

Dec. 3, 1957

N. B. MEARS

2,814,975

PHOTO-PRINTING APPARATUS

Filed Aug. 16, 1954

3 Sheets-Sheet 1

FIG. 1

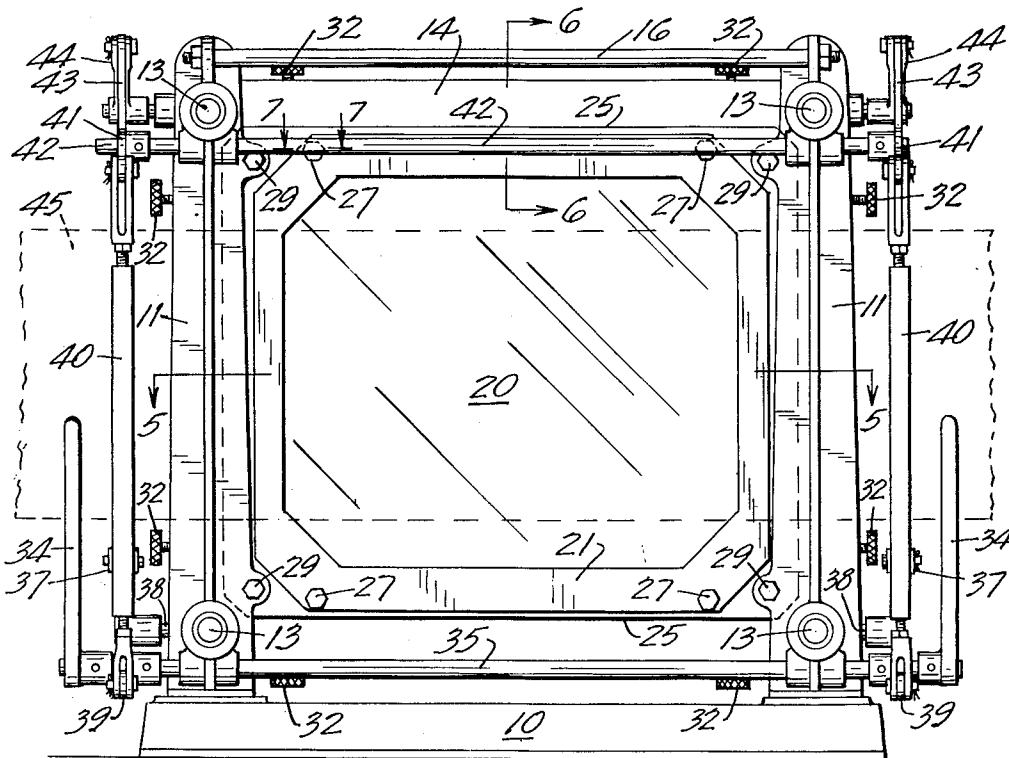
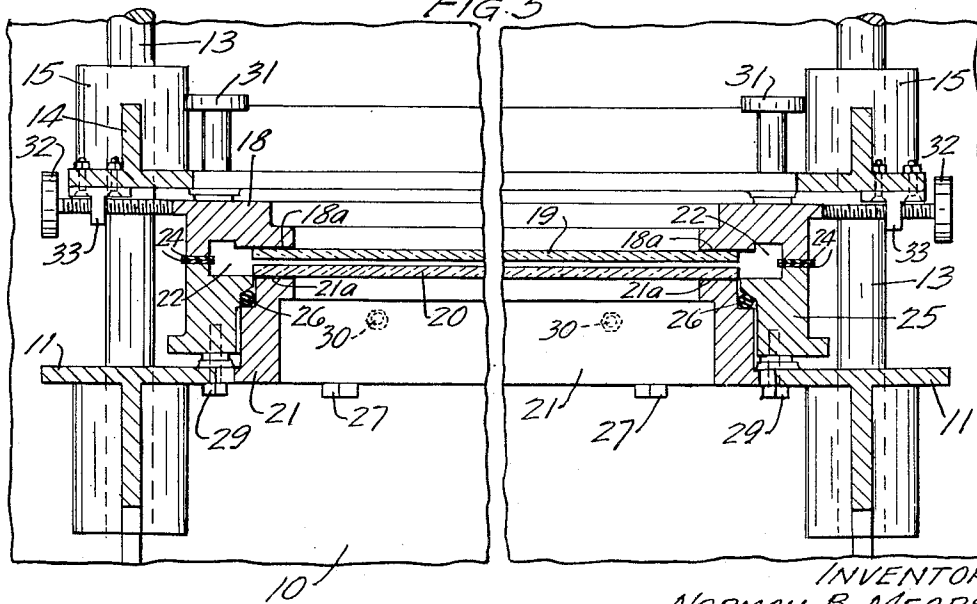


