March 26, 1963 A. G. SHERMAN 3,082,688

SCREEN PRINTING APPARATUS

Filed March 14, 1961 3 Sheets-Sheet 1

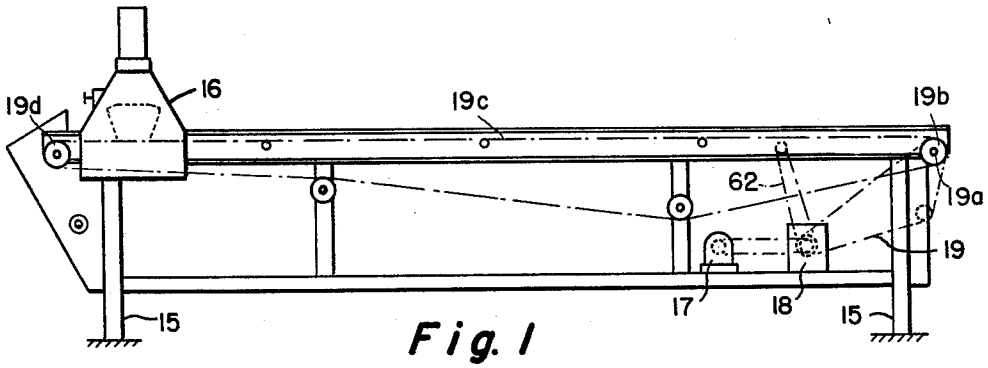


Fig. 1

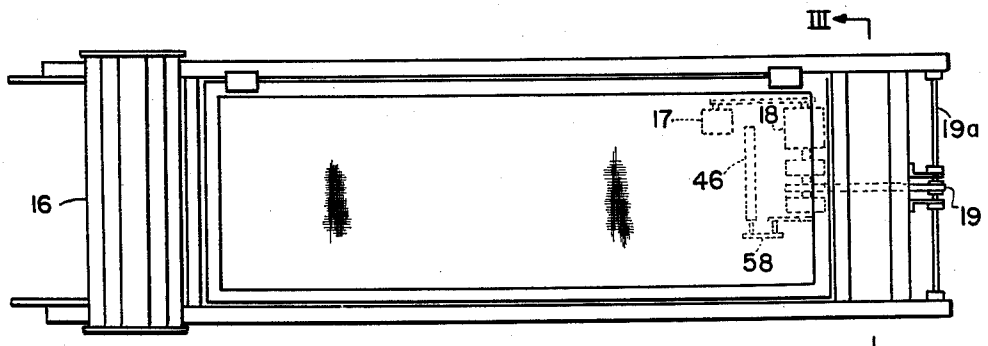


Fig. 2

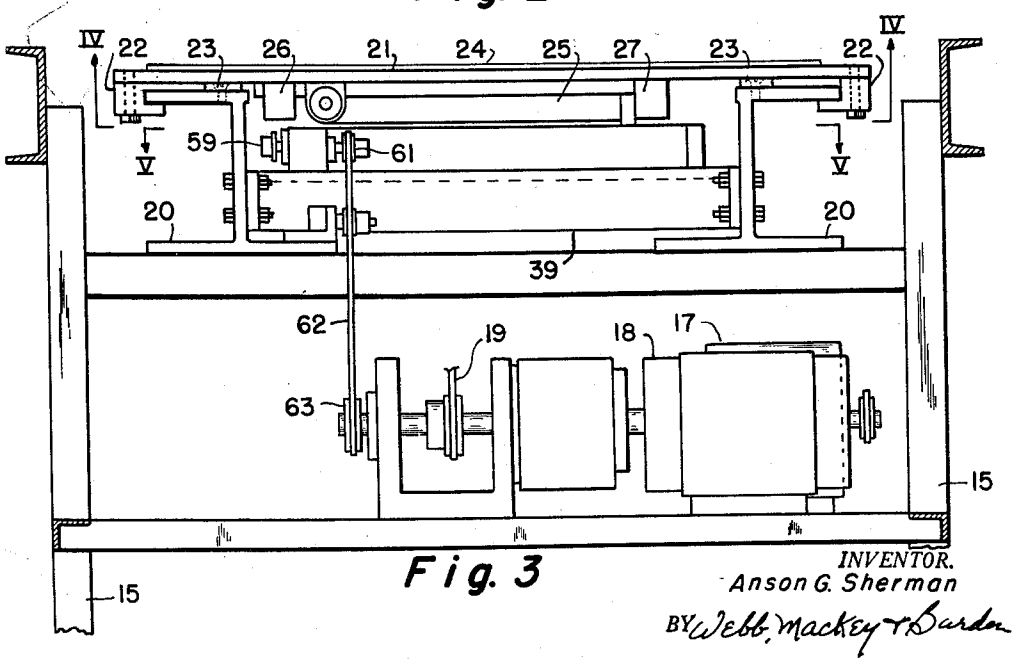


Fig. 3

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SCREEN PRINTING APPARATUS

Filed March 14, 1961 3 Sheets-Sheet 2

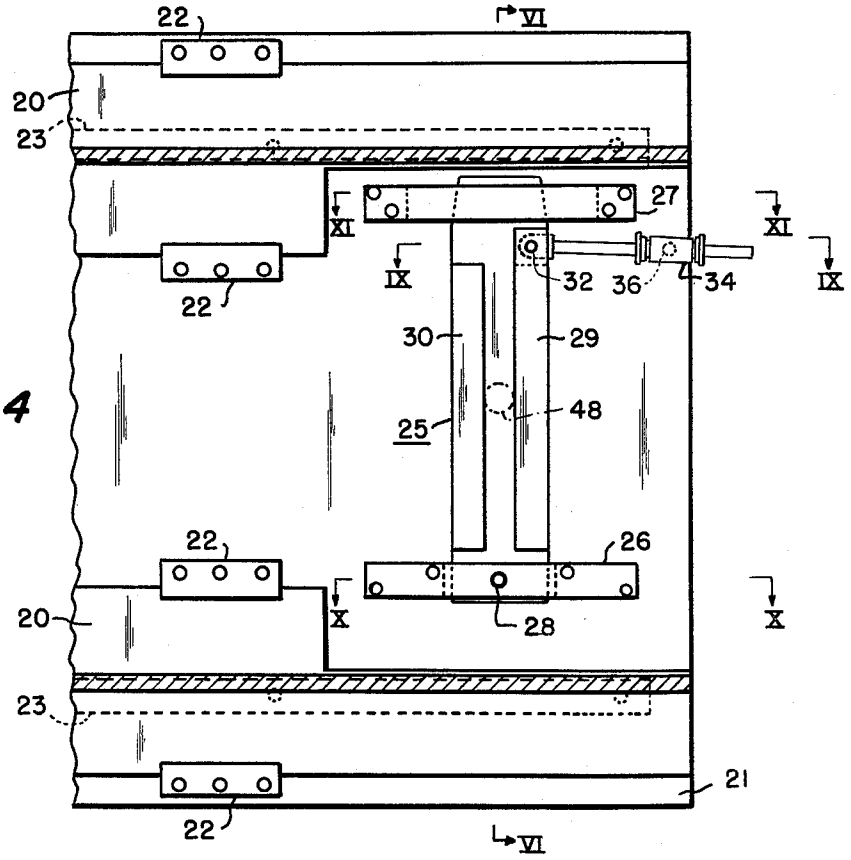


Fig. 4

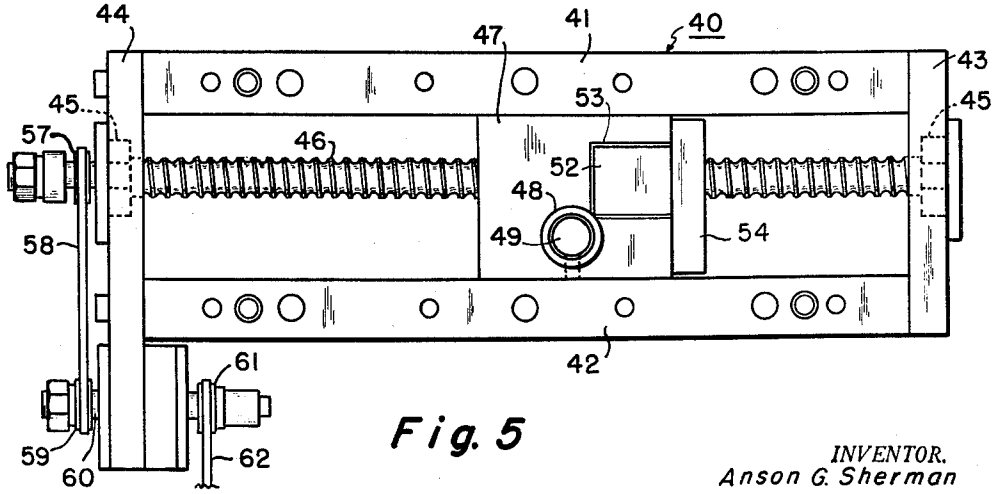


Fig. 5

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SCREEN PRINTING APPARATUS

Filed March 14, 1961 3 Sheets-Sheet 3

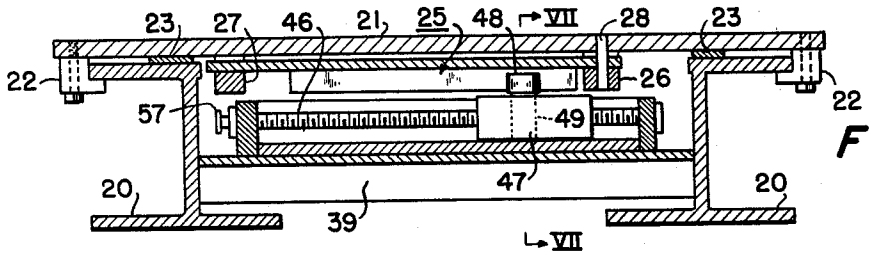


Fig. 6

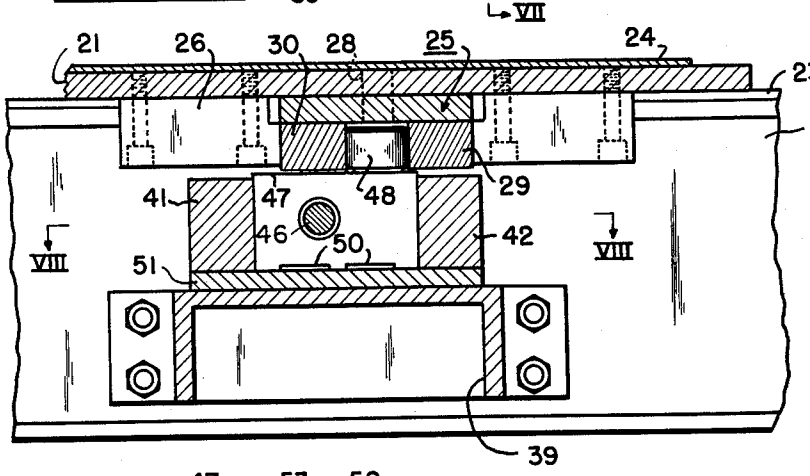


Fig. 7

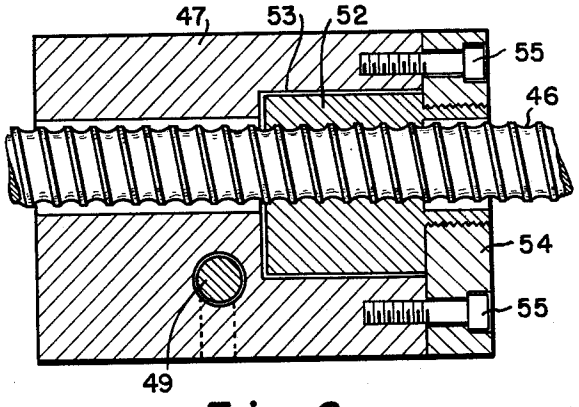


Fig. 8

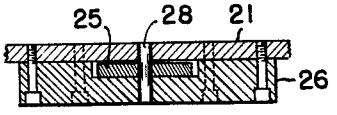


Fig. 10

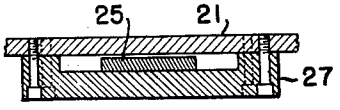


Fig. 11

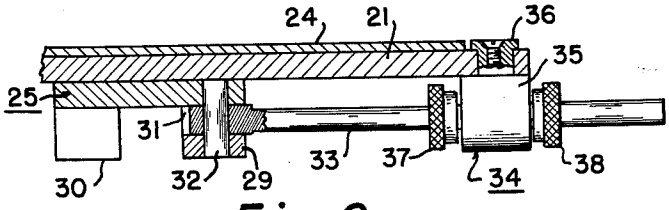


Fig. 9

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United States Patent Office 3,082,688 Patented Mar. 26, 1963

3,082,688
SCREEN PRINTING APPARATUS

Anson G. Sherman, Fort Lauderdale, Fla., assignor to Dry Screen Process, Inc., Pittsburgh, Pa., a corporation of Pennsylvania

Filed Mar. 14, 1961, Ser. No. 95,641
