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Boujon

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[54] METHOD AND APPARATUS FOR OPTICALLY POSITIONING PRINTING PLATES

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[73] Assignee: **J. Bobst & Fils, S.A.,** Prilly, Switzerland

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[21] Appl. No.: **87,209**

[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** **356/168,** 33/184.5, 101/DIG. 12, 350/174, 356/172

[51] **Int. Cl.** **G01b 11/24**

[58] **Field of Search** 350/174; 356/172, 168, 166, 356/162; 33/184.5; 101/DIG. 12

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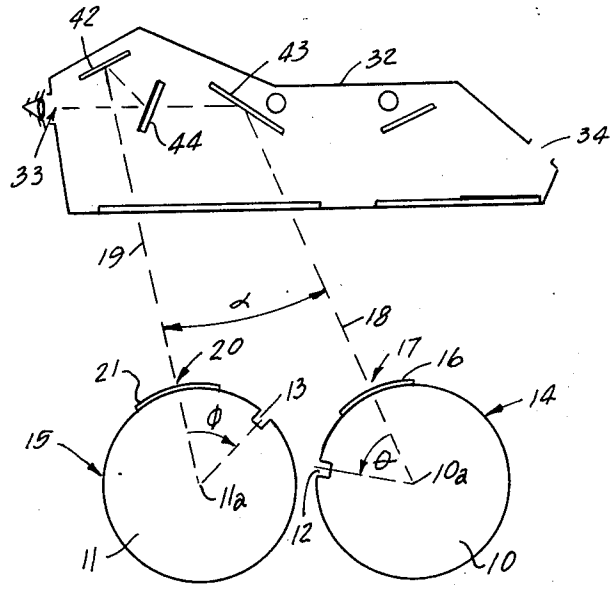
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Assistant Examiner—Jeff Rothenberg
Attorney—Hill, Sherman, Meroni, Gross & Simpson

[57] **ABSTRACT**

The positioning of printing plates on a support means for synchronized color printing wherein successive impressions of various colors or images are to be superimposed is accomplished by the method according to the invention wherein a model having a positive image of the matter to be printed is placed in position on a first support means, a first color printing plate having a reversed image of the matter to be printed is placed on a second support means, the model and the first printing plate are viewed through an optical device situated in predetermined relation to the first and second support means so that with adjustment of the first printing plate the model and the first printing plate will appear in superimposed relation to each other. The model is then removed from the first support means and a second printing plate having a reversed image is mounted on the first support means and again adjusted in position so that when viewed through an optical device the images on the first and second printing plates will appear in superimposed relation to each other. Subsequent printing plates may be aligned in a manner similar to that set forth for the second printing plate. The apparatus for carrying out this method includes a pair of cylinder means mounted on a frame means in predetermined relation to each other and connectable to each other by a coupling means to rotate together in the same or opposite directions. An optical viewing means fixed in predetermined relation to the axis of the cylinder means employs suitable mirrors to allow superimposition between the positive image of the model and the negative images of the first and second printing plates.

11 Claims, 14 Drawing Figures



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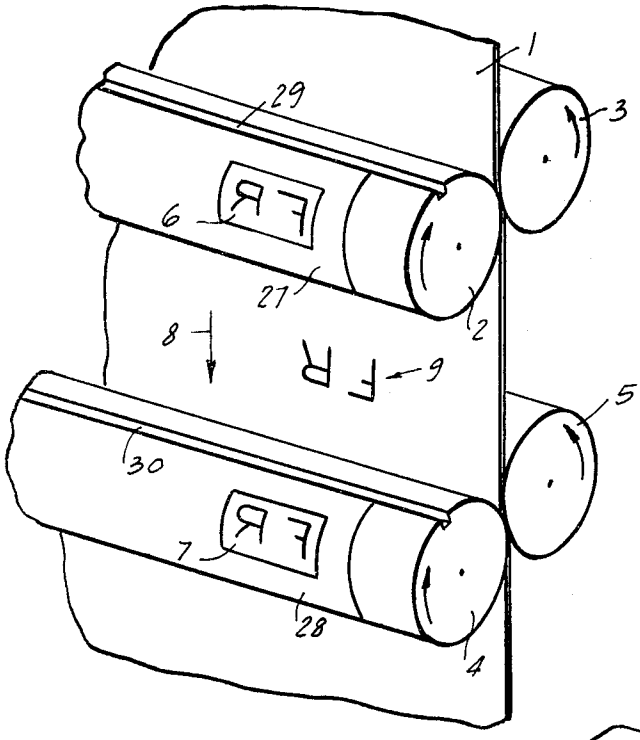


