

Oct. 11, 1955

N. B. MEARS

2,720,146

PHOTO-PRINTING APPARATUS

Filed July 27, 1951

3 Sheets-Sheet 1

FIG. 1

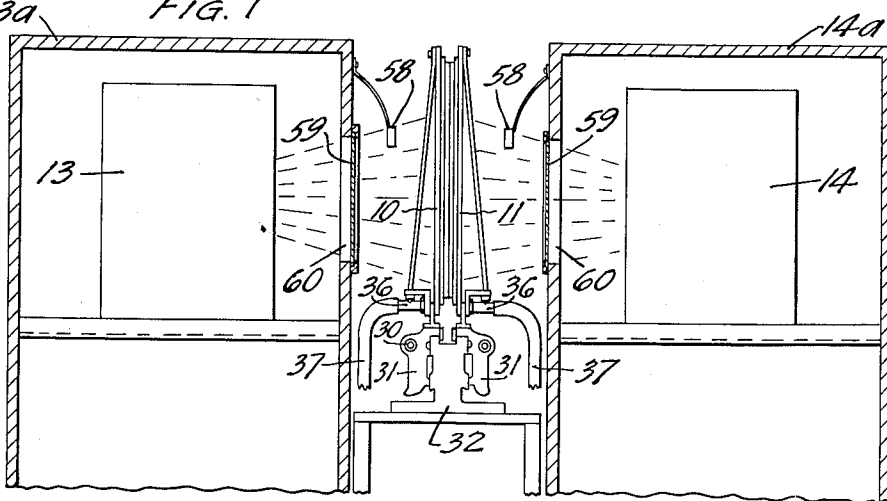
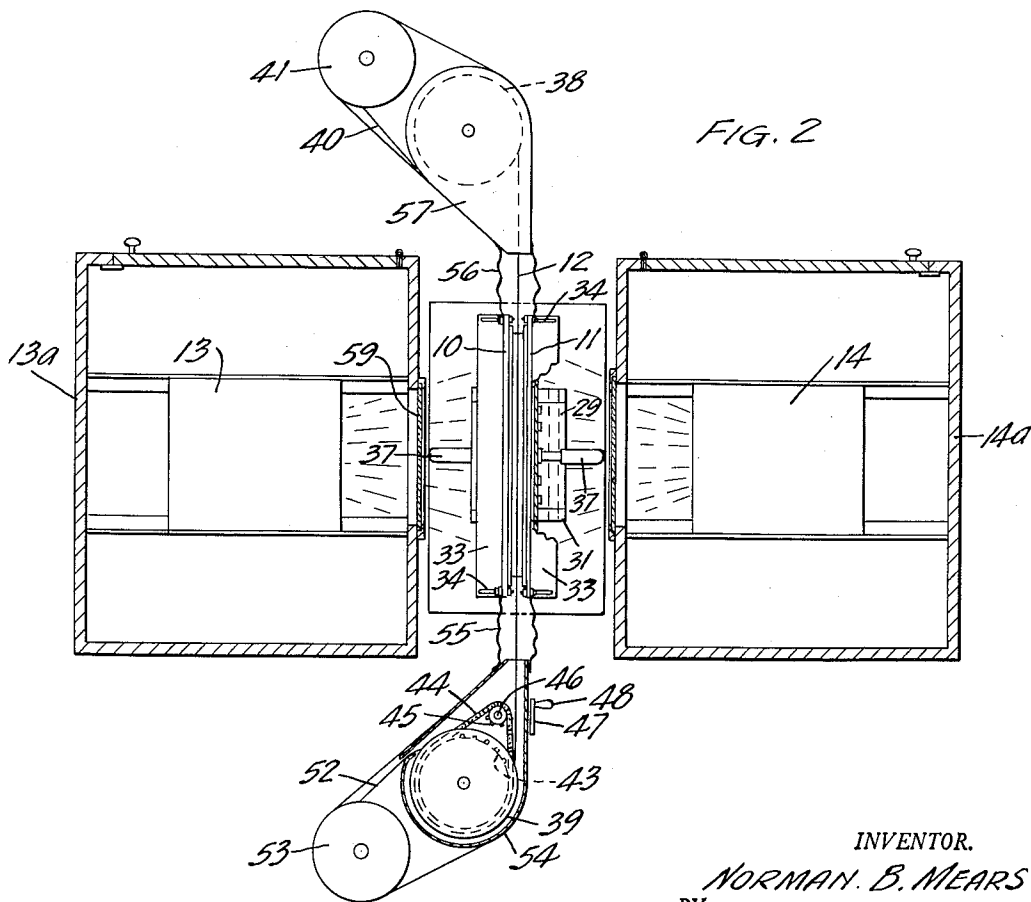


FIG. 2



INVENTOR.

