

Jan. 17, 1939.

O. R. HUGGINS

2,143,984

METHOD OF AND MEANS FOR ENGRAVING A PRINTING SURFACE

Filed April 3, 1937

4 Sheets-Sheet 1

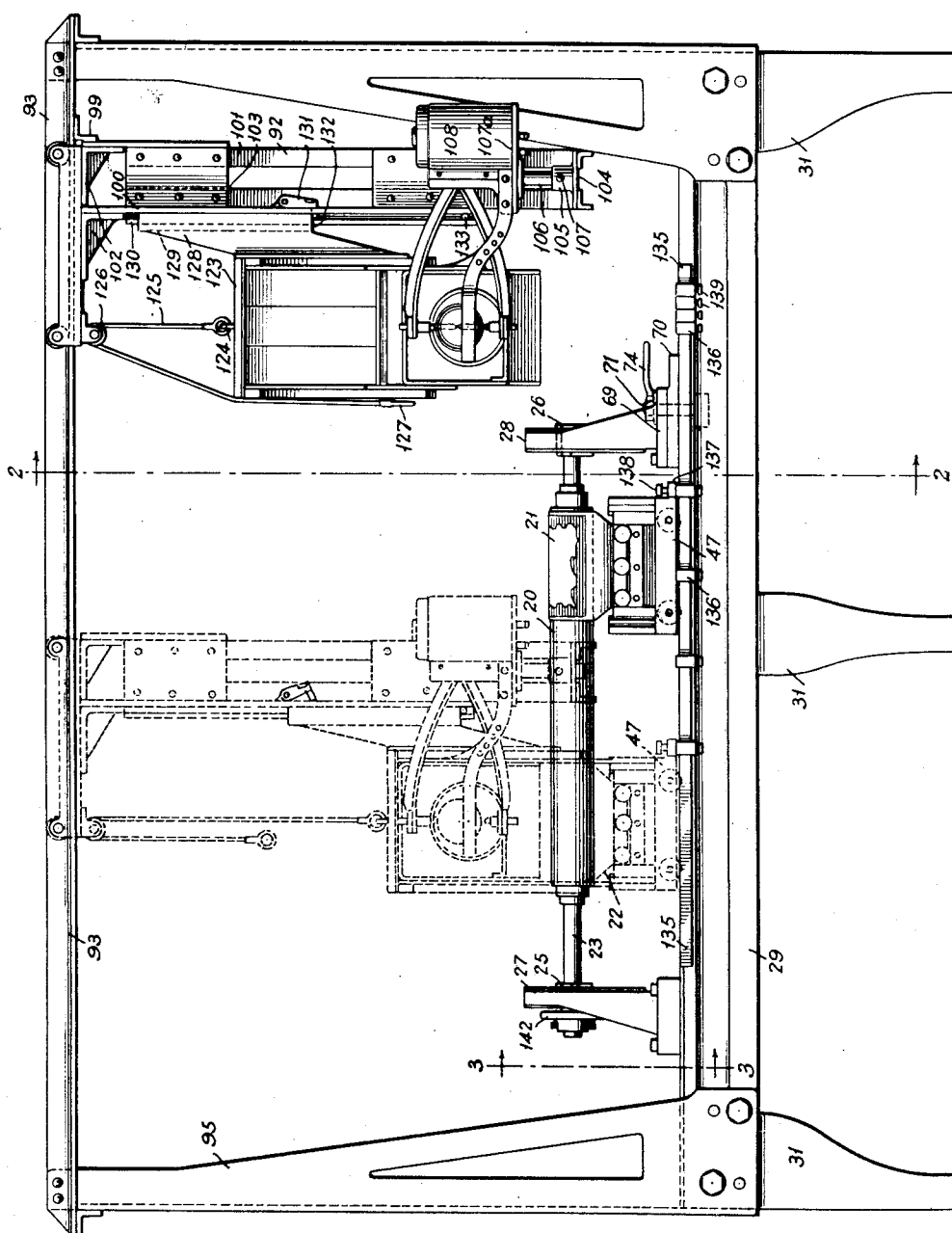


Fig. 1.

BY

INVENTOR
Owen R. Huggins
Frank J. Graham
ATTORNEY

Jan. 17, 1939.