Fig. 2

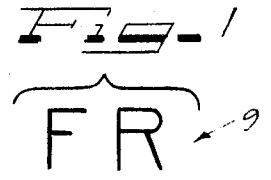


Fig. 1

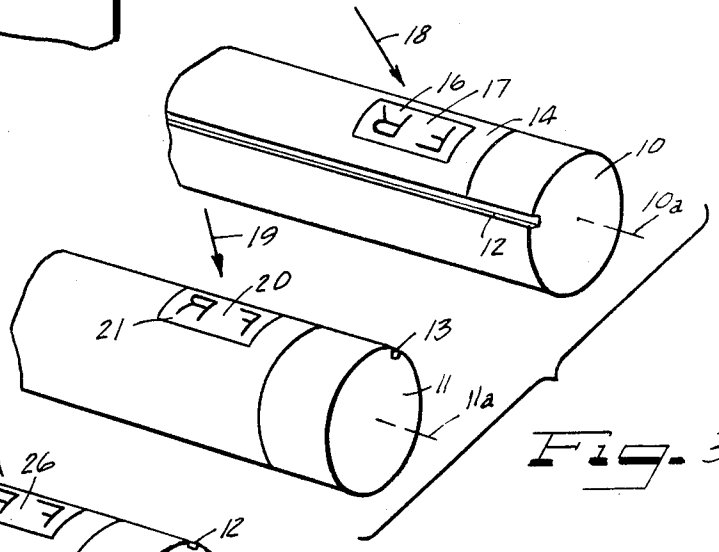


Fig. 3

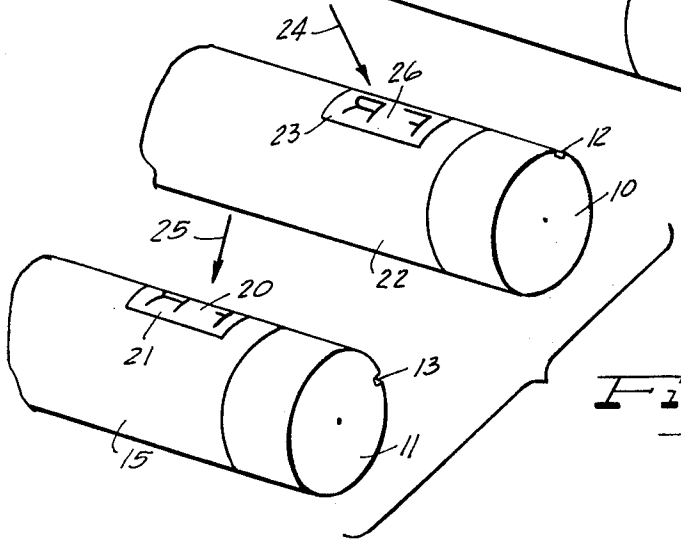


Fig. 4

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Fig. 5

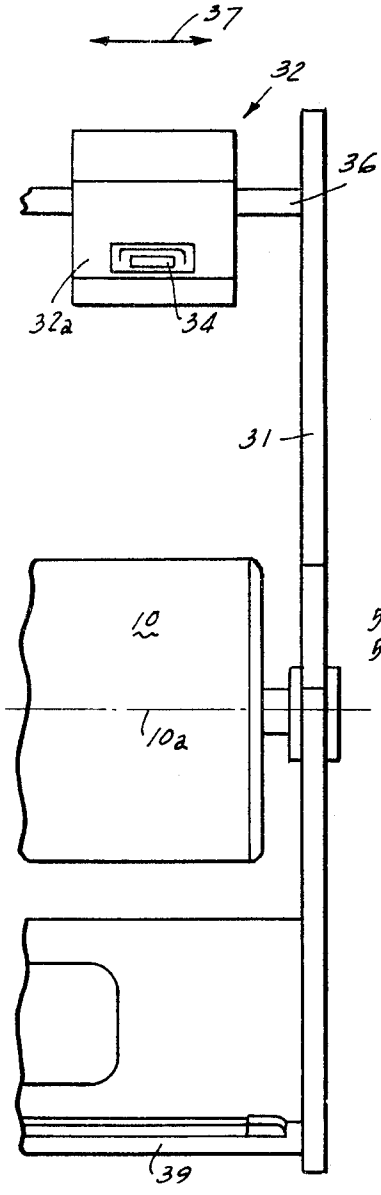
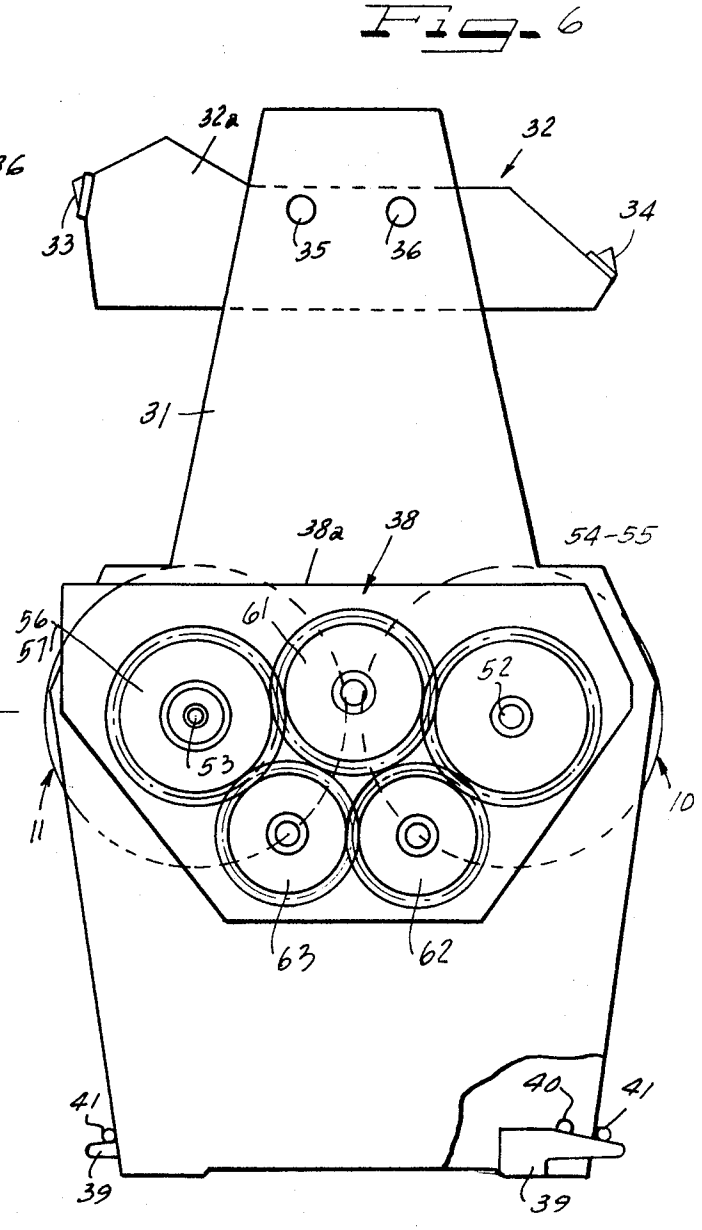


Fig. 6



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Fig. 9

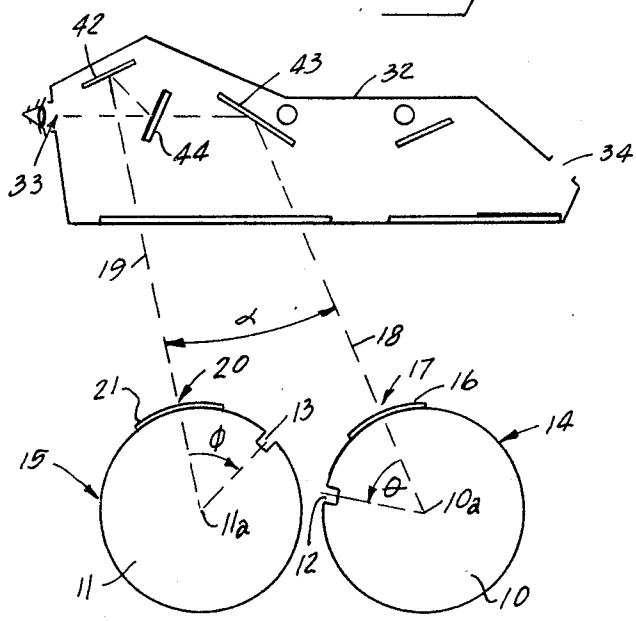
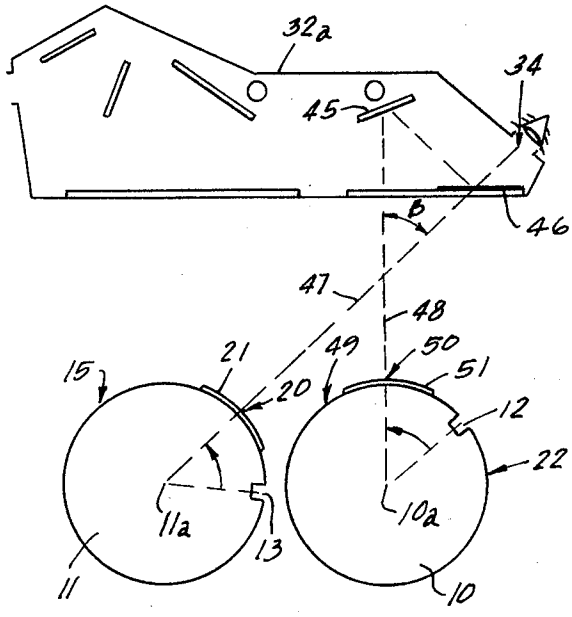