FIG. 5



INVENTOR
BY NORMAN B. MEARS
John E. Rhyker
ATTORNEY

Dec. 3, 1957

N. B. MEARS

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FIG. 2

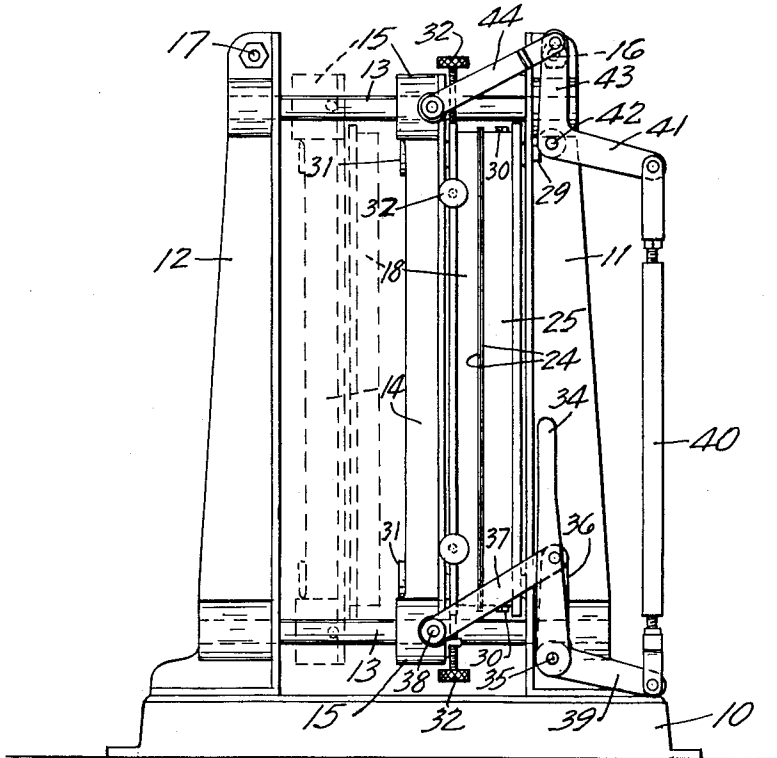


FIG. 6

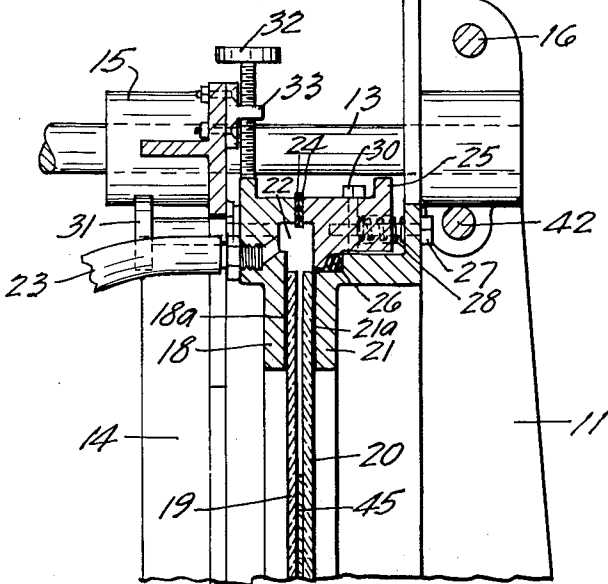
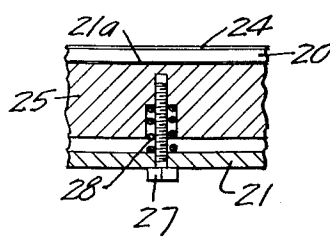


