporting frame 46 which serves to position all components; conductive rails 47 and 48 each secured to frame 46 and insulated therefrom by insulators 49; and a discharge electrode assembly or "scorotron" 50 slidably mounted in frame 46 to pass over transfer support surface 7 (FIG. 2) when generating apparatus 2 is in transferring relation. The "scorotron" 50 is comprised of a support channel 51, generally of conductive material, carrying at each end insulating blocks 52 between which are strung two sets of wires. Scorotron 50 is supported in frame 46 by hangers 53 and 54 which slide on rails 47 and 48, respectively. Each hanger is connected to a separate set of wires whereby the potential of each set of wires may be controlled by applying an appropriate potential to the corresponding rail from power source 58. High voltage power supply 58 is connected to side rails 47 and 48 through wires 62 and 63, respectively, which voltage is thereby transmitted to "scorotron" 50. Corona wires (not shown) are usually charged with a potential in the range of 6000–8000 volts whereas screen wires 61 are usually charged with a potential in the range of 600–800 volts. Frame 46 also supports rotatable reversing lead screw 55 which is adapted to move the "scorotron" 50 back and forth by means of the lead screw block 56 which engages the groove in the lead screw 55 and is attached to support channel 51. Electric motor 57 is pivot mounted to frame 46 whereby wheel 64, secured to the motor shaft of motor 57, is continually engaged by surface friction to lead screw wheel 65 secured to lead screw 55 thereby effecting rotation of lead screw 55. Microswitch 59 is usually provided to stop motor 57 and scorotron 50 after "scorotron" 50 traverses one cycle forth and back to its starting position. Alternatively, other mechanical arrangements may be used.

In operation, corona generating apparatus 2 is placed in transferring relation over transfer support surface 7 as shown in FIG. 2. Power supply 58 and motor 57 are simultaneously energized through switching of microswitch 59 causing "scorotron" 50 to traverse over support surface 7 and deposit charge thereon. Said charge on support surface 7 attracts the powdered image from the xerographic plate 6 onto the support surface 7. Switch 60 provides a safety disconnect of the power supply to the corona generating apparatus 2.

Parallel linkage mechanism 3 is comprised of two sets of support brackets 67, rocker arm brackets 68, and pivot arm bracket 69 assembled in mirror-image relation and joined by counterweight 70. Support brackets 67 attach to work table 1, by means of bolting, welding or other suitable means. Extending perpendicular and upward from bracket 67, and as an integral and fixed part thereof, is cantilevered arm 71, which is journaled at 72. Main shaft 74 extends longitudinally behind brackets 67, through journals 72 and is secured at both ends by rocker arm brackets 68. Counterweight 70 is secured at both ends by bolting through at the lower end of rocker arm bracket 68 with bolts 75 into each tapped end of counterweight 70. Pivot arm bracket 69 is pivot mounted to arm 71 by trunnion 76. Rocker arm brackets 68 connect to support frame 46 of corona generating apparatus 2 by bolt 78 through sleeve bearing (not shown) in bracket 68 into tapped boss 79 of frame 46. Similarly, pivot arm bracket 69 connects to support frame 46 by bolt 80 inserted through the forward end of bracket 69, through washer 81 into tapped boss 82 of frame 46.

By the arrangement above described, the corona generating apparatus 2 can be lifted from operative transfer relation shown in FIG. 2 to its extreme inoperative position shown in FIG. 1, with the apparatus continually maintained in a horizontal plane. By maintaining corona generating apparatus 2 in a parallel horizontal plane the "scorotron" 50 is mintained in concealed relation to the human operator thereby affording safety protection to the operator from inadvertent contact while said scorotron is charged with a high potential. Similarly, the precision made "scorotron" is protected from accidental damage from any passing object. Counterweight 70 serves to effect stability of the corona generating apparatus 2 when in its inoperative position thereby preventing said apparatus from falling downward during its period of inoperativeness.

Raising corona generating apparatus 2 by handle 83 transmits the movement through rocker arm bracket 68 and about shaft 74 in journal 72. Simultaneously, movement is transmitted through pivot arm bracket 69 about trunnion 76. The relative connection points, general configuration, and turning points of brackets 68 and 69 maintain generating apparatus 2, in a parallel horizontal plane.

By the arrangement thus described there is provided a xerographic transfer apparatus that enables rapid and precise positioning between a xerographic plate bearing a xerographic powdered image and a transfer support surface in combination with means to effect transfer of the xerographic powdered image to the support surface. There is provided thereby, expedient xerographic transfer means for the preparation of cartoon movies.

Obviously, many changes could be made in the above-described construction and a number of apparently different embodiments of apparatus could be made within the scope of the invention. Therefore, it is intended that all matter contained in the above description shall be considered as illustrative, and that the invention be limited only as defined in the appended claims.