Fig. 10



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Fig. 7

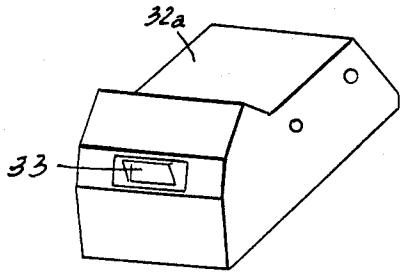


Fig. 8

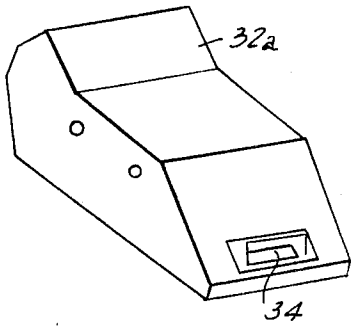
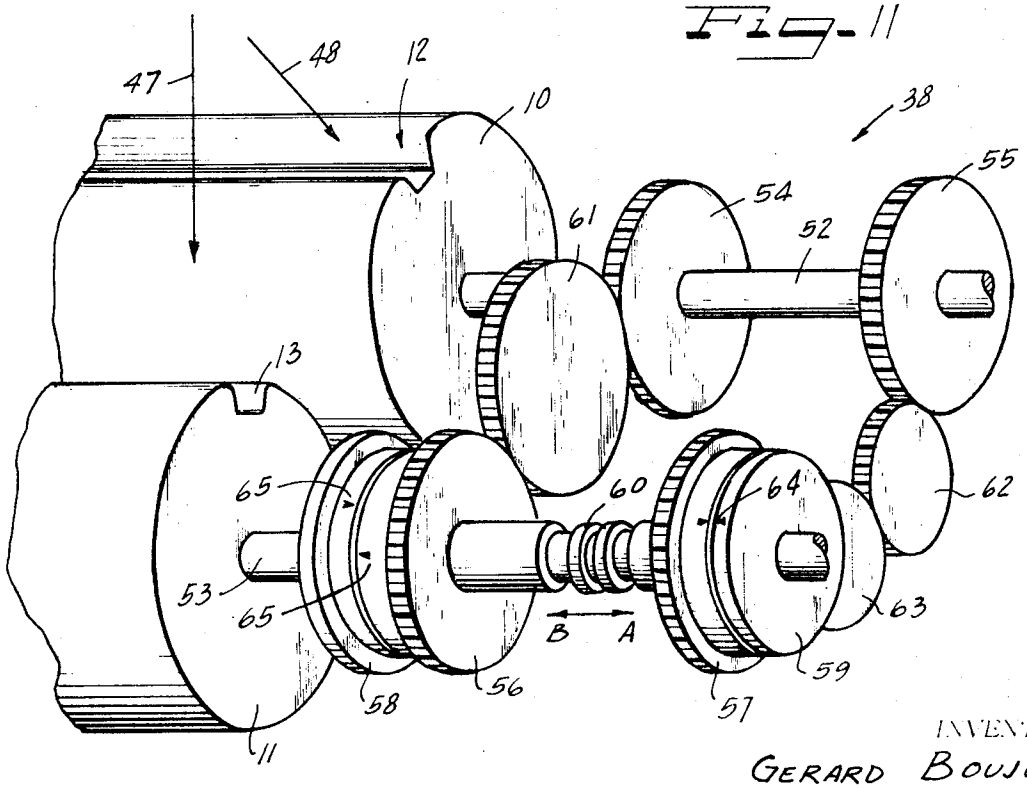


Fig. 11



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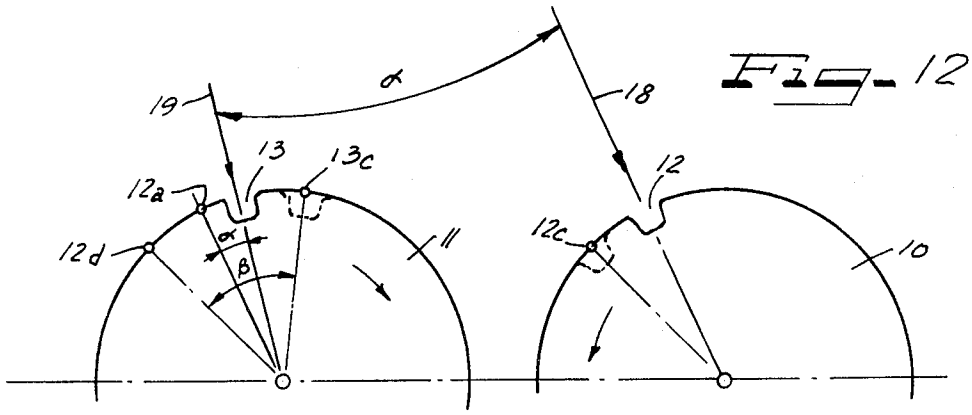