FIG. 7



INVENTOR
NORMAN B. MEARS
BY *John E. Steyer*
ATTORNEY

Dec. 3, 1957

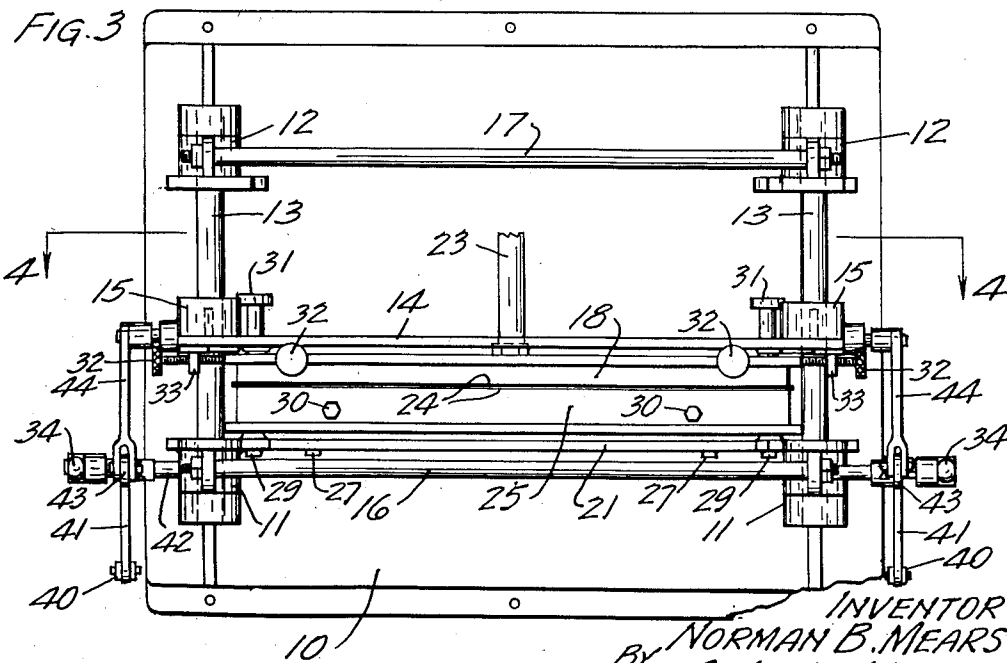
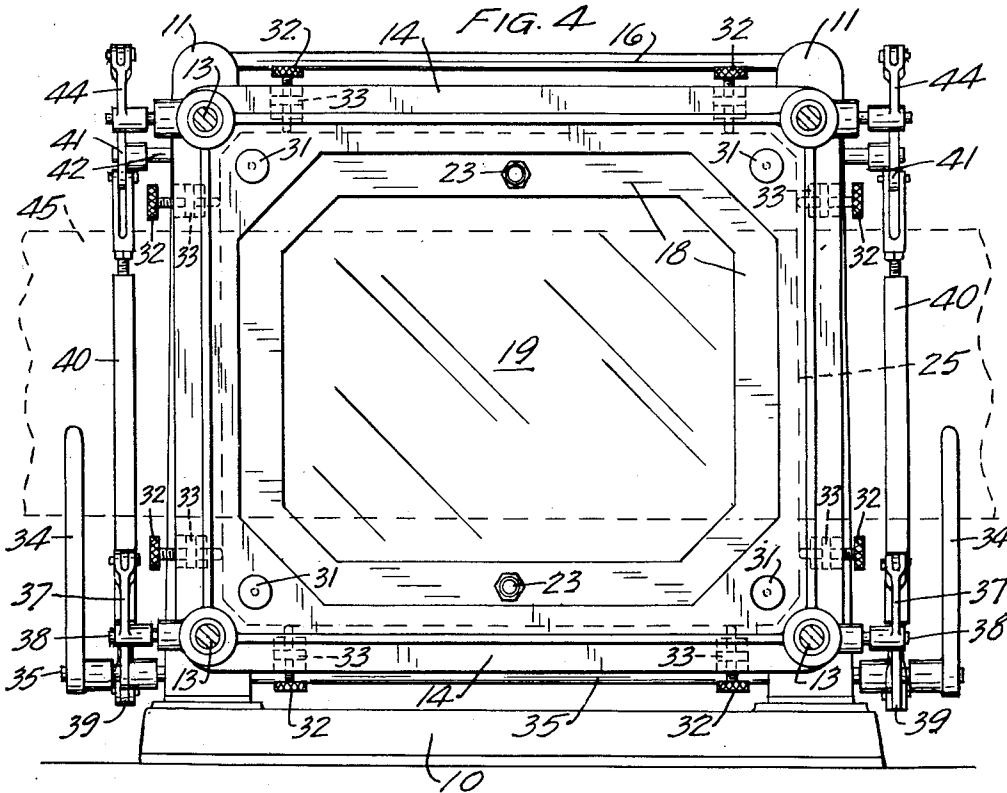
N. B. MEARS