NORMAN B. MEARS

BY

John E. Thompson
ATTORNEY

Oct. 11, 1955

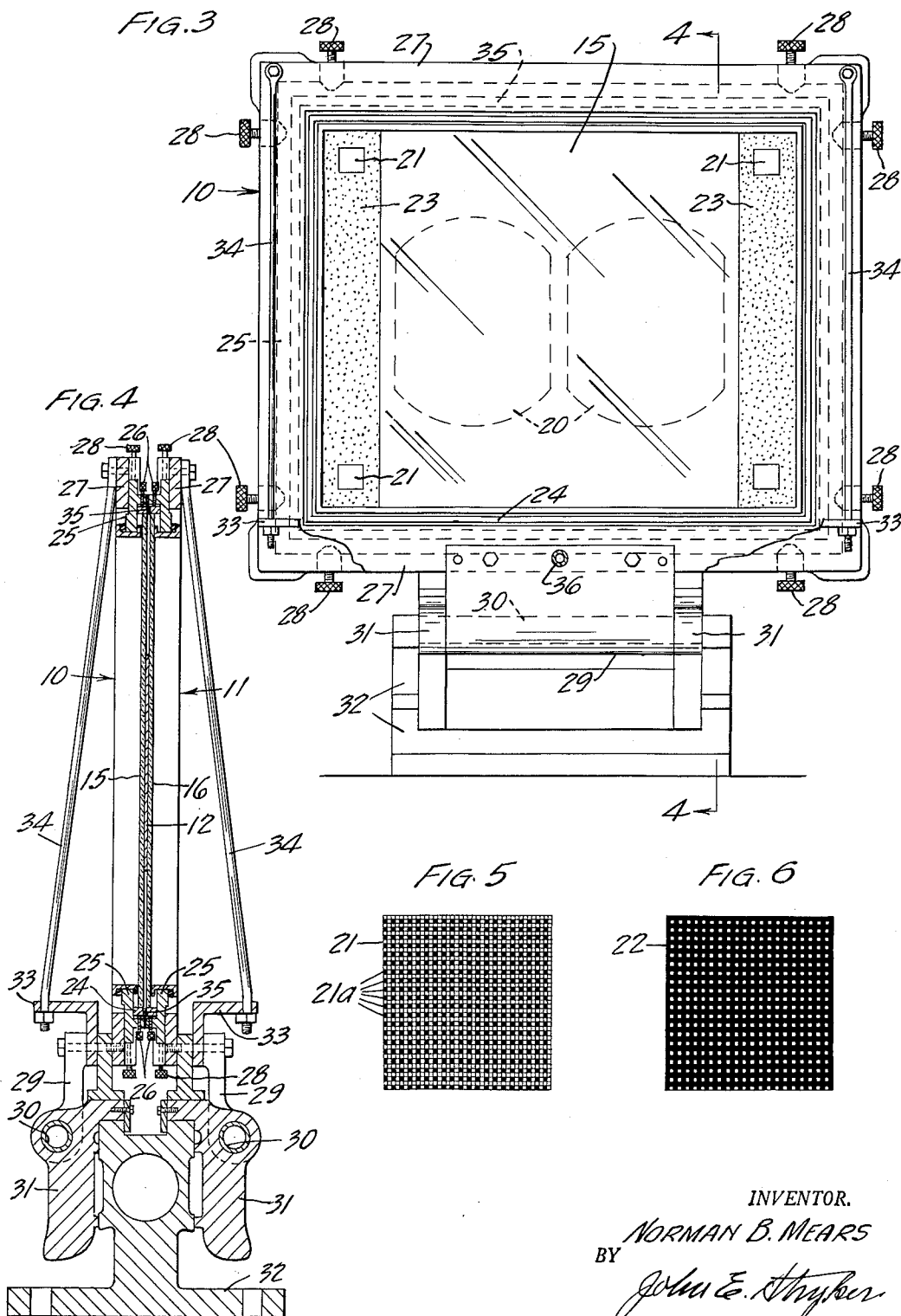
N. B. MEARS

2,720,146

PHOTO-PRINTING APPARATUS

Filed July 27, 1951