What is claimed is:

1. An apparatus for transferring a xerographic powder image from a xerographic plate to a support surface superposed thereon, comprising a work table, lateral and longitudinal slides on the work table surface, independent means for relatively positioning each of the slides, a

means for aligning and securing a xerographic plate on one prepositioned slide, a means for aligning and securing a support surface on the other prepositioned slide, whereby said aligning means serve to align a plate and support surface one above the other, a corona generating apparatus supported on the work table for effecting transfer of a xerographic powder image from a xerographic plate to a support surface, and means for positioning the corona generating apparatus in powder image transferring relation to a xerographic plate and a support surface secured on the slides.

2. An apparatus for transferring a xerographic powder image from a xerographic plate to a support surface superposed thereon comprising a work table, lateral and longitudinal slides on the work table surface; a first grooved slot arranged laterally in the work table surface to accept and guide a lateral slide; a second grooved slot arranged longitudinally in the work table surface to accept and guide a longitudinal slide; independent means for relatively positioning each of the slides in its respective groove, a means for aligning and securing a xerographic plate to one prepositioned slide; and means for aligning and securing a support surface to the other prepositioned slide, whereby said aligning means serve to align a plate and support surface one above the other, a corona generating apparatus supported on the work table for effecting transfer of a xerographic powder image from a xerographic plate to a support surface, and means for positioning the corona generating apparatus in powder image transferring relation to a xerographic plate and a support surface secured on the slides.

3. An apparatus for transferring a xerographic powder image from a xerographic plate to a support surface superposed thereon comprising a work table, lateral and longitudinal slides on the work table surface; a first grooved slot arranged laterally in the work table surface to accept and guide a lateral slide; a second grooved slot arranged longitudinally in the work table surface to accept and guide a longitudinal slide; an independently operative gear drive mechanism connected to the one slide; an independently operative gear drive mechanism connected to the other slide; a means to independently actuate each gear drive mechanism to effect relative positioning of the longitudinal and lateral slides; pins on one prepositioned slide for aligning and securing a xerographic plate thereto; pins on the other prepositioned slide for aligning and securing a support surface thereto; whereby the pins on said slides serve to align a plate and support surface one above the other, a corona generating apparatus supported on the work table for effecting transfer of a xerographic powder image from a xerographic plate to a support surface, and means for positioning the corona generating apparatus in powder image transferring relation to a xerographic plate and a support surface secured on the slides.

4. An apparatus for transferring a xerographic powder image from a xerographic plate to a support surface superposed thereon comprising a work table, lateral and longitudinal slides on the work table surfaces; a first grooved slot arranged laterally in the work table surface to accept and guide a lateral slide; a second grooved slot arranged longitudinally in the work table surface to accept and guide a longitudinal slide; an independently operative gear drive mechanism connected to the one slide; an independently operative gear drive mechanism connected to the other slide; a means to independently actuate each gear drive mechanism to effect relative positioning of the longitudinal and lateral slides; pins on one prepositioned slide for aligning and securing a xerographic plate thereto; pins on the other prepositioned slide for aligning and securing a support surface thereto; whereby the pins on said slides serve to align a plate and support surface one above the other, a corona generating apparatus pivotally mounted on the work table for effecting transfer of a xerographic powder image from a xerographic plate to a support surface; a parallel linkage mechanism connecting the corona generating apparatus to the work table whereby the generating apparatus may be moved to an effective position in which it is in powder image transferring relation to a xerographic plate and support surface secured on the table or to an ineffective position in a parallel plane to the work table surface; and a counterbalancing weight in the parallel linkage mechanism to maintain the corona generating apparatus in either its effective or in its ineffective position.

5. Apparatus for transferring a xerographic powder image from a xerographic plate to a support surface superposed thereon, said apparatus including a work supporting surface, a corona generating apparatus supported in operative relation to said work supporting surface and adapted for effecting transfer of a xerographic powder image from a xerographic plate to a support surface, a first slide member operatively arranged on said work supporting surface and having means for aligning a xerographic plate on said work supporting surface in operative relation to the corona generating apparatus, and a second slide member operatively arranged on said work supporting surface and having means for aligning a support surface in superposed relation to a xerographic plate aligned by first slide member, whereby said aligning means serve to align a xerographic plate and support surface one above the other.

6. Apparatus for transferring a xerographic powder image from a xerographic plate to a support surface superposed thereon, said apparatus including a work supporting surface, a corona generating apparatus supported in operative relation to said work supporting surface and adapted for effecting transfer of a xerographic powder image from a xerographic plate to a support surface, a first slide member arranged to move laterally on said work supporting surface, a second slide member arranged to move longitudinally on said work supporting surface, means on one of said slide members to align a xerographic plate on said work supporting surface in operative relation to the corona generating apparatus, means on the other of said slide members to align a support surface in superposed relation to a xerographic plate aligned on said work supporting surface, whereby said aligning means serve to align a xerographic plate and a support surface one about the other, and variably settable means connected to each slide member to effect movement of the slide members relative to each other.

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