2,814,975

PHOTO-PRINTING APPARATUS

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3 Sheets-Sheet 3



INVENTOR
BY *NORMAN B. MEARS*
John E. Mears
ATTORNEY

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2,814,975

PHOTO-PRINTING APPARATUS

Norman B. Mears, St. Paul, Minn.

Application August 16, 1954, Serial No. 450,015

6 Claims. (Cl. 95—76)

This invention relates to improved apparatus for photo-printing designs simultaneously on the opposite faces of a sheet or web having light-sensitive coatings on both faces whereby the designs may be reproduced in exact registry on the respective faces of the work.

It is an object of my invention to provide simplified precision means for holding printing plates or negatives in firm registering contact with the light-sensitive coatings on opposite faces of a work sheet or web and for actuating one of the plates to and from photo-printing position rapidly and easily.

A further object is to provide a novel and simplified arrangement of supporting frames and sealing means whereby air pressure may be used economically to press the printing plates against opposite faces of the work sheet or web.

Another object is to facilitate and minimize the number of adjustments that are required to retain the image carried by one printing plate precisely in registry with the image carried by the other plate during a large number of printing operations by providing a novel arrangement of a rigid fixed support and fastening means for one of the printing plates and a movable support for the second printing plate including micrometer screw means for moving the second plate in a plane parallel to the first plate to the required registering position.

A further and particular object is to provide improved mechanism for separating one of the printing plates from the other to permit the feeding of the work sheets or web to photo-printing position and for retaining the plates in their precisely registering positions in contact with the work.

My invention also includes certain other novel features of construction which will be more fully pointed out in the following specification and claims.

In the accompanying drawings which illustrate, by way of example and not for the purpose of limitation, a preferred embodiment of my invention:

Figure 1 is a front elevational view of the apparatus;

Fig. 2 is a side elevational view of the same;

Fig. 3 is a top plan view showing the printing frames in closed position;

Fig. 4 is a vertical sectional view taken on the line 4—4 of Fig. 3;

Fig. 5 is a horizontal sectional view taken approximately on the line 5—5 of Fig. 1;

Fig. 6 is a fragmentary vertical section taken on the line 6—6 of Fig. 1, and

Fig. 7 is a fragmentary horizontal section taken on the line 7—7 of Fig. 1.

Referring to the drawings, my improved apparatus has a supporting structure comprising a base 10 and a pair of upright frame members 11 at one side and similar members 12 at the opposite side. Rigidly connecting these frame members together in spaced parallel relation are upper and lower pairs of parallel guide bars 13 for a movable frame 14 having bearings 15 slidably fitting the guide bars.

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The frame members 11 are connected together at their upper ends by a tie rod 16 and the frame members 12 are similarly connected by a rod 17. Detachably and adjustably mounted on the movable frame 14 is a printing frame 18 carrying a translucent printing plate 19. A similar printing plate 20 is mounted in parallel relation to the plate 19 on a printing frame 21. Opposed plane parallel surfaces 18a and 21a are formed on the printing frames 18 and 21 respectively and the plates 19 and 20 are secured by adhesive in sealed relation to these plane surfaces of the respective printing frames. The adhesive joints extend entirely around the perimeter of the printing plates. Grooves in the adjoining faces of the frames adjacent to the margins of the printing plates 19 and 20 form conduits 22 from which air may be exhausted to press the printing plates against the work during the photo-printing operation. Communicating with the conduit 22 at the top and bottom of the printing frame 18 are air hose connections 23 (Figs. 3, 4 and 6). These connections may be extended to a vacuum tank or pump under control of a valve, not shown. Also extending continuously around the margins of each of the frames supporting the plates 19 and 20 are coacting gaskets 24 for sealing the joint between the frames when they are in closed, photo-printing position.