O. R. HUGGINS

2,143,984

METHOD OF AND MEANS FOR ENGRAVING A PRINTING SURFACE

Filed April 3, 1937

4 Sheets-Sheet 3

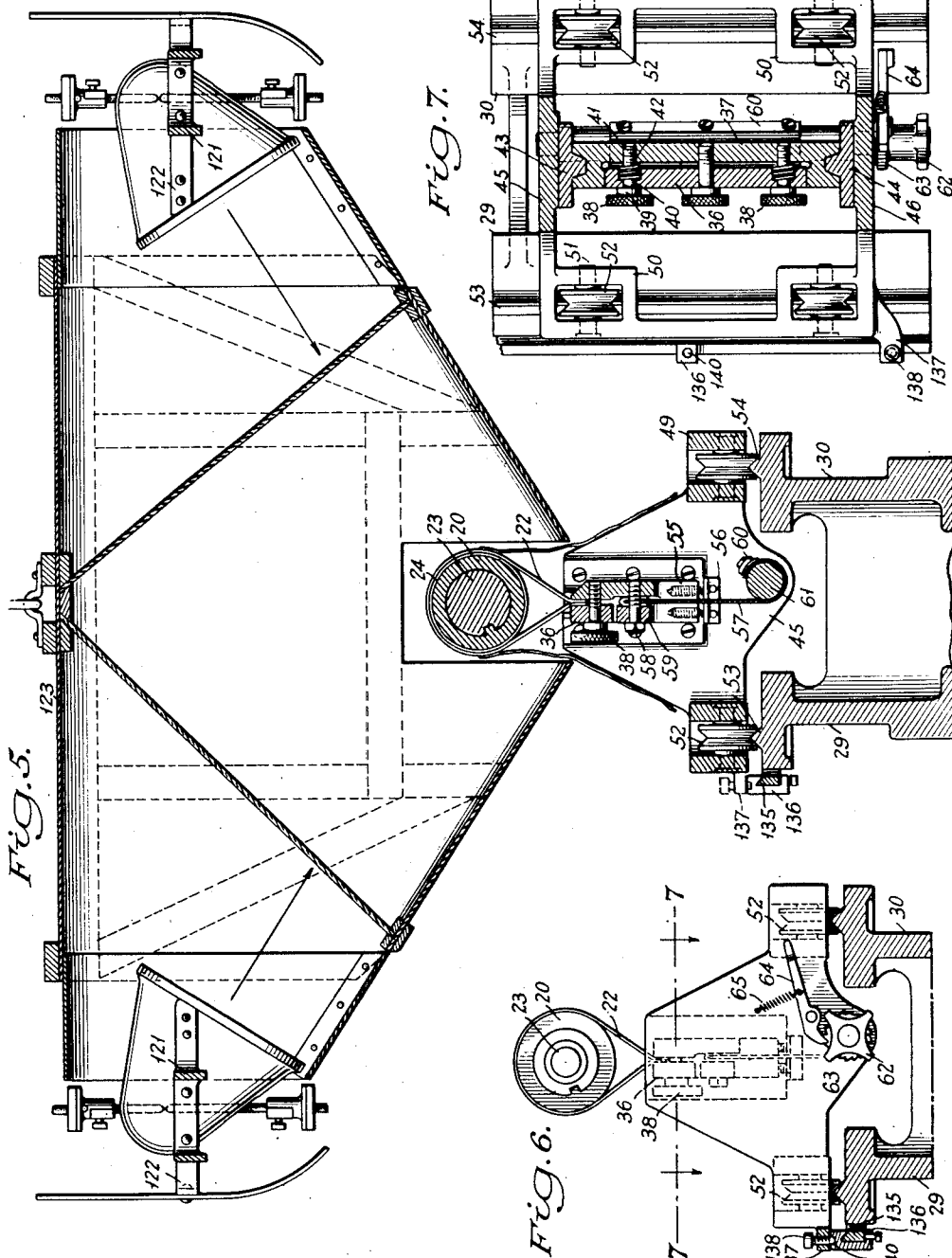


Fig. 6.

Fig. 7.

Fig. 5.

BY

Owen R. Huggins
Frank J. Graham
ATTORNEY

Jan. 17, 1939.