Fig. 12

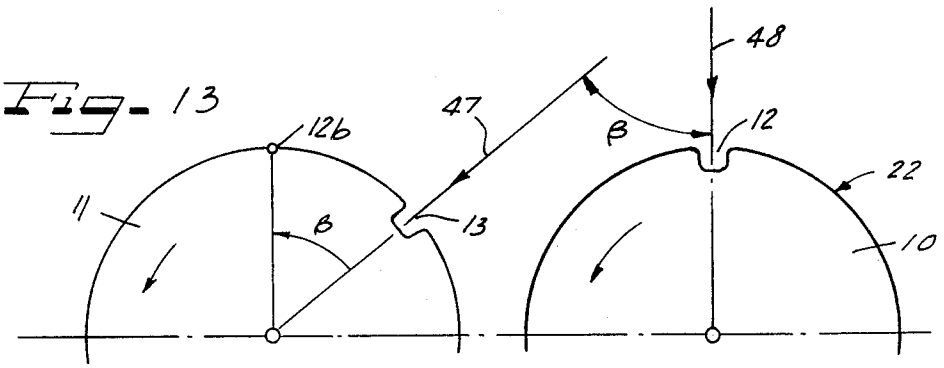


Fig. 13

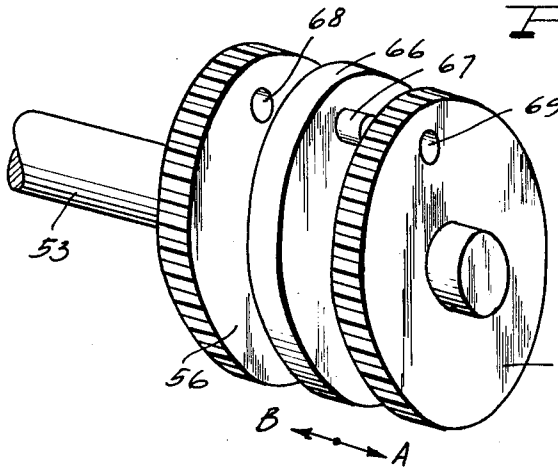


Fig. 14

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METHOD AND APPARATUS FOR OPTICALLY POSITIONING PRINTING PLATES

BACKGROUND OF THE INVENTION

This invention generally relates to printing techniques and equipment and more particularly concerns a method and apparatus for optically positioning color printing plates on printing plate support means at a point removed from the printing press whereby when the printing plates and their support means are attached to the printing press the successive impressions of the various colors or images will be synchronized.

In the printing of colors or in the superimpression of images the various colors or images are added sequentially. Accordingly, it is important that in each case the printing plate which is adding the successive color or image be synchronized with the preceding plate or plates so that the colors or images are accurately superimposed. To arrange these plates in the exact predetermined relation to one another requires that their angular as well as their transverse position on the printing plate support means be accurately determined. In the prior art this synchronizing has been performed by mechanical methods and apparatus which are complicated in their implementation and easily subject to inaccuracies. In addition, in the past the synchronizing of the printing plates has been done while they were in position in the printing press. This is not only inconvenient and presents difficult working conditions but also the printing press is out of operation during this time.

SUMMARY OF THE INVENTION

The method and apparatus according to the invention makes possible the accurate, convenient and efficient positioning of printing plates in synchronized relation and overcomes the disadvantages of the prior art.

The method of optically positioning printing plates for synchronized color printing includes a first procedure and subsequent procedures. In the first procedure a model means of a positive image of the matter to be printed is placed in position on a supporting means which will advantageously include a cylinder means. A first printing plate bearing a negative image of the matter to be printed is placed on second support means in such a position with respect to the model means that when the model means and the printing plate are viewed through a first optical means, the model means and the first printing plate will appear in superimposed relation to one another. The optical viewing means and the support means are placed in generally fixed relation to one another with the optical device movable along the length of the support means. Each of the support means has a reference line thereon and have been positioned in predetermined relation to each other to move in opposite directions therefrom through the same angular rotation. In fact the cylinder means may have identical diameters, parallel axes and be placed very close to one another under the viewing range of the optical means.

In the subsequent procedure under the method the model means is removed from its respective cylinder means and a second negative image printing plate is positioned on the cylinder means in longitudinal and angular relation thereto so that when the first and second negative image printing plates are viewed through a second optical viewing means they will appear in superimposed relation to one another. Again the two cylinder means will have been set to move in the same direction through the same angular rotation so that the position of the printing plates will be positively set with respect to the reference line on the cylinder means. This subsequent procedure may be repeated for third and subsequent negative image printing plates with the number depending upon the plates required to produce the color.

Each of the negative image printing plates will be positioned on a supporting means that can be detachably connected to the first and second cylinder means whereby when the supporting means are detached they may be quickly and conveniently repositioned on a printing press roller in synchronized relation to each other for color printing.

This advantageous method may be carried out on an apparatus which includes a pair of cylinder means mounted on a frame means at predetermined relation to each other and to an optical viewing means. The optical viewing means is set to allow superimposition between a positive and a negative image as would be required in the first procedure under the method and to allow the superimposition of a negative image with a negative image as would be required under the second procedure of the method. Also, the apparatus includes a coupling means whereby the cylinder means may be coupled together to rotate through the same angular degree in opposite directions as required in the first procedure and in the same direction as is required in the second procedure under the method.

The optical means may have a common body portion slidably supported above the cylinder means to move parallel to the axes of the cylinder means. Angularly related mirrors set in predetermined relationship to each other allow the superimposition of the images. The images as superimposed will have the same scale and the length of each sight will be the same. The optical means may be arranged so that the sight for the first procedure is taken in opposite direction from the sight for the second procedure.

The cylinder means embody suitable means for detachably connecting the printing plates and/or the supporting means thereto.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects, features and advantages of the invention will be readily apparent from the following description of certain preferred embodiments thereof, taken in conjunction with the accompanying drawings, although variations and modifications may be effected without departing from the spirit and scope of the novel concepts of the disclosure and in which:

FIG. 1 represents a group of two letters in positive image to be printed;

FIG. 2 is a schematic representation of the synchronized superimpression of different colors from different, spaced printing rolls;

FIG. 3 is a schematic representation of the first procedure of the method with a positive image on one cylinder support means and a negative image on a second cylinder support means;

FIG. 4 is a schematic illustration of the subsequent procedure of the method wherein printing plates bearing negative images are aligned;

FIG. 5 is an elevational view of a portion of the apparatus adapted to carry out the method of the invention;

FIG. 6 is a complete side view of the apparatus of FIG. 5 taken from the side not shown in FIG. 5;

FIGS. 7 and 8 are perspective views of a box containing the optical device;

FIG. 9 is a cross sectional view of the optical device schematically showing the trajectory of the rays and the arrangement of the mirrors as they would appear during the first procedure of the method;

FIG. 10 is a similar cross section of the optical viewing means which schematically shows the trajectory of the rays and the disposition of the mirrors as they would appear at the time of the second procedure according to the method;

FIG. 11 is a perspective view of a drive coupling mechanism aligning the coordinated rotation of the two cylinder means;

FIG. 12 illustrates a means of aligning the cylinder means with respect to the optical viewer and to each other so they may rotate together in opposite directions for the first procedure;

FIG. 13 illustrates a method of alignment of the cylinders with respect to each other and to the optical viewing means for the second procedure of the method; and

FIG. 14 illustrates a simplified coupling means to move the cylinders in fixed relation to each other during the first and second procedures of the method.