7 Claims. (Cl. 101—126)

Screen printing apparatuses are well known and normally include an upstanding frame, a horizontal bed mounted on the frame for supporting the material to be printed, a screen overlying the bed and having a template denoting the configuration to be printed on the material, and a manual or mechanically movable carriage having a reservoir and squeegee which passes over the top of the screen and forces a printing composition through the screen onto the material to be printed. The reservoir contains a heated printing composition which is fed through openings in the bottom of the reservoir onto the screen immediately in front of the squeegee. To insure proper fluidity of the printing composition, it is necessary to heat the screen. An electric current is passed through the metal screen thereby causing thermal expansion in the screen due to the heating. This thermal expansion of the screen is troublesome because the template on the screen expands and thus tolerances cannot be maintained on the printed material.

The present invention is directed to a device for compensating for the expansion of the screen and template due to heating.

This compensation is achieved with my invention by automatically repositioning the material to be printed so that very close tolerances can be maintained. I have found that in printing long pieces of material the deviation from the desired tolerances is quite substantial. My device provides a compensating mechanism which is adjustable for use with all sizes of material to be printed at all temperatures to which the screen may be heated.

My invention is very reliable and produces repetitive, accurate printing once an equilibrium heat condition has been reached in the apparatus during printing.

My invention can also be used to achieve a reverse effect from that described above, in that the configuration being printed can be enlarged beyond the limits of the template denoting the configuration.

My invention is also particularly useful in photoprinting by altering one axis of the configuration being printed. Both axes can be altered by a repetitive printing procedure. Axis altering in photoprinting is particularly desirable in restoring the proper relationship in distorted photographs such as aerial photographs.

In the drawings, I have show a presently preferred embodiment of my invention in which:

FIGURE 1 is a side elevation view of a screen printing apparatus according to my invention;

FIGURE 2 is a plan view of a screen printing apparatus according to my invention;

FIGURE 3 is a cross section end view taken on line III—III of FIGURE 2;

FIGURE 4 is a cross section taken on line IV—IV of FIGURE 3;

FIGURE 5 is an enlarged cross section taken on line V—V of FIGURE 3 with parts removed for clarity;

FIGURE 6 is a cross section taken on line VI—VI of FIGURE 4;

FIGURE 7 is a cross section taken on line VII—VII of FIGURE 6;

FIGURE 8 is an enlarged cross section taken on line VIII—VIII of FIGURE 7;

FIGURE 9 is a cross section taken on line IX—IX of FIGURE 4;

FIGURE 10 is a cross section taken on line X—X of FIGURE 4; and

FIGURE 11 is a cross section taken on line XI—XI of FIGURE 4.

Briefly, my invention includes a mechanism for moving the bed supporting the material to be printed in a direction toward or away from the direction of movement of the squeegee carriage. Thus, as the squeegee carriage moves along the screen, the bed is progressively moved toward or away from the starting point of the carriage movement. The movements of the carriage and the bed are correlated to achieve the desired compensation, enlargement or alteration in the printed material.