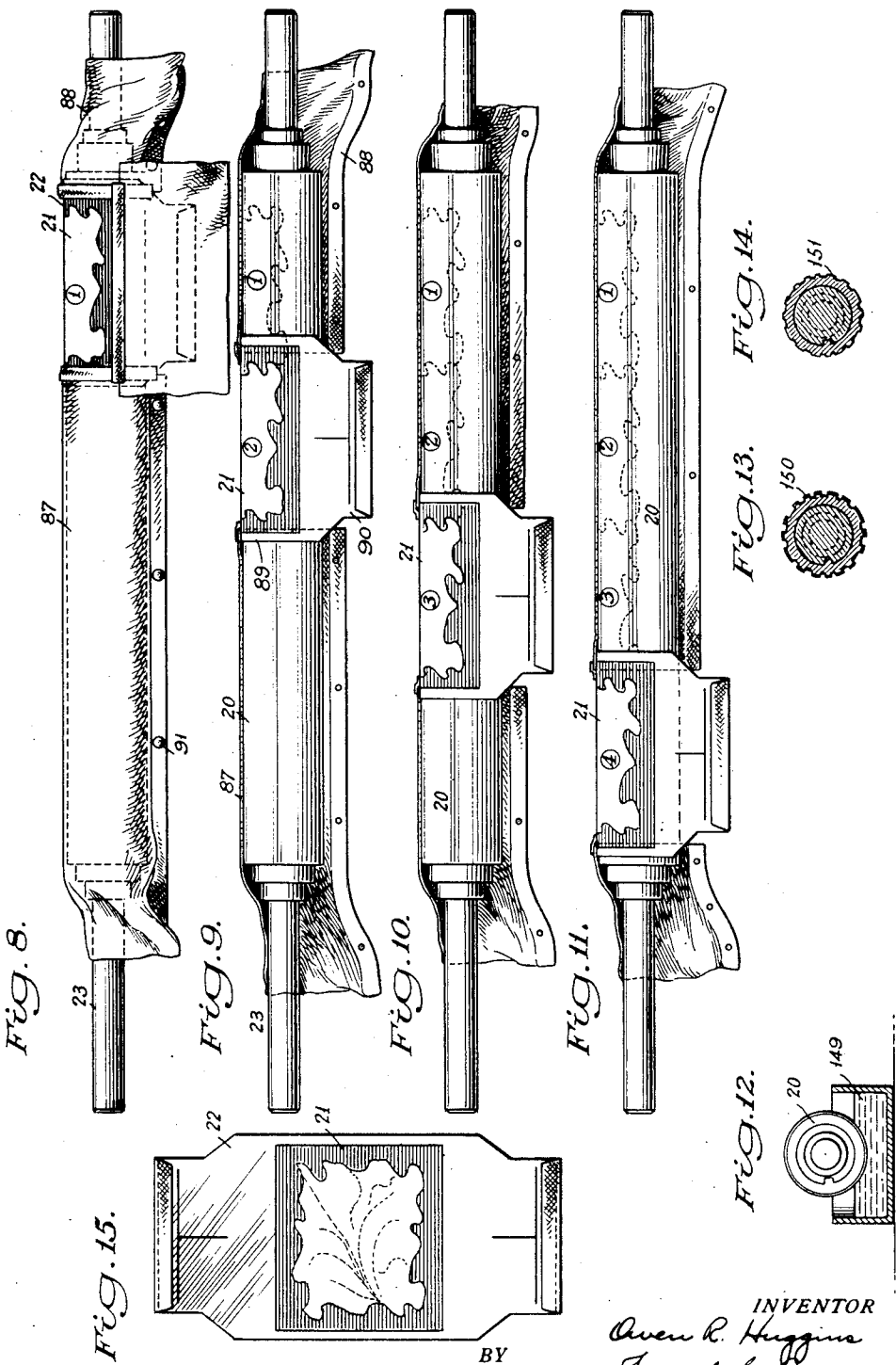
O. R. HUGGINS

2,143,984

METHOD OF AND MEANS FOR ENGRAVING A PRINTING SURFACE

Filed April 3, 1937

4 Sheets-Sheet 4



INVENTOR
Owen R. Huggins
Frank S. Brakham
ATTORNEY

UNITED STATES PATENT OFFICE

2,143,984

METHOD OF AND MEANS FOR ENGRAVING
A PRINTING SURFACEOwen R. Huggins, South Norwalk, Conn., assignor
to Photo-Cylinder Corporation, a corporation
of New York

Application April 3, 1937, Serial No. 134,864

4 Claims. (Cl. 95-5)

This invention relates to methods of engraving a printing surface, and especially one of cylindrical form.

It is the present practice in engraving a cylindrical printing surface with an irregularly shaped design, to employ the so-called pantograph method, but there are certain objections to this method in that it is slow, costly, and incapable of properly reproducing half tones. For these and other reasons, various methods have been suggested for engraving cylinders photomechanically, but thus far the methods suggested have been attended with but little success, as evidenced by the fact that none are at the present time being used commercially to any great extent.

The purpose of the present invention is to engrave irregularly shaped designs upon the printing surface of cylinders photomechanically by a method and means which are commercially practical and capable of reproducing the true tonal effects of the original design. According to the invention, an image of the irregularly shaped design that is to be engraved upon the printing surface of the cylinder is so reproduced upon a flexible film, and the image area or that portion of the film upon which the image is reproduced is made equal in length to an aliquot part of the circumference of the cylinder and in width to a fraction of the length of the printing surface of the cylinder. The cylinder is coated with a light sensitive substance and the film is positioned thereon with the image area over a portion of its sensitized surface. The image area is then brought undistorted into intimate contact with the underlying sensitized surface after which it is subjected to the action of light to create a reproduction of the design upon the sensitized surface of the cylinder. The position of the film is then changed longitudinally and circumferentially predetermined distances to successively bring the image area over the remainder of the sensitized surface of the cylinder. Each time the position of the film is so changed the image area is brought undistorted into intimate contact with the underlying sensitized surface after which it is subjected to the action of light to create a reproduction of the image upon the sensitized surface, and the distance the position of the film is so changed each time is such that the reproductions thus formed merge to form a continuous design.

After the continuous design has been thus formed thereon the sensitized surface is developed and otherwise treated, as is well understood in the art, to form an acid resist after which the

cylinder is rotated in a corrosive bath to etch out the cylinder exposed by the affected areas of the sensitized surface. Then the cylinder is cleaned to remove the unaffected portions of the light sensitive substance after which it is ready for printing purposes.