3 Sheets-Sheet 2



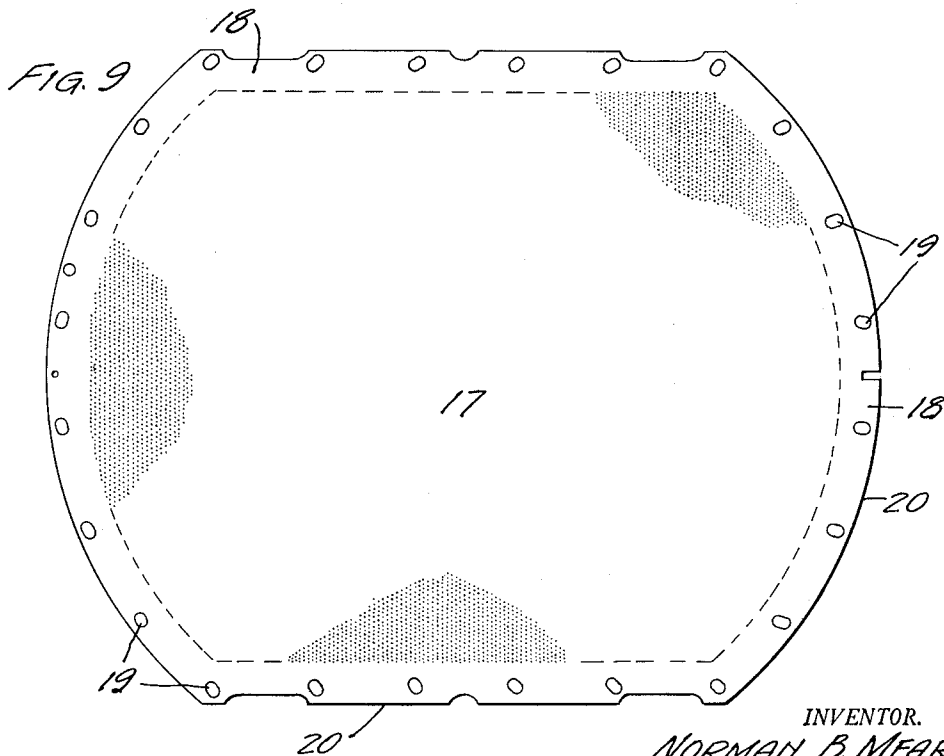
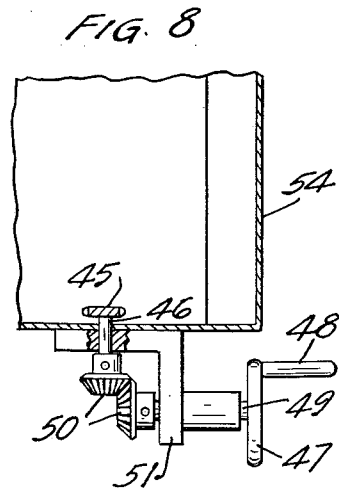
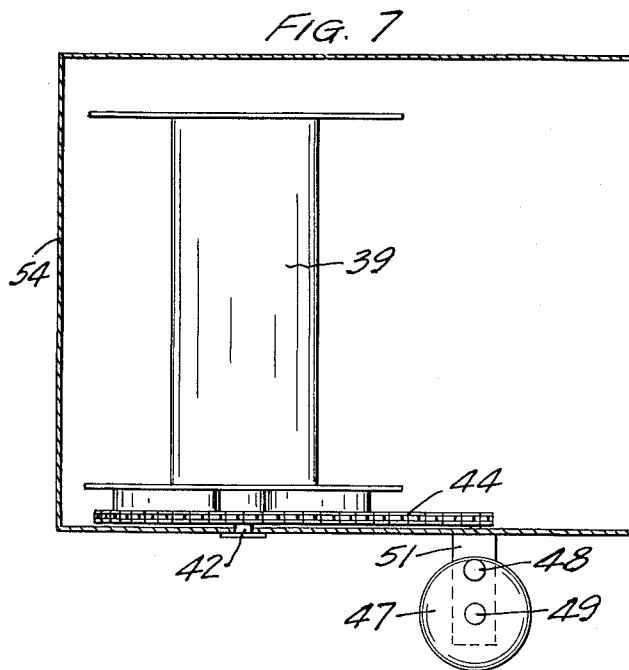
Oct. 11, 1955