To rigidly support the printing frame 21, it is mounted in nesting relation to an auxiliary frame 25 and the latter is connected to the main frame members 11. The joint between the auxiliary frame 25 and printing frame 21 is sealed by means of a gasket 26 which is confined between coacting shoulders on these frames. This gasket 26 may be compressed to seal the joint by tightening bolts 27 which are threaded in the auxiliary frame and pass through holes in the frame 21. Springs 28 are confined on the bolts 27 to bias the frame 21 outward and away from the gasket 26. Bolts 29 fasten the auxiliary frame 25 to the main frame members 11. Pairs of adjusting screws 30 are threaded in the auxiliary frame 25 and have inner ends adapted to engage the outer surfaces of the frame 21 at the top and bottom sides thereof. These screws 30 are tightened to securely fasten the frame 21 in adjusted relation to the frame 25.

Printing frame 18 carrying the plate 19 is adjustably fastened to the movable frame 14, hereinafter sometimes referred to as the second auxiliary frame, by means of four clamp screws 31 extending at right angles to the back face of these frames, and by micrometer screws 32 having axes extending in a plane which is perpendicular to the axes of the clamp screws 31. The latter have shoulders for contact with the back face of the frame 14 and fit loosely in relatively large openings in the frame 14. The inner ends of the screws 31 are threaded in tapped holes in the marginal portions of the printing frame 18 so that the latter is adjustable relative to the frame 14 in a plane perpendicular to the axes of the screws 31 when they are loosened and is held in adjusted position when the clamp screws are tightened. The screws 32 are threaded in brackets 33 which are fixed on the movable frame 14 and have inner ends disposed to make contact with outer edge surfaces of the frame 18 at each of the four sides. By suitable manipulation of the micrometer screws 32 when the printing frame 18 has been freed for limited movement, the position of the printing plate 19 may be adjusted both vertically or laterally relative to the plate 20 to bring the images carried by these plates into registry.

To actuate the movable frame 14 carrying the printing frame 18 and plate 19 to and from closed position in relation to the fixed plate 20 and frame 21, a system of linkage under control of either of a pair of manually operable levers 34 is provided. One of these levers is mounted adjacent to the outer side of each of the frame members 11 and is fixed on a supporting shaft 35 which extends across the front side of the machine and is free

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to be oscillated in suitable bearings carried by the frame members 11. Also fixed on the shaft 35 at each side of the apparatus is an arm 36 connected to a link 37 which is pivotally connected at 38 to the lower portion of the frame 14. The upper portion of the frame 14 is similarly connected to each of the levers 34 through linkage which includes an arm 39 integral with the arm 36, an adjustable link 40 extending upward from the arm 39 to an arm 41 fixed on a horizontal shaft 42 and an arm 43 integral with the arm 41 and connected by a link 44 to the upper portion of the frame 14. By this manually operable mechanism the frame 14 may be moved from the closed position shown in full lines in the drawings to the open position indicated in broken lines in Fig. 2. When in the latter position, a work sheet or web 45, a portion of which is shown in broken lines in Figs. 1 and 4, may be extended between the printing plates 19 and 20 and also between the gaskets 24 extending along the vertical sides of the frames 25 and 18.

Operation

Transparent printing plates 19 and 20 are prepared by known techniques so that each of them carries a negative image of the design to be reproduced on the work sheet or web 45. The emulsions defining the images are preferably developed on the adjoining or contact faces of these plates. The outer marginal surfaces of these plates are then secured to the surfaces 18a and 21a of the respective printing frames so that there is a permanent bond and seal with the frame 18 and 21 extending continuously around the margins of the plates. The frame 21 may then be secured in nesting relation with the auxiliary frame 25 by means of the bolts 27 and with the continuous gasket 26 in place between these frames. Either before or after this operation the auxiliary frame 25 may be secured to the members 11 by means of the bolts 29. As the next step the screws 30 are adjusted to permit movement of the frame 21 relative to the frame 25, the bolts 27 are adjusted to position the plate 20 in properly spaced parallel relation to the plate 19 and to compress the gasket 26 and form an airtight seal between the frames 21 and 25. Then the screws 30 are tightened to rigidly retain the frame 21 in the adjusted position.