For a clearer understanding of the invention reference may be made to the accompanying drawings in which,

Fig. 1 is an elevational view of the machine employed in the present embodiment of the invention for transferring an image from a film onto a coating of light sensitive substance with which a cylinder is provided;

Fig. 2 is an end view in section, the view being taken along the line 2-2 of Fig. 1;

Fig. 3 is an end view in section, the view being taken along the line 3-3 of Fig. 1;

Fig. 4 is a sectional view taken along the line 4-4 of Fig. 3;

Fig. 5 is an enlarged sectional view showing the light source, the light hood and the film tensioning device employed in the machine shown in Fig. 1;

Fig. 6 is an enlarged end view of the tensioning device shown in Fig. 5;

Fig. 7 is a plan view in section of the traveling carriage employed in changing the position of the image area of the film longitudinally with respect to the position of the cylinder, the view being taken along the line 7-7 of Fig. 6;

Fig. 8 is an elevational view showing the relative positions of the cylinder, the film, and the light shields, which are employed to protect the regions of the sensitized surface of the cylinder outside the area beneath the image area of the film at the time the initial reproduction is made on the sensitized surface of the cylinder;

Figs. 9, 10, and 11, are elevational views partially in section showing the relative positions of the elements mentioned in connection with Fig. 9, but at the time the second, third, and fourth reproductions are being made along the length of the cylinder;

Fig. 12 is an end view in section of a fixing bath;

Fig. 13 is an end view in section of a cylinder after being removed from the fixing bath;

Fig. 14 is an end view in section of a cylinder after being treated after its removal from the fixing bath; and

Fig. 15 is a plan view of the film from which an image is to be transferred to a cylinder.

In operation, the design to be engraved upon the printing surface of a cylinder is photo-

raphically reproduced upon the central portion 21 of a flexible film 22, which portion is herein-after referred to as the image area of the film. The length of the image area throughout its width is made equal to an aliquot part of the circumference of the cylinder and the width of the image area throughout its length is made any desired dimension although for economic reasons it is made small as compared to the length of the printing surface of the cylinder. In the present embodiment of the invention the length of the image area throughout its width is made equal to one half the circumference of the cylinder and the width of the image area throughout its length is made equal to approximately one quarter the length of the printing surface of the cylinder. It is to be noted, however, that due to the irregularities of the edges of the design the over all length of the image area is greater than one half the circumference of the cylinder and the overall width of the image area is greater than one quarter the length of the printing surface of the cylinder.

The image thus reproduced upon the image area 21 is transferred onto the surface of the cylinder 20 the number of times necessary to cover with an endless design that portion from which it is desired to print, and to this end the cylinder 20 is keyed to a mandrel 23 and it is provided with a coating of light sensitive substance 24. The mandrel 23 is journaled at its opposite ends in split bearings 25 and 26 carried by bearing assemblies 27 and 28 respectively that are supported by oppositely disposed frame members 29 and 30 which are maintained in spaced parallel relationship by a plurality of supporting legs 31, and to prevent lateral displacement of the mandrel 23 it is provided with an annular groove 32 into which is positioned a key 33 carried by the cap portion of the split bearing 25. The film 22 is placed over the cylinder 20 with the image area 21 positioned adjacent one end thereof. The image area 21 is then brought undistorted into intimate contact with the underlying sensitized surface of the cylinder, and here it is to be noted that inasmuch as the over all length of the image area is greater than half the circumference of the cylinder the film must be brought into contact with more than half the circumferential surface of the cylinder. In the present embodiment of the invention wherein the width of the image area is small as compared to the length of the cylinder this intimate contact is brought about by bending the ends of the film backwardly and clamping the doubled ends thus formed between a bar 36 and a vertically movable block 37 by means of studs 38. The studs 38 are provided with a shoulder 39 which is positioned adjacent the outer face of the clamping bar 36, a shank portion 40 which extends through a hole in the clamping bar 36, and a threaded end portion 41 which is threaded into an aligned tapped hole in the block 37, and to automatically separate the clamping bar 36 from the block 37 to aid in removing the film when the studs 38 are backed off a compression spring 42 is positioned about the shank portion 40 of the end studs in a recess formed in the clamping bar 36. The block 37 is positioned between gibs 43 and 44 carried by upstanding plates 45 and 46 respectively which form the end walls of a movable carriage 47. The side walls of the movable carriage 47 comprise spaced beams 48 and 49, and the end of each beam is provided with a journal box 50 having a shaft 51 upon which

a grooved roller 52 is mounted. The two rollers on the front beam 48 are positioned on a carriage guiding gib 53 which extends longitudinally along the top face of the front frame member 29 and the two rollers on the rear beam 49 are positioned on a similar gib 54 which extends longitudinally along the top face of the rear frame member 30.

The vertically movable block 37 is maintained in its normal raised position by means of springs 55 that are positioned in recesses in the lower face thereof and which rest on a cross plate 56 that is connected at its opposite ends to the end plates 45 and 46 of the movable carriage 47. To bring the image area 21 into intimate contact with the underlying portion of the sensitized surface of the cylinder 20 the block 37 is pulled downwardly from its normal raised position against the action of the springs 55, and to this end the upper end of a resilient strap 57 is secured by screws 58 between the block 37 and a clamping bar 59. The lower end of the strap 57 is secured by a clamp 60 to a shaft 61 that is journaled at its opposite ends in the upstanding side plates 45 and 46 of the movable carriage 47. One end of the shaft 61 extends outwardly and it is provided with a hand wheel 62 and a ratchet wheel 63. A pawl 64 that is adapted and arranged to engage the teeth of the ratchet wheel 63 is pivotally secured to the upstanding side plate 46, and a spring 65 having one of its ends fastened to the free end of the pawl 64 and its other end fastened to the side plate 46 is provided to maintain the pawl 64 in engagement with the teeth of the ratchet wheel 63. To bring the image area 21 of the film 22 into intimate contact with the underlying portion of the sensitized surface of the cylinder 20, the shaft 61 is rotated by the hand wheel 62. As the shaft 61 rotates the strap 57 stretches and in stretching it pulls the block 37 and the blanket 34 downwardly and so carries the image area 21 without distortion into intimate contact with the underlying sensitized surface of the cylinder 20.