N. B. MEARS
PHOTO-PRINTING APPARATUS

2,720,146

Filed July 27, 1951

3 Sheets-Sheet 3



INVENTOR.
NORMAN B. MEARS
BY
John E. Mupker
ATTORNEY

1

2,720,146

PHOTO-PRINTING APPARATUS

Norman B. Mears, West St. Paul, Minn., assignor to Buckbee-Mears Company, St. Paul, Minn., a corporation of Minnesota

Application July 27, 1951, Serial No. 238,816

3 Claims. (Cl. 95—73)

This invention relates to the manufacture of articles of precision from thin metal webs or sheets by a succession of operations which may comprise coating both sides of the web or sheet with a light-sensitive material or enamel, photo-printing a pattern or design on the light-sensitive coating, developing the printed coating to expose the areas of the metal covered by the soluble portions of the coating, heating the web to carbonize or otherwise harden the insoluble coating, defining the pattern or design and thereafter etching through the exposed areas of the web or sheet to form apertures therein of the precise sizes and shapes and in the precise locations required. The present invention relates particularly to apparatus for photo-printing identical designs simultaneously on the opposite faces of the light-sensitized coating on the sheet or web whereby the designs or patterns are reproduced in exact registry on opposite faces of the work sheet or web.

It is an object of my invention to increase the rate of production and improve the quality of certain articles of manufacture requiring photo-printing on light-sensitive coatings at both sides of the work by providing photo-printing apparatus adapted to contact print simultaneously and rapidly from plates between which the work is fed with a minimum of manual operations.

A particular object is to provide apparatus of the class described including a pair of vacuum printing frames each carrying a printing plate upon which the required design has been reproduced photographically or otherwise whereby during the printing operation the printing plates are pressed against opposite light-sensitive coatings on the blank material, in combination with means for moving a continuous web of the coated material between the printing plates.

Among the articles of manufacture which may be improved and reduced in cost by the present invention are apertured masks for television tubes, control grids for electric discharge devices, fine screens for the mechanical separation of solid particles, reticles for fire control and sighting instruments and other articles requiring precise location of minute perforations or apertures in thin metal blanks.

Referring to the accompanying drawings which illustrate an embodiment of my invention, by way of example and not for the purpose of limitation:

Figure 1 is a somewhat diagrammatic end elevational view of the printing frames and light sources;

Fig. 2 is a part top plan view and part horizontal sectional view showing the apparatus;

Fig. 3 is a side elevational view showing one of the printing frames and support therefor;

Fig. 4 is a vertical sectional view through both printing frames and their supports;

Figs. 5 and 6 are elevational views showing a pair of the preferred devices for facilitating the location of the designs on the respective printing plates in exact registry one with the other, preparatory to the photo-printing operation;

2

Fig. 7 is a vertical sectional view through the housing for the web receiving roll;

Fig. 8 is a fragmentary, part sectional and part elevational view showing certain details of the actuating mechanism for the reel, and

Fig. 9 is an elevational view showing an apertured mask for a color television tube constituting one of the articles of manufacture which may be produced economically in quantity by the use of the present invention.

