Dec. 22, 1959 K. F. TRIPP 2,917,994

APPARATUS FOR PRINTING ON CURVED SURFACES

Filed April 8, 1958 2 Sheets-Sheet 1

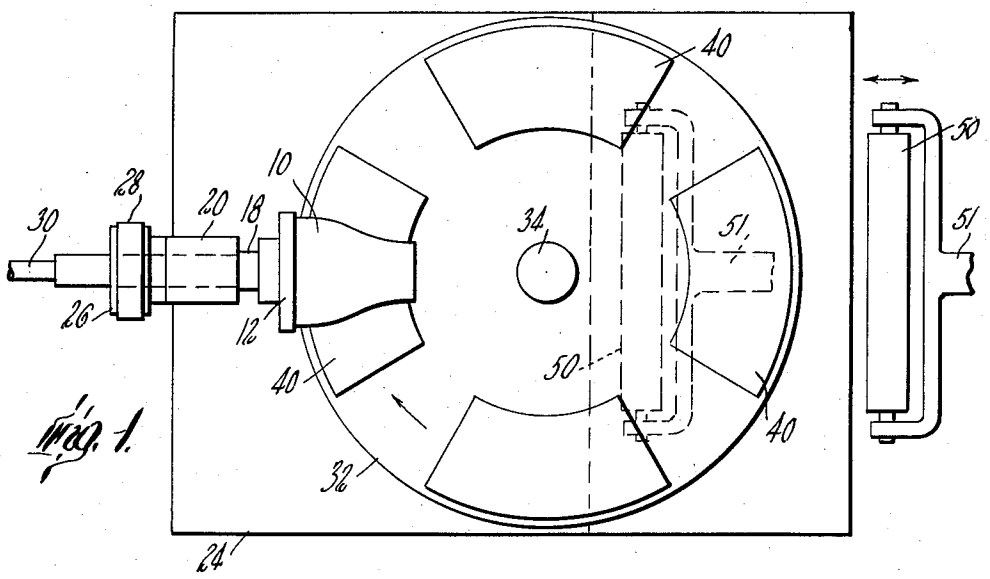


Fig. 1.

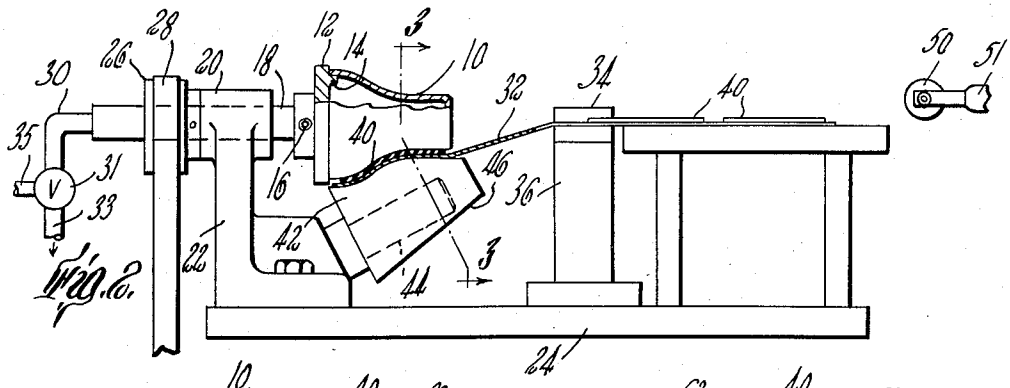


Fig. 2.

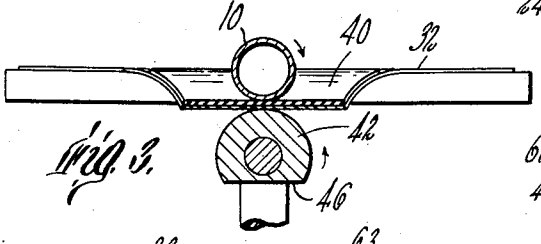


Fig. 3.