DESCRIPTION OF A PREFERRED EMBODIMENT

To print an image **9**, such as shown in FIG. **1** as including letters F R, in various colors by a process as illustrated, for example, in FIG. **2**, the image must be placed on printing rolls such as illustrated at **2** and **4** in FIG. **2** in a synchronized relation to each other so that as a web **1** moves between the pairs of printing and back-up rollers in a direction indicated by the arrow **8**, the printing plates **6** and **7** will be exactly superimposed with the image **9** on the web **1**. The rolls **2** and **4** carry the plates **6** and **7** for successive impressions by different colors and are known as the printing rollers. The cylinders **3** and **5** support the web or sheet material **1** against the printing rollers at a tangential point and are referred to as backing or support rollers. To print the image **9** on the material **1** it is evident that the printing plate **6** must be positioned on the roller **2** in both angular and longitudinal relation to the position of the printing plate **7** on the roller **4**.

Each of the printing rollers **2** and **4** ordinarily will have detachably mounted thereon a printing plate support means **27, 28** respectively. The support means **27, 28** are fixed in position on the rollers **2** and **4** in a predetermined relation to reference lines **29, 30**. In actuality these reference lines **29, 30** may be suitable means for detachably connecting the supporting means **27, 28** to the rollers **2, 4**, respectively.

To overcome the awkward and complicated printing plate positioning methods of the prior art which were require to be performed directly on the rolls **2** and **4** by suitable mechanical means, I have invented a method of positioning the printing plates at a point removed from the printing rolls **2, 4** and with a simple, accurate method employing optics.

FIG. **3** is a schematic illustration of a first procedure according to my method wherein a model **16** having a positive image of the matter to be printed is positioned on a cylinder means **10** and a printing plate **21** bearing a negative image of the matter to be printed is placed on an adjacent cylinder means **11** in fixed relation to the model **16**. In the second or subsequent procedure according to my method the printing plate **21** serves as a guide for the positioning of such additional printing plates **23** as may be required to reproduce the desired number of colors or image superimpositions.

The cylinder means **10** and **11** as shown in FIGS. **3** and **4** have identical diameters, which diameters may be identical to that of the printing rolls **2** and **4**. The cylinders **10** and **11** have parallel axes **10***a* and **11***a* and are conveniently arranged in immediate proximity to one another.

As shown, each of the cylinder means **10** and **11** has a groove **12, 13** respectively, extending along a generatrix and constituting the reference line from which a thin supporting means **14, 15** respectively may be wound on the cylinder. As shown in FIG. **3** the support **14** extends in an opposite angular direction from the reference line **12** then the support means **15** extends from the reference line **13**.

A model printing plate **16** is placed on the support means **14** in a predetermined angular and longitudinal position. The model plate **16** bears a positive image that is readily legible. With the model plate **16** in position, a point **17** is sighted on the plate **16** preferably near the center of the plate by an optical means to be hereinafter described. The optical means will allow the simultaneous viewing of the cylindrical means **10** and **11** as symbolized by the arrows **18** and **19**. The first sight **18** passes through the point **17** and continues on radially through the axis **10***a* of the cylinder means **10** and the second line of sight **19** similarly passes through a corresponding point **20** of a plate **21** positioned at a supporting means **15** on the cylinder means **11**. The line of sight **19** also passes through the axis **11***a* of the cylinder means **11**. The first printing plate **21** bearing a negative image of the image to be reproduced must be placed so that when seen through the optical device with its image reversed, it will superimpose itself exactly on the model plate **16**. This positioning is facilitated by the innerconnection of the cylinder means **10** and **11** as will be hereinafter explained to turn through equal angles from the reference line toward each other. This completes the first procedure whereby the first printing plate **21** is positioned on the cylinder means **11** in correspondence with the model plate **16** on the cylinder means **10**. It should be noted that the model of the printing plates could be put in plate without the support **14**.

With the first procedure accomplished, the model plate **16** and its support **14** are removed from the cylinder means **10** and replaced with a new support means **22** as shown in FIG. **4**. This begins the second procedure whereby a second printing plate **23** bearing a negative of the image to be reproduced is placed on the cylinder means **10** and aligned with the first printing plate **21** so that in operation their images will be synchronized to superimpose upon each other. With the second printing plate **23** in position, two new sights **24** and **25** are taken through the optical means hereinafter to be described with the line of sight **25** again passing through the point **20** of the printing plate **21** and on radially through the axis **11***a* of the cylinder means **11**.

For this operation the cylinder means **11** will be turned so that the angles between the point of contact **26** and the reference line **12** will correspond to the angle between the point **20** and the reference line **13** will be equal. With the cylinder means **10** and **11** in this position the printing plate **23** will be adjusted on the cylinder means **10** to the position where, when viewed through the optical means, its image will be superimposed upon the image of the printing plate **21**. It will now be understood that the printing plate **21** on the support means **15** will be identically positioned with respect to the reference line **13** as the printing plate **23** on the support means **22** is positioned with respect to the reference means **12** so that when the support means **15** and **22** are transferred to the printing rollers the images will be perfectly synchronized.

The second procedure may be duplicated for any number of printing plates **23** required for each set up. In each case the printing plate will be perfectly synchronized with the first printing plate **21**. The advantage obtained by this method is that after having positioned the plate of the first color according to a positive imaged model, the plate of each of the additional colors is positioned in accordance with this first plate on a single comparison basis. Moreover, this comparison is made direct and through a simple optical viewer.

The apparatus for carrying out the above described method is shown beginning with FIG. **5** as including a frame **31** supporting the first and second cylinder means **10, 11** respectively, in parallel, juxtaposed relation. As shown, the frame **31** supports transverse members **35** and **36** on which an optical viewing device generally indicated at **32** is slidably mounted for transverse movement along the length of the cylinder means **10, 11**.