Since it is important that the image area 21 of the film 20 throughout its length be brought into intimate contact with the underlying sensitized surface of the cylinder 20 and since the normal raised position of the block 37 is fixed, the split bearings 25 and 26 in which the opposite ends of the mandrel 23 on which the cylinder 20 is mounted are rendered adjustable to accord with cylinders of different sizes, and to this end the left hand bearing assembly 27 comprises a cross beam 66 having downwardly extending legs 67 which are secured in fixed position by pins 68 to the upper faces of the frame members 29 and 30. The right hand bearing assembly 28 comprises a pair of superimposed plates 69 and 70 slidably mounted on the upper faces of the frame members 29 and 30, and to guide the right hand assembly as it is moved along the frame members 29 and 30 the lower plate 70 is recessed to accord with the guiding gibs 43 and 44 on the upper faces thereof. To lock the right hand bearing assembly 28 in a desired position a stud 71 is positioned in aligned apertures in the superimposed plates 69 and 70. The lower end of the stud 71 is threaded through a clamping plate 72 positioned beneath shelves 73 on the frame members 29 and 30 and the upper end of the stud is provided with a handle 74 which, when turned in one direction, rotates the stud to draw the clamping plate 72 into frictional engagement with the shelves 73 and which, when turned in

the opposite direction, rotates the stud to free the clamping plate from its friction engagement with the shelves. The central portion of the cross beam 66 of the left hand bearing assembly 27 is provided with a boss 75 through which the lower end of an adjusting screw 76 is threaded, and the central portions of the superimposed plates 69 and 70 of the right hand bearing assembly 28 are provided with aligned apertures through which the lower end of a similar adjusting screw 77 is threaded. The upper ends of the adjusting screws 76 and 77 are provided with annular heads 78 which are maintained by means of apertured plates 79 in recesses in the lower faces of the bearings 25 and 26. Turning the adjusting screws 76 and 77 acts to raise or lower the bearings 25 and 26, and to aid in the turning of the screws they are provided with annular nuts 80 fixed thereto by set screws 81 and having holes 82 adapted to receive the end of a turning tool. To guide the bearings 25 and 26 as they are raised or lowered each assembly is provided with a pair of vertically disposed gibs 83 and 84 positioned in recesses formed in the outer side faces of the bearings 25 and 26, and to lock the bearings after they have been adjusted to a desired position the adjusting screws 76 and 77 are provided with lock nuts 85 having holes 86 adapted to receive the end of a turning tool, the lock nut on the adjusting screw 76 of the left hand bearing assembly 27 serving, when brought into engagement with the upper face of the cross beam 66, to lock the left hand bearing 25 and the lock nut on the adjusting screw 77 of the right hand bearing assembly 28 serving, when brought into engagement with the upper face of the cross plate 69, to lock the right hand bearing 26 in position.

The image area 21 of the film 22 having thus been brought undistorted into intimate contact with the underlying sensitized surface of the cylinder 20, means are provided to prevent light from striking the sensitized surface of the cylinder except through the image area, and to this end as shown more clearly in Fig. 8, a pair of opaque sleeves 87 and 88 are positioned about the cylinder 20 adjacent the sides of the image area 21 and a semi-circular frame 89 having flaps 90 is positioned over the film 22 with the sides of the frame 89 adjacent the sides of the image area 21 and with the flaps 90 extending downwardly in overlapping relationship with respect to the ends of the sleeves 87 and 88. The sleeves 87 and 88 are flexible and they may be made of strips of dark closely woven cloth re-enforced along oppositely disposed ends to support the male and female portions of snaps 91 by means of which these ends are brought together to form sleeves. The flaps 90 are made of like material and they are secured to the horizontally disposed ends of the semi-circular frame 89.

The sensitized surface of the cylinder outside the regions of the overlying image area 21 being protected, the image area is subjected to the action of light to create a reproduction of the image upon the underlying sensitized surface of the cylinder 20, and to this end a traveling carriage 92 is mounted on oppositely disposed rails 93 and 94 which are supported above the frame members 29 and 30 by posts 95. The carriage 92 comprises a plate 96 having upturned flanges 97 that are provided with rollers 98 which rest on the rails 93 and 94, and to limit the travel of the carriage 92 to the right to which position it is moved between reproducing operations a stop