To mount the printing frame 18 on the movable frame 14 the clamp screws 31 are used but are not drawn up tight until after the micrometer screws 32 have been manipulated to bring the image carried by the plate 19 in exact registry with that carried by the plate 20. In further preparation for the photo-printing operation, the hose connections 23 are extended to a suitable vacuum tank or suction pump and the movable frame 14 is moved to an open position such as that indicated in broken lines in Fig. 2 by suitable manipulation of one of the levers 34. The work sheet 45 is then extended adjacent to or upon the inner face of the plate 20 and the frame 14 carrying the plate 19 is actuated to closed position. Finally the suction is applied through the connections 23 to exhaust air from the conduit 22 and from between the work sheet and plates 19 and 20. This causes the printing plates to be pressed firmly against opposite faces of the work sheet. Exposure of the outer faces of the plates 19 and 20 to actinic light of suitable power for the photo-printing operation follows and is continued for the time required. The vacuum seal is then broken by admitting air at atmospheric pressure through the hose connections 23, and one of the levers 34 is manipulated to separate the plates and allow removal of the photo-printed area of the work sheet from between the printing frames. Repetition of the printing operation may be performed rapidly on a succession of sensitized work sheets or on unexposed portions of the web 45.

As a guide to the manipulation of the micrometer screws 32 in the positioning of the images carried by the respective printing plates in registry, I prefer to use an

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indexing device such as that described in my copending application for patent for Photo-Printing Apparatus, Serial No. 238,816, filed July 27, 1951, now Patent No. 2,720,146. As more fully therein described, the indexing device may comprise photo-mechanically reproduced designs of minute opaque dots carried by one printing plate and a similar design of translucent dots on an opaque background carried by the other printing plate and so located in relation to the main designs on the respective plates as to cause the latter to be in exact registry one with the other when the opaque dots are superimposed on the translucent dots by suitable adjustment of the relative positions of the plates in the printing apparatus.

Since printing plates of large size (from four to nine square feet in area) are now required, special precautions must be taken to avoid breakage of these expensive plates. My improved apparatus is designed to minimize breakage by providing marginal supports for the plates which are in exact parallelism. This is accomplished by my arrangement of the printing frames 18 and 21 generally and, in particular, by providing the auxiliary frame 25 which embraces the printing frame 21 and is provided with the bolts 27, springs 28 and screws 30. The clamp screws 30 afford the final rigid fastening, but with these screws loose the plate 19 may be closed against the plate 20 while the several springs 28 are compressed sufficiently to allow movement of the plate 20 into exact parallelism with the plate 19. The bolts 30 are then tightened to hold the frame 21 in rigid adjusted position.

The present invention has been successfully used in the manufacture of precision articles from thin metal webs or sheets where the articles require the formation of a pattern or design of precisely located apertures or perforations. The procedure includes the photo-printing of the designs on opposite faces of a metal web or sheet followed by etching through the area of the design from both sides. Among the articles of manufacture which may be improved and reduced in cost by the present invention are aperture masks for color television tubes, control grids for electric discharge devices, fine screens, reticles for fire control and sighting instruments and other precision articles.

My improved printing apparatus reduces the cost of manufacturing such articles in quantity by reducing the time required for the photo-printing of designs on the light-sensitive blank surfaces and effects a particularly important saving in the time required to adjust the printing plates to their registering positions one with the other and for actuating the apparatus to and from printing position for each of the successive printing operations. By the simplified construction described, I effect further important savings in the time required to substitute one set of printing plates for another in the production of different articles or groups of articles requiring photo-printing on both sides of the work.

I claim:

1. Apparatus for photo-printing designs in registry on opposite faces of a sheet having light-sensitive coatings on both faces comprising, a fixed supporting structure, a first printing frame rigidly connected to said supporting structure, an auxiliary frame movable to and from said printing frame and having a central opening adapted to receive a second printing frame, a second printing frame carried by said auxiliary frame in said opening, said printing frames having central openings and opposed parallel surfaces extending outward from all sides of said openings, translucent printing plates closing said openings in the printing frames respectively and each carrying an image of the design to be reproduced on said sheet, means securing said plates in sealed relation to said opposed surfaces of the respective printing frames, means for actuating said auxiliary frame and second printing frame to and from closed position in relation to the first printing frame and micrometer screw means for adjusting the posi-

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tion of said second printing frame relative to said first printing frame and auxiliary frame in a plane parallel to said printing plates.