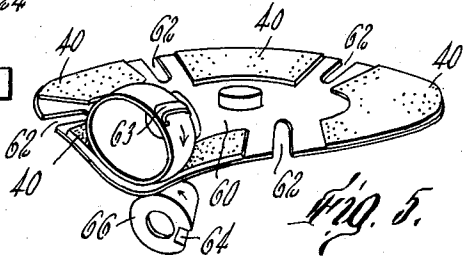


Fig. 5.

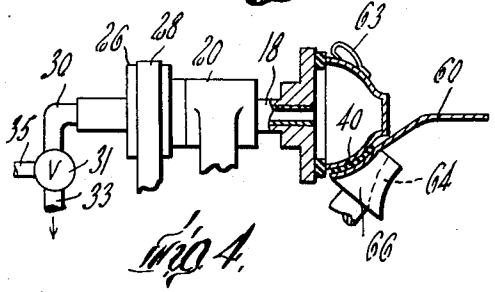


Fig. 4.

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APPARATUS FOR PRINTING ON CURVED SURFACES

Filed April 8, 1958 2 Sheets-Sheet 2

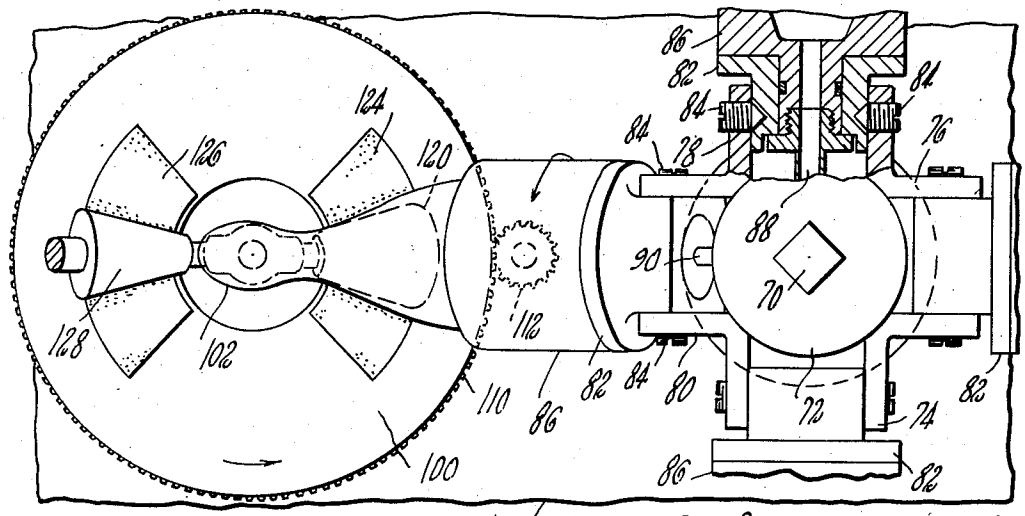


Fig. 6.