Referring to Figs. 1, 2 and 4, I provide vacuum printing frames indicated generally by the numerals 10 and 11 which are supported in face to face relation one to the other to receive a thin metal sheet or web 12 between them. The web 12 has both of its faces coated with a light-sensitive material or enamel suitable for receiving photographic reproductions of the required design or pattern of apertures. Light sources 13 and 14 are located at opposite sides of the pair of printing frames so that the photo-printing exposure of the web 12 to light may be performed simultaneously through printing plates 15 and 16 carried by the respective frames 10 and 11. Each of the plates 15 and 16 constitute a master negative reproduction of the design or pattern to be reproduced on the web 12. The plates 15 and 16 may be constructed from suitable plate glass and of such size as to carry the developed patterns or designs for a plurality of the individual articles to be manufactured. For example, where apertured masks for television tubes are to be produced two or more, of the individual designs for such masks may be formed on each of the plates 15 and 16. As indicated in Fig. 9, the mask design may comprise a multiplicity of uniformly spaced dots of identical size and shape extending over the entire area 17 within relatively narrow margins 18 as well as outlines 19 defining perforations in the margins 18 and outlines 20 defining the edges of the individual masks. Thus the complete identical designs, including the outlines of the individual articles, are formed and developed, by suitable photographic procedure, on each of the printing plates 15 and 16 so that the designs on one of these plates may be placed in exact registry with those on the other plate.

Indexing devices, indicated respectively by the numerals 21 and 22, adapted to facilitate the adjustment and securing of the designs on one of the printing plates in exact registry with those on the other are reproduced photo-mechanically on the plates 15 and 16 respectively, simultaneously with and as a part of the main design. As shown in Figs. 3 and 5, the devices 21 each comprise a rectangular area upon which a multiplicity of opaque dots 21a are located in regularly spaced relation one to the other. These opaque dots are severally identical in size, relative location, shape and spacing to a multiplicity of transparent dots defined by openings in the otherwise opaque areas of the devices 22 carried by the plate 16. The operator, by adjusting the position of one of the plates 15 or 16 relative to the other, merely places the opaque dots 21a in registry with the transparent areas of the device 22 to make the entire area of the superimposed indexing devices 21 and 22 appear opaque. This brings the main designs on the respective plates 15 and 16 into exact registry one with the other. Pairs of the registering devices are preferably located near each side margin of the plates 15 and 16. Bands of opaque coating, indicated by the stippled areas 23 in Fig. 3, are provided as a background for each pair of the indexing devices to facilitate observation during the adjustment of the position of one of the printing plates relative to the other. Examination of the indexing devices should be made with a moderately strong light directed toward the observer from the opposite side of the printing frames and this makes it desirable to provide the opaque areas 23

extending from the margins of the indexing devices on at least one of the overlapping or superimposed printing plates.

Each of the plates 15 and 16 is reinforced at its margins by metallic frame members 24 and the latter are secured in place on supporting frame members 25 on all sides by screws 26. The frame comprising the members 25 is, in turn, supported and adjustable on an outer rectangular frame 27 which is provided with lugs and readily accessible adjusting screws 28. These screws are threaded in the lugs carried by the frame 27 and arranged to engage the frame members 25 to provide adjustment and to secure the printing plate 15 in precisely adjusted positions relative to the plate 16 whereby the design carried by one of the plates may be placed in registry with that carried by the other.

Each of the frames 10 and 11 is supported on a hinge member 29 which is pivotally supported for lateral oscillating movement on a shaft 30. Fixed bearings 31 formed on a base casting 32 support the shafts 30. Rigidly secured to each of the hinge members 29 is a longitudinally extending bar 33 from which a pair of brace rods 34 extend to the upper portion of the frame 27.

To seal one of the printing frames in face to face relation to the other, suitable gaskets 35 (Figs. 3 and 4) are provided on the contact faces of the frame members 25. Air may be exhausted from the space between the printing plates 15 and 16 through suitable air passages formed in the frame members 25 and 27 and in the hinge members 29, the latter passages communicating with laterally projecting nipples 36. Flexible conduits 37 are connected to the nipples 36 and extend to a vacuum tank or other air exhauster under control of a valve or valve, not shown. Since vacuum printing frames for contact printing are common articles of manufacture, further details of the printing frames will be evident to those skilled in the art.