Referring specifically to FIGURE 1, the conventional screen printing apparatus includes a rigid frame having legs **15**, a squeegee and reservoir carriage **16** movable during printing from left to right in FIGURE 1, and power means to move the carriage longitudinally along the frame. A suitable squeegee and reservoir carriage is shown in my copending application Serial No. 95,545 filed March 14, 1961. Normally, the power means is an electric motor **17** operatively connected to a speed reducer **18** which in turn is operatively connected to a chain drive **19**. The chain drive **19** turns a cross shaft **19*a*** rotatably mounted at one end of the frame on which the squeegee carrier slides. Sprocket wheels **19*b*** at each end of the shaft support and carry chains **19*c*** which extend along sides of the top of the frame and are secured at one point in their lengths to the carrier **16**. The chains are endless and return from sprockets **19*d*** at the other end of the frame to the sprockets **19*b*** as shown in FIGURE 1. The motor **17** is reversible, and driving the motor in each direction will move the carriage fore and aft over the screen. An automatic control for the motor such as is shown in U.S. Patents Nos. 2,039,907, 2,688,-917 or 1,898,406 can be used if desired.

The conventional screen printing apparatus normally has a stationary bed on which the material to be printed is placed, and a screen is positioned over the bed and material. The screen has a template delimiting the configuration to be printed on the material. Typical screens having a template or a stencil which can be used in my apparatus are shown in U.S. Patents Nos. 2,606,-492, 1,898,406 and 2,002,335. The screen is heated by passing a low voltage, high amperage current through the screen from one end of the screen to the other. Suitable arrangements for mounting the screen and for supplying a heating current to it are shown in U.S. Patents Nos. 2,731,912 and 2,895,412.

My printing apparatus is substantially the same as known apparatuses except a pair of spaced elongated I-beams **20** are rigidly affixed longitudinally to the frame of the apparatus and a bed **21** is slidably mounted on the beams by brackets **22**. A brass wear plate **23** is affixed to each beam between the bed and the beam to promote sliding of the bed on the beams. Thus, the bed and material **24** to be printed are movable longitudinally of the frame.

Preferably, at the right-hand end of the bed, as viewed in FIGURE 1, a U-shaped guide **25** is positioned with its open side downward on the underside of the bed. A flange portion of each beam **20** is cut away to provide room for the guide **25** as shown in FIGURE 4. This U-shaped guide is maintained tight against the underside of the bed by a pair of brackets **26** and **27** which are bolted to the bed as shown in FIGURES 9 and 11. One end of the guide is pivoted on a pin **28** relative to the bracket **26** and bed and the bracket **26** has a U-shaped opening sufficiently large to permit horizontal pivoting of the guide. The other end of the guide **25** is slidably positioned within a U-shaped opening in

bracket 27 as shown in FIGURE 11. The opening in bracket 27 is sufficiently large to permit the guide to pivot on pin 28.

The guide 25 has a pair of spaced parallel bars 29 and 30 projecting downwardly. The bar 29 is longer than bar 30 (see FIGURE 4) and has an opening 31 at its projecting end to provide a yoke for a pin 32 pivotally mounting a shaft 33 of a micrometer adjustment mechanism 34. The shaft 33 extends through a sleeve 35 which is swingably affixed to the underside of the bed by a screw and sleeve 36 as shown in FIGURES 4 and 9. The sleeve is swingable relative to the bed in a horizontal plane. Two knurled nuts 37 and 38 are threaded on a threaded portion of shaft 33 on opposite sides of sleeve 35 and permit adjustment fore and aft of the shaft 33 and guide 25. Other types of well-known adjustment means may be substituted for mechanism 34 so long as the adjustment of the guide 25 may be made in very small increments, preferably in thousandths of an inch.

Thus, by proper manipulation of the knurled nuts, the guide 25 is moved fore and aft about the pivot pin 28 to place the bars 29 and 30 at the desired transverse angle to the longitudinally extending axis of the bed.