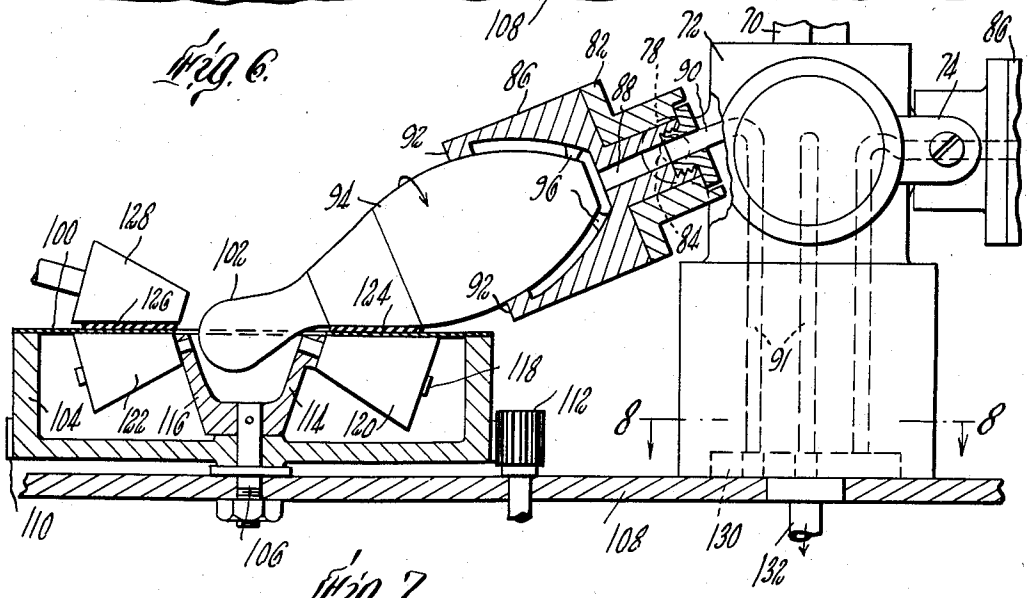


Fig. 7.

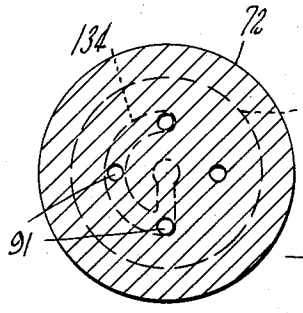


Fig. 8.

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APPARATUS FOR PRINTING ON CURVED SURFACES

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Application April 8, 1958, Serial No. 727,077

4 Claims. (Cl. 101—36)

This invention relates to printing on curved surfaces and pertains more specifically to printing on articles having a generally conical surface; that is, articles having a surface of generally circular cross-sectional configuration with one end smaller than the other.

Although printing methods and apparatus used for marking or decorating a variety of articles have been developed, conventional printing methods and apparatus have not been suitable for marking or decorating articles of circular cross-sectional configuration which vary in diameter from one end to the other, particularly when the variation is not uniform so that the article has compound curved surfaces, common examples of which are coffee cups, flower vases, drinking goblets and the like. Such articles present difficulties in printing because when rotated about their own axes the peripheral surface speed varies from one end to the other, indeed, varies irregularly when the article has compound curved surfaces, so that slippage occurs between the printing member and the article as the printing member is pressed against the surface of the article, resulting in smearing of the impression. Attempts to overcome this difficulty have in the past usually resulted in magnification of the slippage effect. Moreover, if the printing member is specially shaped in an effort to avoid slippage, it then becomes impossible to ink the printing member uniformly with a conventional inking roll. The problem is particularly difficult in the case of articles the surface of which is a compound curve; that is, articles the surface of which is curved longitudinally.

One object of the present invention is to provide means for printing on an article having a surface or portion thereof of generally conical configuration with a minimum of slippage.

Another object is to provide a printing device of the type described in which a resilient, flexible, normally flat sheet printing element is employed which is inked in flat condition and is then deformed temporarily to a configuration in which it mates with the curved surface of the article.

Still another object is to provide a printing device for printing on generally conical articles in which the article is mounted for rotation about its own longitudinal axis adjacent a normally flat, resiliently flexible sheet printing element mounted for rotation relative to the article in a generally circular path, the center of said path coinciding with the apex of the article.

A still further object is to provide a printing apparatus of the type described in which the holder for the article and the printing element are arranged so that the article if extended to its theoretical apex would intersect the center of rotation of the printing member.

A further object is to provide a printing device of the type described in which the contact at any instant between the resilient flexible normally flat sheet printing element and the surface of the article to be printed is limited to substantially line contact; that is, is limited to a very narrow longitudinal zone extending axially of the article.

Other and further objects will be apparent from the drawing and from the description which follows.