The printing frames 10 and 11 may be separated one from the other to permit the web 12 to be passed between them by admitting air at atmospheric pressure between the plates 15 and 16 and then oscillating one of these frames outward from the other as permitted by the hinge members 29 carried by the supporting shafts 30.

As shown in Figs. 2, 7 and 8, the web 12 having coatings of light-sensitive material on its faces, is supported on rolls 38 and 39 and is extended from one of these rolls to the other in a vertical plane. In order to protect the light-sensitive coating on the roll 38 against damage by abrasion, the successive convolutions of the web on this roll may be separated by a web 40 of paper or other suitable material which is wound on a separate roll 41 as the web 12 is withdrawn from the roll 38. The receiving roll 39 is fixed against rotation on a vertical shaft 42 and a sprocket wheel 43 is fixed on this shaft and operatively connected by a chain 44 and a sprocket wheel 45 to a shaft 46. A hand wheel 47 has a crank handle 48 and is fixed on a shaft 49 which is operatively connected by bevel gears 50 to the shaft 46. A bracket 51 is secured to the housing for the roll 39 to afford supporting bearings for the shafts 46 and 49.

By this reel mechanism the web 12 may be wound on the roll 39 intermittently as required to present a succession of portions of the web 12 for exposure between the printing frames. In winding the web on the roll 39, the several convolutions thereof are separated by a protective web 42 of paper or other suitable sheet material which is withdrawn from a roll 53 and wound on the roll 39 simultaneously with the winding of the web 12 thereon.

To guard against the uncontrolled exposure of the photo-printed web to the strong light emanating from the sources 13 and 14, the roll 39 is enclosed in a housing 54 having narrow openings through which the webs 12 and 52 are received and opaque flexible shield members 55 are extended from the housing 54 to each of the printing

frames 10 and 11, as indicated in Fig. 2. By a similar arrangement of opaque shield members 56 at the opposite side of the printing frames light is excluded from the portions of the web 12 extending from the printing frames to a housing 57 enclosing the feed roll 38. This housing is similar to the housing 54.

Light sources 13 and 14 may comprise carbon arc lamps or other suitable sources of actinic light of the required candlepower and are preferably provided with automatic controls whereby each exposure to light from source 13 is equal, in number of light units directed through the printing plate 15, to the exposure from source 14 through the plate 16. Such controls result in uniformity of the photo-printing on the respective coatings at opposite faces of the web 12. The controls may include an electric switch for starting the exposure and automatic switches under control of independent automatic time exposure meters for terminating the exposure from the respective sources 13 and 14 when the required number of units of light have been directed through the respective printing plates 15 and 16. As indicated in Fig. 1, an electronic control element 58 may be provided for each of the exposure meters, these control elements being located in the path of light emanating from the sources 13 and 14. Housings 13a and 14a are provided for the light sources 13 and 14 and cooling means, e. g. electric fans, may be provided for dissipating the heat from the light sources. Excessive heating effects are further minimized by separating the light sources from the printing frames by transparent closure members 59 for apertures 61 through which the light passes to the printing frames.

In operation, the printing frame 10 or 11, or both of them, may be moved to open position by oscillating one or both of them outward on the supporting shafts 30, thereby permitting free movement of the web 12 in the space between the plates 15 and 16. The operator then draws the required length or portion of the blank web 12 to a position between the printing plates by operating the crank handle 48 of the reel which turns the roll 39, an end of the web having been secured to this roll. As the web 12 is wound on the roll 39 a portion of the protective web 52 is also wound on this roll and an equal length of the web 12 is withdrawn from the feed roll 38. The printing frames are then closed at opposite faces of the web 12.