Located immediately below the guides is a channel 39, having its open side downward, affixed crosswise to the I-beams 20 as shown in FIGURE 3. A cam follower mechanism 40, shown in FIGURE 5, is integrally affixed to the top side of channel 39. The mechanism 40 includes a pair of parallel spaced guides 41 and 42 extending transversely of the bed and parallel to bars 29 and 30. End plates 43 and 44 are affixed to guides 41 and 42 and each has an opening and bearing 45 which rotatably support an elongated screw 46. The elongated screw 46 passes through a cam follower block 47 having a cam follower 48 rotatably mounted on a shaft 49 affixed to and projecting from the top of the block 47. The block 47 is slidably mounted between the guides 41 and 42 and has recessed portions 50 on its underside to reduce the frictional drag between the block and a plate 51 on which the guides 41 and 42 are mounted. The cross section shown in FIGURE 8 illustrates the construction of the cam follower block which includes a nut 52 fitted in an opening 53 in the block such that the nut cannot rotate relative to the block and a projecting threaded sleeve on the nut threadably engaged with an end plate 54 which is bolted to the end of the block by bolts 55. The center of the nut is threaded to match the threads of the screw 46 and the screw is threaded into the nut. Thus, as the screw revolves in either direction about its longitudinal axis, the cam follower block 47, nut 52, end plate 54 and cam follower 48 are moved right or left along the guides 41 and 42, as viewed in FIGURE 5. The cam follower 48 is of sufficient size to rotatably fit between the bars 29 and 30 affixed to the underside of the bed, and, as the screw moves the cam follower block, the cam follower engages one of the bars 29 or 30 (which are positioned at a transverse angle to the longitudinal axis of the bed) and moves the bars 29 and 30 and bed longitudinally of the frame.

One end of the screw 46 has an integral sheave 57 which receives a continuous belt 58. The belt 58 passes around a second sheave 59 integral with a shaft 60 rotatably mounted in a bearing affixed to the end wall 44. The inside end of the shaft 60 has a second sheave 61 which carries a continuous belt 62 driven by another sheave 63 mounted on the shaft of the speed reducer 18 as shown in FIGURE 3. Thus, both the squeegee carriage 16 and the bed moving apparatus are correlated in movement relative to each other due to the common motor 17. I have shown a preferred embodiment for correlating these drives; however, it is understood that the screw 46 can be driven by a motor separate from the motor driving the squeegee carriage 16. My preferred embodiment shown in the drawings is merely a convenient way of correlating the movements of the squeegee carriage and bed.

In operation, the material 24 to be printed is placed in a stationary position upon the bed 21, the screen is positioned over the material to be printed, and the knurled nuts 37 and 38 are adjusted to place the guides 29 and 30 at a desired transverse angle relative to the longitudinal axis of the bed to permit the bed to move the desired distance toward or away from the point from which the squeegee carriage moves.

The reservoir on the squeegee carriage 16 is then filled with printing composition and the motor 17 activated to start the squeegee carriage moving from left to right as viewed in FIGURE 1. Simultaneously, the screw 46 will commence rotation thereby moving the cam follower block 47 crosswise of the bed 21. As the cam follower block moves, the cam follower 48 engages the bars 29 or 30 and progressively moves the bed in a direction toward or away from the direction of movement of the squeegee carriage. Thus, the bed and material 24 move toward the squeegee carriage to compensate for expansion of the template due to heating the screen or away from the squeegee carriage to enlarge the printed material.

Initially, it is primarily a trial-and-error procedure in determining precisely the position of bars 29 and 30 for the compensation, enlargement or axis alteration. By proper manipulation of the knurled nuts 37 and 38 after several printing operations, an accurate procedure can be achieved. Heat equilibrium is achieved in the apparatus after several printing runs to compensate for the heat expansion of the template. The bed is moved away from the point from which the squeegee moves to compensate for this heat expansion of the template.

Frequently, the movement of the bed is only a few thousandths of an inch. Thus, the machining of the parts of the bed moving apparatus must be extremely accurate.

While I have described a present preferred embodiment of my invention, it may be otherwise embodied within the scope of the following claims.

I claim:

1. A screen printing apparatus including a rigid frame, a bed supported on and movable relative to said frame, material to be printed being positionable on said bed, a printing screen positionable over said bed, first means movable over said screen to deposit a printing composition on and through the screen onto the material being printed; second means operatively connected to said bed to move the bed in a direction parallel to and relative to the direction of movement of the first means while said composition is being deposited on said material, and third means to coordinate the movements of the first and second means such that a predetermined movement of the first means effects a second predetermined movement of the second means and bed.