The optical means **32** includes a box **32***a* which has two viewing openings or finders **33** and **34** therein which permit sightings to be taken as will hereinafter be described with regard to FIGS. **9** and **10**. The sighting means includes two sets of mirrors **42, 43, 44** and **45, 46**. Each set of mirrors permits the taking of two sights in two directions as shown in FIGS. **9** and **10**, for example, through the axes of the cylinder means. In the case of the sighting taken through a first opening **33** in the first procedure whereby the positive image on the model plate **16** is to be superimposed with the negative image on the printing plate **21**, the mirrors reverse the image so that they may be superimposed upon each other on the same scale. The sights are located generally in a plane perpendicular to the axes of the cylinder means with the first viewing means reversing one of the images and the second viewing means furnishing two images in the same orientation. The model plate **16** and the subsequent plates **21, 23** will be of the same size and scale. The lengths of the two trajectories of each sight means **33, 34** are equal when measured from the viewpoint **33, 34** corresponding to the surface of the cylinder means. This will be understood by those skilled in the art even though the drawings, and especially FIGS. **9** and **10** may not represent these exact distances.

In addition, the apparatus includes a mechanism, generally indicated at **38** in FIG. **11** and hereinafter described in greater detail with reference to FIG. **11**, set in a casing **38***a* and functions to permit the coupling of the cylinder means **10** and **11** so that they have the same speed of rotation, either in the opposite direction, or in the same direction while at the same time allowing a modification of the relative angular positions.

In addition to the coupling mechanism **38** and the components thereof, the casing **38***a* may advantageously contain a reversable electric motor, not shown, which serves to drive the cylinder means as well as to slow down the rotation and to lock the cylinders in any desired position. The motor may be controlled by pneumatic valve pedals **39** located on each side of the base of the apparatus frame. A pneumatic tube **40** may control one of the rotational directions and another tube **41** may control the reverse rotational direction. This apparatus is compact, simple and readily located at a point remote from the printing apparatus itself. It will of course be understood that the apparatus may be placed wherever conditions permit.

In FIG. **7** the box **32** of the optical means is shown in a perspective view taken from the side having the view opening **33** used for the first procedure. FIG. **8** on the other hand shows the same box as seen from the side having the view means **34** used at the time of the second and subsequent procedures. The transverse sliding rod supports **35** and **36**, are not shown, however, the holes through which they pass may be seen.

The schematic representation in FIG. **9** illustrates the construction of the optical device **32** in longitudinal cross section through the opposite viewer openings **33**, **34**, and shows the lines of sight from the view finder opening **33** during the first procedure in which the model plate **16** is used as a guide to position the first printing plate **21**. The cylindrical means **10** and **11** are positioned below the optical means **32** with the cylinder means **10** carrying the support means **14** and the cylinder means **11** carrying the support means **15**. As previously mentioned the model plate **16** may not require a support means. Also, the support means are suitably secured to the cylinder means in predetermined relation to the grooves or reference lines **12** and **13**. It will be understood that the cylinder means **10** and **11** have been previously aligned through the use of their reference lines **12** and **13** as will be explained hereinafter with regard to FIG. **12**.

The set of mirrors **42**, **43**, **44**, are arranged in the box **32***a* of the optical means for use in the first procedure wherein the image of the first printing plate **21** will be reversed by the mirror **42** and reflected off model **83** requires **127** conditions surface of the semi-transparent mirror **44** to appear in superimposed relationship to the eye at the view finder opening **33** with the positive image model plate **16**. The mirrors **42** and **43** which provide total reflection, and the semi-transparent mirror **44**, are arranged in the viewing means box **32***a* so as to superimpose at the point of the view finder opening **33** the luminous rays **18** and **19** passing through the axes **10***a* and **11***a* of the cylinder means **10** and **11** respectively. Thus, the point **17** of the model plate **16**, placed on the support **14** of the cylinder means **10**, will be superimposed at the point **20** of the first printing plate **21** which has been placed on the cylinder means **11**.

Accordingly, the images of the model plate **16** of the first printing plate **21** can be superimposed providing that the points **17** and **20** are corresponding points and providing that one of the images is reversed in relation to the other. This inversion of the image of the model is effected through the total reflection mirror **43**.

The exact relative positioning by superimposition of the model plate **16** and the first printing plate **21** to obtain the correct superimpression of the image on the material **1** can exist when an arc θ determined between the point of sights **17** of the model plate **16** and the reference line **12** is identical to an arc ϕ determined between the point of sight **20** of the plate **21** and the reference line **13**. In addition the proper positioning requires that the two images **16** and **21** be of the same size and that the trajectories of the rays **18** and **19** between the view finder opening **33** and the points of sight **17** and **20** are of an equal length. With these conditions met, the plate **21** will be placed in its correct position by moving it on its support **15** while viewing its exact superposition with the image of the model plate **16** through the view opening **33**. In this manner the first procedure superimposes the first printing plate **21** angularly and longitudinally of the model plate **16**.

The procedure for positioning the second and subsequent printing plates as represented by the printing plate **51** is shown in FIG. **10** which is a cross section of the box **32** similar to that of FIG. **9**. A different set of mirrors **45**, **46** are used for this optical sighting with the mirror **45** giving a total reflection while the mirror **46** is semi-transparent. Thus, with the eye positioned at the view opening **34** a direct line of sight **47** may be had through the semi-transparent mirror **46** through the point **20** on the plate **21** and through the central axis **11***a* of the cylinder means **11**. A second line of sight **48** passes through the center **10***a* of the cylinder means **10** up through the point of sight **50** on the plate **51**, is reflected by the mirror **45** and appears on the semi-transparent mirror **46** superimposed on the printing plate **21**. In this way the plate **51** may be adjusted to provide exact correspondence with the printing plate **21**. More specifically the point **20** of the plate **21** is superimposed with the point **50** of the plate **51**. The reversal of one of the images of the printing plates in relation to the other does not occur since one image reaches the view opening **34** directly and the other reaches it after double reflection.

In this second procedure of the method of the invention, the exact positioning of the plates requires that the arcs determined between the points of sight **20** and **50** and the respective reference lines **13** and **12** be equal and in the same direction. Also, the optical means must be positioned so that the length of the two sight lines between the finder opening **34** and the points of impact **20**, **50** on the cylinder means **10**, **11** is equal. Thus, the length of the ray **47** must be equal to the length of the ray **48**. Again as drawn these may not be exactly equal, however, this will be understood by one skilled in the art.

The second plate **51** will thus be put in place correctly by moving it by hand on its support until the desired superimposition of the images is viewed through the view opening **34**. The second plate **51** will thus be positioned angularly and longitudinally in relation to the first plate **21**. This second procedure may also be applied to each of the following plates so that the positions of the images thereon will be synchronized in the printing press.