2. Photo-printing apparatus in accordance with claim 1 wherein said micrometer screw means for adjusting the positions of the second printing frame relative to the first printing frame comprises, micrometer screws threaded in said auxiliary frame and severally engaging side surfaces of said second printing frame, said side surfaces normally being spaced from the auxiliary frame and means for securing said printing frame in adjusted positions on the auxiliary frame.

3. Apparatus for photo-printing designs in registry on opposite faces of a sheet having light-sensitive coatings on both faces comprising, a rigid supporting structure; first and second printing frames carried by said structure and having central openings and opposed parallel surfaces extending outward from all sides of said openings, translucent printing plates closing said openings respectively and each carrying an image of the design to be reproduced on said sheet, means securing said plates in sealed relation to said opposed surfaces of the respective printing frames, an auxiliary frame embracing said first printing frame, means for sealing the junction of said auxiliary frame with said first printing frame, means for rigidly securing said auxiliary frame to said supporting structure, a second auxiliary frame supporting said second printing frame for movement to and from the first printing frame, micrometer screw means for adjusting the position of said second printing frame relative to the second auxiliary frame and in a plane parallel to the first printing frame, means for actuating said second auxiliary frame to and from closed position in relation to the first printing frame and means for sealing the junction of the second-printing frame with the first auxiliary frame when in closed position.

4. Apparatus for photo-printing designs in registry on opposite faces of a sheet having light-sensitive coatings on both faces comprising, a rigid supporting structure; first and second printing frames carried by said structure and having central openings, translucent printing plates closing said openings respectively and each carrying an image of the design to be reproduced on said sheet, means securing said plates to opposed front surfaces of the respective printing frames, an auxiliary frame embracing said first printing frame, screw means extending substantially at right angles to a back surface of the first printing frame and engaging said auxiliary frame to adjustably space said frames apart, means for rigidly securing the first printing frame in adjusted positions relative to said auxiliary frame, means for rigidly securing said auxiliary frame to said supporting structure, means supporting said second printing frame for movement to and from the first printing frame, spring means interposed between said first printing frame and said auxiliary frame permitting

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angular adjustment of one of the printing frames relative to the other printing frame, and means for actuating said second printing frame to and from closed position in relation to the first printing frame.

5. Apparatus for photo-printing designs in registry on opposite faces of a sheet having light-sensitive coatings on both faces comprising a rigid supporting structure, first and second printing frames carried by said structure and having central openings and opposed parallel surfaces extending outward from all sides of said openings, translucent printing plates closing said openings and each carrying an image of the design to be reproduced on said sheet, means securing said plates in sealed relation to said opposed surfaces of the respective frames, an auxiliary frame extending adjacent to said first printing frame, compressible means for sealing the junction between said auxiliary frame and said first printing frame, means for sealing the junction between said auxiliary frame and the second printing frame, means for actuating one of said printing frames to and from closed position in relation to the other, and resilient means interposed between said auxiliary frame and said first printing frame disposed to yieldingly bias said first printing frame away from said auxiliary frame and toward the second printing frame when said frames are in closed position, one relative to the other.

6. Apparatus for photo-printing designs in registry on opposite faces of a sheet having light-sensitive coatings on both faces comprising, a rigid supporting structure, first and second printing frames carried by said structure and having central openings and opposed parallel surfaces extending outward from all sides of said openings, translucent printing plates closing said openings and each carrying an image of the design to be reproduced on said sheet, means securing said plates in sealed relation to said opposed surfaces of the respective printing frames, an auxiliary frame extending adjacent to said second printing frame in spaced relation to the sides thereof, micrometer screw means threaded in said auxiliary frame and engaging marginal surfaces of said second printing frame to adjust its position relative to said auxiliary frame in a plane parallel to the first printing plate, means for securing the second printing frame in adjusted positions relative to said auxiliary frame and means for actuating one of said printing frames to and from closed position in relation to the other.

References Cited in the file of this patent

UNITED STATES PATENTS

601,882	Schwarz	Apr. 5, 1898
759,469	Rachel	May 10, 1904
1,870,008	Huebner	Aug. 2, 1932
1,978,493	Huebner	Oct. 30, 1934