2. A screen printing apparatus according to claim 1 wherein said first means includes a squeegee and printing composition supply, said second means includes a guide on the bed and a cam follower affixed to the frame and engaged by said guide, said cam follower being operatively connected to said third means such that the cam follower moves a predetermined distance upon movement of the first means a predetermined distance.

3. A screen printing apparatus including a rigid stand; a screen operatively positioned on the stand; a bed operatively positioned below the screen on the stand; said bed being movable relative to the screen in a longitudinal direction; a squeegee mounted on the stand and movable longitudinally over and in engagement with the screen, power means to move the squeegee longitudinally, and means driven by said power means to move the bed longitudinally and parallel to the movement of the squeegee, the longitudinal movement of the bed and being correlated with longitudinal movement of the squeegee.

4. An apparatus according to claim 3 wherein a printing composition is deposited on the screen, the material to be printed is placed on the bed below the screen, the printing composition being forced by the squeegee through

portions of the screen onto the material to be printed as the squeegee moves across the screen; means to heat said screen such that the screen expands due to thermal expansion; said bed and material being movable in a direction parallel to the movement of the squeegee to compensate for the expansion of said screen, and said means for moving the bed and material being adjustable to move the bed and material sufficiently to compensate for the expansion of the screen.

5. An apparatus according to claim 3 wherein said means for moving the bed includes a pair of spaced parallel guides affixed to the bed, said guides extending transversely to the direction of movement of the bed; a cam follower positioned between and engageable with said guides, a rotatably mounted screw extending transversely of the bed and rigidly mounted on said stand, the screw threadably engaging a threaded hole in the cam follower, a motor mounted on the stand and operatively connected to rotate the screw about its longitudinal axis such that the cam follower moves along the screw and engages said guides, said guides being adjustably positioned so as to extend across the bed and form an angle with the longitudinal axis of the bed whereby movement of the cam follower between the guides moves the bed along its longitudinal axis.

6. A screen printing apparatus having a heated screen over which a squeegee moves to deposit a printing composition through the screen onto material to be printed positioned below the screen; a bed positioned below the screen and supporting the material to be printed; said bed being movable in a direction relative to the direction of movement of the squeegee; and power means to move the squeegee and bed in synchronism to compensate for changes effected in the screen due to heating.

7. A printing apparatus including a rigid frame; a bed mounted on and slidable longitudinally of said frame and material to be printed positionable on said bed; a screen affixed to the frame and overlying the bed and material, said screen having a template having open spaces denoting the configuration to be printed on said material; a squeegee mounted on the frame and movable longitudinally over and in contact with the screen; a motor to move the squeegee over the screen; the squeegee distributing a printing composition through the screen at the open spaces in the template onto the material; means to heat the screen thereby causing thermal expansion of the screen and distortion of said configuration; a first pair of spaced parallel guides pivotally affixed to the bed, said guides being positioned at a transverse angle to the direction of movement of the bed and in a plane parallel to the plane of the bed; a second pair of parallel guides affixed to the frame and positioned adjacent and spaced from the first guides and in a plane parallel to the plane of the first guides; a block slidably positioned between and movable along said second pair of guides, a screw positioned between the second pair of guides and threadably engaging a threaded hole in the lock, the screw being mounted for rotation about its longitudinal axis; a drive mechanism on the frame for rotating the screw to move the block along the second guides; a cam follower mounted in said block and extending between and in engagement with said first pair of guides; said two pairs of parallel guides extending in directions forming an angle with each other whereby movement of the block along the second guides causes the first pair of guides and bed to move longitudinally of the screen to reposition the bed and material to be printed relative to the screen, said movement being in a direction the same as the direction of movement of the squeegee.

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2,039,909	Kem et al.	May 5, 1936
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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,082,688 March 26, 1963

Anson G. Sherman

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 2, line 28, after "along" insert -- the --; column 6, line 19, for "lock" read -- block --.

Signed and sealed this 22nd day of October 1963.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

EDWIN L. REYNOLDS
Acting Commissioner of Patents