The construction and operation of the mechanism contained in the casing **38** as seen in a side view of FIG. **6** and in perspective in FIG. **11** includes an axle **52** supporting the cylinder means **10** and an axle **53** supporting the cylinder means **11**. Two similar gear wheels **54** and **55** are permanently connected in spaced relation to an extension of the axle **52**. The axle **53** carries two identical gear wheels **56** and **57** thereon positioned and spaced generally in the same relation as the gears **54** and **55**. The gears **56** and **57** normally turn free on this axle, however, they can be alternately connected to the axle **53** through a pair of coupling devices **58** and **59** respectively. This connection is controlled by a sleeve **60**. With the sleeve **60** in an idle position the two gears **56** and **57** turn free on the axle **53** and do not drive it. When the sleeve **60**, however, is moved in the direction of the arrow A the gear **57** is coupled with a plate **59** that is permanently affixed to the axle **53** to thereby drive the axle. On the other hand when the direction selector means **60** is moved in the direction of the arrow B it causes the gear **56** to engage the coupling device **58** and thereby drive the axle **53**.

The gears **54** and **56** each mesh with a gear wheel **61** that is positioned between them so that the gears **54** and **56** will always have the same rotational direction. This is particularly advantageous in the second procedure.

For the first procedure where the cylinder means **10** and **11** must always turn in an opposite direction, a pair of intermediate gears **62** and **63** are positioned between and in en-

gagement with the gears 55 and 57. From this it will be seen that as the direction selector means 60 alternately engages the gears 56 and 57 with their respective coupling device the cylinder means 10 and 11 may be made to rotate in predetermined relation to each other but in the same or opposite directions.

The gear means as shown in FIG. 11 may be driven manually, however, in view of the generally high weight of the cylinder means 10 and 11 it is advantageous to employ a reversable motor, not shown, acting through a high reduction gear on one of the gears 54 or 55 or, on any one of the intermediate gears 61, 62 or 63 which are all interconnected to rotate with the cylinder means 10. The control of this motor, not shown, will be understood by those skilled in the art from the description of the control means 39, 40 and 41 in FIG. 6.

From the foregoing description of FIG. 11 it will be seen that the cylinder means 10 and 11 will turn together through equal angles in the same or an opposite direction according to whether they are coupled to the coupling means 58 or 59. In each case the rotation will begin from a predetermined respective angular position.

The theory behind the use of the method according to the invention requires that a sight is taken on an easy to locate point on the printing plate or model and that these points of sight or reference are at equal but opposite angular distances from their respective reference lines or grooves 12 and 13. The mechanism according to the invention requires no other previous predetermined measurement but the one adjustment whereby the reference lines are aligned through the optical viewer 32 so that the sight lines will be exactly referenced thereto. It should be noted that while the specification has referred to the grooves or reference lines 12 and 13, it will be understood that in actuality these may be means for detachably connecting the supporting means such as 14, 15 or 22 to the respective cylinder means. This type of device may include a tightening bar cooperating with a groove on the cylinder means and have a hooking means for the supporting means that is placed on the cylinder means. In addition the placement of the support means on the cylinder means 10, 11 as well as on the printing rolls may be facilitated by engraving the cylinder means and printing rolls according to a precise squaring thereby permitting the edges of the support means to be easily aligned therewith.

As shown in FIG. 11 the grooves 12 and 13 occupy positions corresponding to the areas of intersection of the sight lines 47 and 48 which, as shown in FIG. 10, represent the second or subsequent procedure for the synchronization of the two printing plates. Starting from the position as shown, for example, in FIGS. 11 and 13 and rotating the cylinder means 10 and 11 through equal angles, until the reference point such as 20, for example, has been located will position the cylinder means 10 for positioning of the second or subsequent printing plate 51. The movement of the cylinder means 10 and 11 through the equal angles in the second procedure is effected by moving the selecting means 60 in the direction A and thereby coupling the coupling disc 59 to the gear 57. In order not to have to look for and re-establish these relative positions of the two cylinder means for each time the operation is performed, it has been found convenient to engrave an indicator 64 on the coupling disc 59 and the gear 57, as shown, in FIG. 11.

With the sleeve coupling selector means 60 in an idle position, it will be necessary to turn one of the cylinder means by hand or by motor so as to align the two indicators 64. At this point the sleeve 60 will be coupled in the direction A and, from thereon, any rotation of any cylinder means in any direction will have the effect of rotating the other cylinder means in the same direction through the gear train as explained with regard to FIG. 11.

A pair of indicators 65 on the coupling disc 58 and on the gear 56 will also permit, with the sleeve selector 60 occupying the idle point, bringing the cylinder means 10 and 11 into the relative angular position corresponding to the sights of the first procedure as explained with respect to FIG. 9. With these indicators aligned and the selector 60 moved in the direction B to couple the members 56 and 58, the cylinder means 10 will turn at equal angles, but in an opposite direction from one another as required by the first procedure of the method. In place of the indicating means 64 and 65 it will be understood that other equivalent means could be used. Thus, where the coupling mechanisms present a small angular clearance of their respective elements, a greater accuracy may be obtained by using an indicating means comprising an axial hole and a cone shaped rod so that when the two are brought together the gear and coupling means will be properly indexed and move together.

A simple method of changing from the coupling of the cylinder means 10 and 11 as required for the first procedure wherein they rotate in opposite directions to the coupling for the second procedure wherein they rotate in the same direction and vice versa is shown in FIGS. 12 to 14. Thus, in FIG. 12 there is shown the cylinder means 10 and 11 with their reference line grooves 12 and 13 in the lines of sight 18 and 19. FIG. 13 on the other hand illustrates the second procedure with the cylinder means 10 and 11 having their reference line grooves 12 and 13 in the lines of sight rays 47 and 48.

With the cylinder means in the position of FIG. 12, a ray or line of sight is traced on the projection of the cylinder means 11 parallel to the ray or line of sight passing through the reference line groove 12 of the cylinder means 10 to obtain the point 12*a* on the surface of the cylinder means 11. Similarly, in FIG. 13 a corresponding point 12*b* is located on the cylinder means 11. The arc 13–12*a* corresponds to the angle α equal to the angle between the lines of sight or rays 18 and 19. See also FIG. 9. In FIG. 13 the arc 13 to 12*b* corresponds to an angle β equal to the angle formed between the rays or lines of sight 47 and 48 shown in FIGS. 10 and 13.