As the next operation, the designs carried by the plates 15 and 16 are placed in exact registry one with the other by manipulating the adjusting screws 28 to bring the opaque dots 21a on the devices 21 carried by the plate 15 into registry with the transparent openings of the oppositely disposed devices 22 carried by the plate 16. Registry is indicated by the complete blacking out or opacity of the areas defined by each pair of the indexing devices 21 and 22. Air is then exhausted from between the plates 15 and 16 by opening of the vacuum connection with the frames 10 and 11. This causes the faces of the plates 15 and 16 carrying the designs to be pressed firmly against opposite faces of the web 12. Thereupon, the photo-printing exposure to light from the sources 13 and 14 is made by closing the light circuits which remain closed for the period of time required for the exposure. As hereinbefore indicated, automatic time controls for the exposure meters for each of the sources 13 and 14 may be provided to insure uniform and equal exposure at opposite faces of the web 12 prior to the opening of the light circuits. The operator then actuates the vacuum control valve to admit air between the printing frames and the frames are separated to permit the further movement of the web 12 from the roll 38 toward the roll 39. Thus, after each exposure, a portion of the web 12 is advanced to the receiving roll 39 to replace the portion which has been exposed between the plates 15 and 16 by a blank or unexposed portion.

In this manner a multiplicity of the designs representing the individual articles to be formed are reproduced

5

rapidly, accurately and in precise registry on the respective coated faces of the web 12. From time to time during the operation, the relative positions of the designs carried by the plates 15 and 16 may be checked by examination of the registering devices 21—22. The examination may be made with the aid of a magnifying glass and correction of the relative positions of the plates may be accomplished quickly and easily by manipulation of the appropriate adjusting screws 26. The web 12 may be of any desired width and length within the capacity of the printing frames and the web feeding and receiving rolls.

Having described my invention, what I claim as new and desire to protect by Letters Patent is:

1. In apparatus for photo-printing on a sheet having a coating of light-sensitive material on both faces, a printing plate supported adjacent to each of the faces of said sheet, said plates having developed thereon main designs, one of said plates being movable in a plane parallel to the other plate to bring said designs on the respective plates to a predetermined relative position, a coated area on one of said plates defining an opaque pattern in predetermined fixed relation to said main design on said plate, a coated area on the second plate defining a similar pattern of translucent openings in an opaque background, said openings being disposed to be placed in registry with said opaque pattern and being located in fixed relation to the main design on the second plate whereby a predetermined relative position of the main designs on said plates is indicated by the positioning of said opaque pattern in registry with said openings defining the pattern in the coated area of the second plate.

2. In apparatus for photo-printing on a metal sheet having a coating of light-sensitive material on both faces, a printing plate supported adjacent to each of the faces of said sheet, said plates having developed thereon identical main designs defining apertures in and the outlines of a thin metal article to be formed from said sheet, one of said plates being movable in a plane parallel to the other plate to bring said designs on the respective plates in registry, a coated area on one of said plates defining a group of spaced, opaque dots in predetermined fixed positions in relation to the main design on said plate, a

6

coated area on the second plate defining a group of translucent openings in an opaque background, said openings being disposed to be placed in registry with said opaque dots and being of approximately equal size and located in the same fixed relation to the main design on the second plate as the opaque dots defined by said coated area of the other plate, whereby the registering positions of the main designs on said plates are indicated by the positioning of said group of dots in registry with said openings in said coated area of the second plate.

3. In apparatus for photo-printing on a sheet having a coating of light-sensitive material on both faces, a printing plate supported adjacent to each of the faces of said sheet, said plates having developed thereon main designs and one of said plates being movable in a plane parallel to the other plate to bring said designs on the respective plates to a predetermined relative position, the improvements which comprise, a coating on one of said plates defining a multiplicity of opaque dots arranged in a predetermined pattern on a translucent background of substantial area and in predetermined fixed relation to the main design on said plate, a coating on the second plate defining a similar pattern of translucent dots on an opaque background of substantial area and located in a predetermined fixed relation to the main design on a second plate, said patterns of dots being disposed to be placed in registry one with the other to cut off the transmission of light through registering areas of said patterns which substantially exceed the areas of the dots, whereby said predetermined relative position of the main designs on the respective plates is indicated when such substantial areas of said patterns in registry appear entirely opaque.

References Cited in the file of this patent

UNITED STATES PATENTS

601,882	Schwarz	Apr. 5, 1896
1,632,278	Douglass	June 14, 1927
1,786,070	Jones	Dec. 23, 1930
1,920,400	Jones	Aug. 1, 1933

FOREIGN PATENTS

5,827	Great Britain	of 1914
261,054	Great Britain	Nov. 12, 1926
416,258	Great Britain	Sept. 13, 1934