member 99 is connected across the lower faces of the rails 93 and 94. A pair of lamp supporting members 100 and 101 that are secured at their upper ends by brackets 102 to the lower face of the outer edge of the plate 96 extend downwardly and outwardly. The downwardly extending portions of the lamp supporting members are connected by plates 103 and the outwardly extending portions are provided with a plate 104 having a hub portion 105 in which the lower end of a shaft 106 is fixed by a set screw 107. The upper end of the shaft 106 is provided with a plate 107 upon which an arc lamp assembly 108 is mounted. In like manner, a pair of similar lamp supporting members 109 that are secured by similar brackets 111 to the lower face of the inner edge of the plate 96 extend downwardly and outwardly. The downwardly extending portions of these lamp supporting members are also connected by plates 112 and the outwardly extending portions are provided with a plate 113 having a hub portion 114 in which the lower end of a shaft 115 is likewise fixed by a set screw 116. The upper end of the shaft 115 is also provided with a plate 117 upon which a similar arc lamp assembly 118 is mounted.

The arc lamp assemblies 108 and 118 are of standard construction and a detailed description thereof is not deemed necessary. It is to be noted, however, that they are capable of adjustment and that each lamp is provided, as usual, with a reflector 119. Each reflector opens into a light tunnel 120 that is fixedly mounted by brackets 121 to the arms 122 upon which the reflectors 119 are secured. A vertically movable light hood 123 is positioned between the light tunnels 120 and it is adapted and arranged to fit over the cylinder 20 beyond the ends of the image area 21 when it is in its down position. The ends of the light hood 123 are open and they are so shaped that the hood forms a continuation of the light tunnels 120 so as to direct the rays of light emitted by the lamps 108 and 118 against the image area 21 of the film 22. To raise and lower the light hood 123 the upper face thereof is provided with a clamp 124 to which one end of a rope 125 is secured. The rope 125 is trained over a pulley 126 secured to the lower face of the plate 96 and its other end is provided with a handle 127, and to guide the hood 123 in a fixed path as it is raised and lowered it is provided with a bracket 128 having a vertical groove 129 in which is positioned a gib 130 secured to the downwardly extending portion of the left front lamp supporting member 100. The light hood 123 is maintained in its normal raised position by means of a latch 131 which is pivotally mounted on the downwardly extending portion of the left front lamp supporting member 100 and which is adapted and arranged to engage a shoulder 132 formed on the lower face of the bracket 128, and to arrest the downward movement of the light hood 123 at a desired position a pin 133 is secured to the gib 130 in the path of the shoulder 132.

In operation the movable carriage 92 is positioned to the right while the image area 21 is being brought into intimate contact with the underlying portion of the sensitized surface of the cylinder 20 and while the remaining portion of the sensitized surface of the cylinder is being protected against the action of light. Thereafter the carriage 92 is moved to the left to carry the light hood 123 and the lamps 108 and 118 over the image area 21 of the film 22 after which the hood is lowered and the lights adjusted and rendered

ered active. The light thus directed against the image area 21 of the film 22 creates a reproduction of the image onto the sensitized surface of the cylinder 20.

After the image has been thus reproduced upon the sensitized surface of the cylinder 20, the lights are rendered inactive, the hood 123 is raised and the carriage 92 is moved to the right. The tension on the strap 57 is then released and as it is released the springs 55 operate to move the block 37 upwardly to its normal raised position to break the intimate contact between the film 23 and the sensitized surface of the cylinder 20.

The position of the film 22 is then changed longitudinally with respect to the cylinder 20 by moving the carriage 47 to the left until the right hand end of the image on the film lies in exact register with the left hand end of the reproduction on the cylinder as shown more clearly in Fig. 9. The cycle of operations is repeated to create a second reproduction of the image onto the sensitized surface, after which the position of the film 22 is again changed longitudinally with respect to the cylinder 20 by moving the carriage 47 to the left until the right hand end of the image on the film lies in exact register with the left hand end of the second reproduction on the cylinder as shown more clearly in Fig. 10. Again the cycle of operations is repeated to create a third reproduction of the image onto the sensitized surface. And since in the present embodiment of the invention the width of the image area is equal to a quarter the length of the printing surface of the cylinder the position of the film is once more changed longitudinally with respect to the cylinder by moving the carriage 47 to the left until the right hand edge of the image lies in exact register with the left hand edge of the third reproduction. Again the cycle of operations are repeated to create a fourth reproduction of the image onto the sensitized surface of the cylinder.

To aid in thus moving the carriage 47 to the left to bring the right hand edge of the image into exact register with the left hand edge of the reproduction the front frame member 29 is provided with a beveled carriage positioning rail 135 upon which a plurality of stop members 136 are slidably mounted and the carriage 47 is provided with an overhanging bracket 137 through which is threaded a positioning screw 138 having a pointed lower end. The lower faces of the stop members 136 are provided with set screws 139 which when brought into engagement with the lower face of the positioning rail 135 locks the stop members to the rail, and the upper faces of the stop members 136 are provided with recesses 140 which exactly conform with the size and shape of the pointed lower end of the positioning screw 138. When the image area 21 on the film 22 has been positioned adjacent the right hand end of the cylinder 20 and brought into intimate contact with the underlying sensitized surface of the cylinder during the first reproducing operation a number of the stop members 136 (in the present case four) which correspond with the number of times the position of the image area is to be changed longitudinally with respect to the cylinder are moved along the guide rail 135 from their usual place of storage at the right until they are positioned in front of the cylinder. The last or terminal stop of the group thus moved is positioned beneath the pointed lower end of the positioning screw 138 after which the screw is threaded downwardly to force the pointed lower end into the recess 140 in the top face of the stop, and as the pointed lower