Starting from the positions indicated in FIGS. 12 and 13 and turning the cylinder means in their respective directions through any angle, it is clear that the angle α will increase in view of the fact that in FIG. 12 the two cylinders turn in a direction opposite to one another. By contrast in FIG. 13 the angle β will remain constant due to the rotation in the same direction of the cylinders, it being understood that in both cases the cylinders turn at the same speed. During this turning a time will come when, as shown, in FIG. 12 the groove or reference line 12 will be at the point 12*c* as shown in dotted lines and the groove reference line 13 will be in the corresponding position 13*c*, also indicated in dotted lines, so that the direction of the ray or line of sight 18 passing through the point 12*c* on the cylinder means 10 will correspond and be seen through the sight line 19 to be superimposed on a point 12*d* on the surface of the cylinder means 11 so that the included angle between 13 *c* and 12*d* will correspond and be equal to the angle β defined by the arc 13–12*b* as shown in FIG. 13.

With these angles thus determined initially, it is evident that by coupling the cylinder means 10 and 11 to move together in the same or opposite direction, they may be easily made to pass through the sighting positions as shown in FIGS. 12 and 13. In fact this coupling from one manner of rotation to the other can, as shown in FIG. 14, be effected between the gears 56 or 57 and the axle 53 of the cylinder means 11 without need of adjustment when passing from one procedure to the other through the simple axial displacement in either direction A or B of a coupling component such as the disc 66. As shown here the disc 66 is provided with oppositely directed dog-clutch elements 67 which are arranged to coincide, when the alignment conditions of FIGS. 12 and 13 have been reached, with axial holes 68 and 69 on the two gears 56 and 57 respectively. By making the dog-clutch elements slightly conical, couplings of great accuracy and no clearance will be consistently obtained. Thus, instead of having two pairs of indicators such as 64 and 65 as shown in FIG. 11 which require two distinct positionings, a indicator means such as illustrated in FIG. 14 will suffice to fix the positions of the gears to allow them to pass directly from one driving method to the other.

From the above description of the invention it will be seen that I have provided a method and apparatus for optically positioning printing plates that is accurate, convenient and efficient and overcomes the disadvantages of the prior art.

Although minor modifications might be suggested by those versed in the art, it should be understood that I wish to embody within the scope of the patent warranted hereon all such modifications as reasonably and properly come within the scope of my contribution to the art.

I claim:

1. A method of optically positioning printing plates, for synchronized printing including a first procedure of optically positioning a first printing plate means in predetermined relation to a model means and a subsequent procedure of optically positioning any subsequent printing plate means in predetermined relation to the first printing plate means so that said printing plate means may be separately arranged to print images in superimposition, and wherein said first procedure includes placing said model means on a first cylinder means in predetermined longitudinal and angular relationship with respect to a predetermined reference line of the cylinder means, positioning a supporting means on a second cylinder means in relation to a predetermined reference line on the second cylinder means, said first and second cylinder means having identical diameters, parallel axes and being juxtaposed, attaching a first printing plate means on the supporting means, viewing said model means and said first plate means through a first optical device having a predetermined setting, adjusting the position of said first printing plate means so that the image of the model means and the first plate means will be superimposed, removing the model means from the first cylinder means; and wherein said subsequent procedure includes attaching a supporting means to said first cylinder means and applying thereto a second printing plate means, viewing said first and second plate means through a second optical device having a predetermined setting, and aligning said printing plate means so that images of the first and second plate means will be superimposed on each other.

2. A method of optically positioning printing plates according to claim 1 wherein third and subsequent printing plate means are positioned by a subsequent procedure including the steps set forth with respect to the second printing plate means.

3. An apparatus for optically positioning printing plates for synchronized printing comprising first and second plate support means mounted in predetermined relation to each other, an optical viewing means fixed in predetermined relation to said plate support means whereby plates on the surface of said support means may be aligned and wherein said optical viewing means has first and second sighting means therein and first and second sets of mirrors therein wherein said first set of mirrors are so positioned that a positive image on said first support means and a negative image on said second support means will appear superimposed when viewed through said first sighting means and sighted through said first set of mirrors; and wherein said second set of mirrors are so positioned that a negative image on each of said first and second support means will appear in superimposed relationship when viewed through said second sighting means along a line of sight through said second set of mirrors.

4. An apparatus for optically positioning printing plates according to claim 3 wherein said first and second plate means are mounted on respective first and second cylinder means, said cylinder means being connectible to each other by a first gear train and a second gear train, said coupling means being operable to alternately engage either or none of said gear trains whereby when said first gear train is engaged said cylinders move in opposite directions and when said second gear train is engaged said cylinders move in the same direction.

5. An apparatus for optically positioning printing plates according to claim 4 wherein said coupling means has an indicator means thereon to provide consistent and accurate coupling between the coupling means and the gear trains.

6. An apparatus for optically positioning printing plates according to claim 5 wherein said indicating means include a conical projection on said coupling means and an axially aligned hole on said gear train means.

7. An apparatus for optically positioning printing plates according to claim 3 wherein said first and second plate means are mounted on respective first and second cylinder means, said cylinder means each having a reference line thereon, said reference lines being disposed in predetermined relation to each other, each of said cylinder means having a connector means thereon at said reference line, a printing plate support means being detachably connected to said cylinder means by said connector means.

8. An apparatus for optically positioning printing plates according to claim 3 wherein said support means are connectible to each other by a coupling means whereby they rotate in predetermined relation to each other.

9. A method of optically positioning printing plate means on first and second support means each having a parallel, axially extending reference line on the surfaces thereof comprising the steps of positioning said reference lines in predetermined relation to each other, rotating each of said support means in an opposite direction through an equal angle, placing a positive image of the matter to be printed in a predetermined position on said first support means in relation to its respective reference line, placing a first plate means having a negative image of the matter to be printed on said second support means, sighting said positive and negative images through a first optical viewing means which viewing means will reverse one of said images with respect to the other, adjusting the position of said first plate means so that said images will appear in superimposed relation to each other when viewed through said first viewing means, removing said positive image from said first support means and replacing it with a second plate means having a negative image of the matter to be printed, sighting said negative images on said first and second plate means through a second optical viewing means which viewing means will not reverse one of said images with respect to the other, and adjusting the second plate means so that the images will appear in superimposed relation to each other.

10. A method of optically positioning printing plates according to claim 9 including the steps of removing said second plate means from said first support means and replacing said second plate means with a third plate means having a negative image of the matter to be printed, and repeating the steps taken with respect to said second plate means whereby said first plate means serves to successively position all printed plates necessary to print the same image.

11. A method of optically positioning printing plates according to claim 9 wherein said support means each include a cylindrical roller having a sheet member mounted thereon, said roller having a groove in its cylindrical surface, said groove being fixed relative to said reference line, and including the steps of mounting a portion of said sheet member in said groove, said plate means being placed on said sheet member whereby said position of said plate means is adjusted by movement of said sheet member, said adjustment being effected by movement of said sheet means in said groove.

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