end of the screw 138 enters the recess 140 it operates to move the stop to its final position after which it is locked to the rail 135. The remaining stops in the group are then spaced until the distance between the centers of the recesses 140 is exactly equal to the width of the image area of the film. In consequence when changing the position of the image area longitudinally with respect to the cylinder prior to the second, third, and fourth reproduction operation it is only necessary to successively locate the pointed lower end of the adjusting screw 138 in the recess 140 in the top surface of the successive stops 136 to bring the right hand edge of the image on the film into exact register with the left hand edge of the reproduction on the cylinder.

After the reproductions are thus created throughout the length of the cylinder the carriage 47 is moved back to the position it occupied during the first reproducing operation and the position of the image area 21 is changed circumferentially with respect to the cylinder to bring the image area above an unexposed aliquot portion of the cylinder sensitized surface. To aid in this operation one end of the mandrel 23 upon which the cylinder 20 is mounted is provided with an indexing device. As shown more clearly in Figs. 3 and 4, the indexing device 141 comprises a disc 142 which is secured to one end of the mandrel 23 by a set screw 143. The disc 142 is provided with a plurality of holes 144 and normally it and the mandrel 23 are locked in fixed position by means of a pin 145 which extends through one of the holes and into an aligned hole 146 in the left hand bearing 25. In the present embodiment of the invention the holes 144 in the disc 142 are divided into two sets, one set being identified by the numerals 2.4 and comprising four holes spaced 90 degrees apart. The other set is identified by the numerals 3.6 and comprises six holes spaced 60 degrees apart. The set of four holes is provided to take care of cases where the length of the image area 21 is made equal to a quarter or a half the circumference of the cylinder 20 and it is necessary to rotate the cylinder either a quarter or a half revolution to bring one end of the image area 21 into exact register with an opposite end of a reproduction, and the set of six holes is provided to take care of cases where the length of the image area on the film is made equal to a sixth, a third, or a half, the circumference of the cylinder and it is necessary to rotate the cylinder a sixth, a third, or a half, a revolution to carry one end of the image area into exact registration with the opposite end of a reproduction.

In the present case where the length of the image area throughout its width is made equal to half the circumference of the cylinder, the mandrel 23 is initially locked in fixed position by inserting the pin 145 through one of the holes 144 in the disc 142 and into the aligned hole 146 in the left hand bearing 25. The mandrel 23 is maintained locked in this fixed position until after the reproductions are created along the length of the cylinder 20. Then when the position of the image area 21 is changed circumferentially with respect to the cylinder 20 the pin 145 is removed and the disc 142 is turned to rotate the mandrel 23 beneath the film 22 and the overlying blanket 34. In the event the pin 145 was initially inserted through one of the holes marked 2.4 the disc 142 is rotated until the second one thereafter so marked is brought into alignment with the hole 146 in the bearing 25 or in the event the pin was initially inserted through one of the holes marked

3.6 the plate is rotated until the third one there-
after so marked is brought into alignment with
the hole 146 in the bearing 26. In either case the
mandrel 23 is rotated through 180 degrees and
the ends of the image on the film lie in register
with the ends of the reproduction on the cylin-
der. After the position of the image area has been
so changed with respect to the cylinder the cycle
of operations are continued four more times to
create four more reproductions along the cylin-
der. In this manner the surface of the cylinder
20 from which it is desired to print is covered with
eight reproductions which merge to form a con-
tinuous design.

After the continuous design has been thus re-
produced upon the sensitized surface of the cylin-
der the mandrel 23 carrying the cylinder 20 is
removed from the bearings 25 and 26. The sen-
sitive coating on the surface of the cylinder is
developed in a manner well understood in the
art to form an acid resist after which the cylin-
der is rotated in a corrosive bath 149 to etch out
the affected areas 150 as is shown more clearly in
Fig. 13. Then the cylinder is cleaned in any
suitable manner to remove the unaffected por-
tions 151 as shown in Fig. 14, after which it is
ready for printing purposes.

In the present embodiment of the invention
the ends of the film 22 are shown and described
as being connected between the bar 36 and the
vertically movable block 37 to enable the image
area 21 to be drawn downwardly without distor-
tion into intimate contact with the underlying
surface of the cylinder 20. It is to be noted, how-
ever, that this arrangement is satisfactory be-
cause in the present embodiment of the invention
the width of the image area is an aliquot part of
the length of the cylinder in which case the en-
tire image area is brought into intimate contact
with the underlying surface of the cylinder. In
the event, however, that the width of the image
area is an aliquant part of the length of the cylin-
der a portion of the image area necessarily ex-
tends beyond one end of the cylinder while re-
productions of the image on the remaining por-
tion are being created on this end of the cylinder
to complete the endless design. In consequence,
if such an arrangement is employed when the
width of the image area is an aliquant part of the
length of the cylinder that portion of the film
which extends beyond the end of the cylinder is
quite likely to be drawn downwardly beyond the
end of the cylinder while the remaining portion
would be arrested as it was brought into intimate
contact with the cylinder and so cause distortion
of the image area. Then if the distorted image
area was thereafter positioned over an unexposed
portion of the cylinders sensitized surface and
subjected to a pull it would not be brought into
intimate contact with the cylinder and in conse-
quence the light after it passed through the film
would diffuse and so cause an unsatisfactory re-
production. To avoid this possibility of distortion
when the width of the image area is an aliquant
part of the length of the cylinder a transparent
blanket is positioned over the film and the ends
of the blanket, rather than the ends of the film,
are clamped between the bar 36 and the verti-
cally movable block 37. When a blanket is em-
ployed it is secured to the film so that the two
move as a unit, this being accomplished by mak-
ing the blanket slightly narrower than the film
and by pasting the two together by adhesive
strips which must be positioned outside the im-
age area of the film.

Also, it is to be understood that while the image
area is moved successively from one end of the
cylinder to the other in the present embodiment
of the invention, other arrangements may be
employed to expose to light the entire printing
area of the cylinder or any selected part thereof.

Having thus described my invention, I claim:

1. In the method of photo-mechanically en-
graving the printing surface of a cylinder, the
steps which comprise rendering said surface sen-
sitive to the action of light, creating upon a flex-
ible film an image of a design element having
irregular borders and of such size that two design
elements interfitted along their widths equal the
circumference of the cylinder and the overall
width of the image being less than the length of
the printing surface of the cylinder, bringing the
image bearing portion of the film into contact
with a light unaffected area of said sensitized sur-
face, subjecting the image bearing portion of the
film to the action of light to create a reproduc-
tion of the image upon said sensitized surface,
repeatedly changing the position of the film lon-
gitudinally and circumferentially with respect
to the position of the cylinder to bring the image
bearing portion of the film over other light un-
affected areas of said sensitized surface, bring-
ing said image bearing portion of the film into
contact with the underlying light unaffected area
each time the position of the film is so changed,
and subjecting said image bearing portion of the
film to the action of light each time it is brought
into contact with the sensitized surface of the
cylinder to create other reproductions of said
image on said sensitized surface, the distances
that the position of the film is so changed with
respect to the position of the cylinder being such
that the reproductions of the image on the sensi-
tized surface of the cylinder interfit to form a
continuous design.

2. In the method of photo-mechanically en-
graving the printing surface of a cylinder, the
steps which comprise rendering said surface
sensitive to the action of light, creating upon a
flexible film an image of a design element hav-
ing an irregular border, the overall width of said
image being less than the length of the printing
surface of the cylinder and the length of the im-
age throughout its width being equal to one-half
the circumference of the cylinder, bringing the
image bearing portion of the film into intimate
contact with a light unaffected area of said sen-
sitized surface, subjecting the image bearing por-
tion of the film to the action of light to create a
reproduction of the image upon said sensitized
surface, repeatedly changing the position of the
film longitudinally and circumferentially with
respect to the position of the cylinder to bring
the image bearing portion of the film above other
light unaffected areas of said sensitized surface,
and subjecting the image bearing portion of the
film to the action of light each time it is brought
into contact with said surface to create upon said
surface a reproduction of the image, the distance
that the position of the film is so changed with
respect to the position of the cylinder being such
that the reproductions of the image on the sensi-
tized surface interfit to form a continuous de-
sign.

3. In combination, a light sensitive cylinder, a
film having an irregularly shaped design element
whose overall length is such that two design ele-
ments interfitted along their widths equal the
circumference of the cylinder and whose overall
width is less than the length of the printing sur-

face of the cylinder, means for positioning that portion of the film carrying the design element above a light unaffected area of said cylinder, means for repeatedly changing the relative positions of the film and cylinder longitudinally and circumferentially to bring that portion of the film carrying the design element above other light unaffected areas of said cylinder, means for bringing that portion of the film carrying the design element into intimate contact with said cylinder each time it is positioned above a light unaffected area, means for subjecting said cylinder to the action of light through that portion of the film carrying the design element, and means for shielding the remaining portion of said cylinder against the action of light.

4. In combination, a light sensitive cylinder, a film having an irregularly shaped design element whose width is less than the length of the printing surface of the cylinder and whose length throughout its width is one-half the circumference of the cylinder, means for positioning that portion of the film carrying the design element

above a light unaffected area of said cylinder, means for repeatedly changing the relative positions of the film and cylinder longitudinally and circumferentially to bring that portion of the film carrying the design element above other light unaffected areas of said cylinder, means for bringing that portion of the film carrying the design element into intimate contact with said cylinder each time it is positioned above a light unaffected area, means for subjecting said cylinder to the action of light through that portion of the film carrying the design element each time said portion is brought into contact therewith to create a reproduction of the design element on said sensitized surface, means for shielding the remaining portion of said cylinder against the action of light, and means for so limiting the distances that the relative positions of the film and cylinder are changed that the reproductions of the design elements on the sensitized surface interfit to form a continuous design.

OWEN R. HUGGINS.