The present invention is applicable both to articles which are true cones, i.e., extend to a point, to articles which are truncated cones, and to articles which have only a portion of their surfaces of conical configuration; and the term "generally conical" will be used to embrace all of these. When the "apex" of the article is mentioned, it will be understood that this includes the point formed by extending the sides of truncated cones or conical surfaces to the theoretical intersection. In the case of articles having compound curved surfaces, the theoretical apex of the article can only be approximated; and since some slippage must necessarily occur between some part of the article and the printing member in this case, the theoretical apex is usually chosen with a view to minimizing whatever slippage is necessarily present.

In the drawings:

Fig. 1 is a plan view showing one embodiment of the present invention;

Fig. 2 is a view in side elevation, partly broken away and in section, of the embodiment shown in Fig. 1;

Fig. 3 is a view in section taken along line 3—3 of Fig. 2;

Fig. 4 is a view in side elevation, partly broken away and in section, showing a second embodiment of the invention;

Fig. 5 is an isometric view, partly broken away, showing the embodiment of Fig. 4;

Fig. 6 is a plan view, partly broken away and in section, of still another embodiment of the invention;

Fig. 7 is a view in side elevation, partly broken away and in section, showing the embodiment of Fig. 6; and

Fig. 8 is a view in section taken along line 8—8 of Fig. 7.

In the embodiment shown in Figs. 1 to 3 inclusive, the article to be printed is a drinking glass **10** of generally conical configuration having its open end larger than its closed end and having its wall curved longitudinally so that its surface is a compound curve. The article **10** is mounted with its larger open end against a resilient rubber-like mounting disk **12** provided with a projecting circular rib **14** which serves to position the article against the disk. Disk **12** is in turn secured by means of a collar and set screw **16** to hollow shaft **18** journaled in bearing **20** which is supported by means of bracket **22** bolted to base plate **24**. Sheave **26** is likewise secured to shaft **18**, sheave **26** being driven from any suitable source of power (not shown) by means of belt **28**.

Mounted concentrically within hollow shaft **18** is a tube **30** which extends from an aperture in the face of mounting disk **12** and has its other end connected through a three-way valve **31** to a pipe **33** leading to a suction or vacuum pump (not shown) and to a vent **35** opening to the atmosphere. The suction provided through tube **30** serves to hold article **10** firmly in place on mounting disk **12**, the article being mounted for rotation about its longitudinal axis (which coincides with that of shaft **18**) when shaft **18** is driven by belt **28** and sheave **26**.

Arranged adjacent to article **10** is a generally circular printing member including a supporting member **32** of thin, resiliently flexible material such as springy sheet metal secured at its center, in the embodiment shown, to fixture **34** which is mounted for rotation on the upper end of pedestal **36**, which in turn is fixed to base plate **24**. Member **32** is arranged so that the center of fixture **34** is located at the point defined by extending the converging walls of article **10**. Because of the longitudinal curvature of article **10**, the location of this point may be approximated by assuming that the wall of article

10 is longitudinally straight and extends through the points of maximum and minimum diameter. Accordingly, the axis of rotation of shaft 18 and article 10 intersects the axis of rotation of member 32 at the center of member 32.

Mounted on the upper face of supporting member 32 at spaced intervals along its periphery are a plurality of thin, resiliently flexible sheet printing elements 40, 40 of rubber-like material, these printing elements being normally flat and arranged to pass adjacent article 10 as member 32 is rotated about its center point. Each printing element 40 carries raised printing areas on its face in the desired design for imprinting the article 10.

Adjacent article 10 is a pressure roll 42 which is mounted for rotation on stub shaft 44, the axis of shaft 44 being convergent with the axis of article 10 and aligned with the center of member 32, as best shown in Fig. 2. Pressure roll 42 has a curved surface mating with the curved surface of article 10, but cut away or relieved at 46 throughout a portion of its periphery. The surface of the article and of the pressure roll are complementary in longitudinal outline as seen in Fig. 2. The diameter of pressure roll 42 is greater than that of article 10 so that the length of the arcuate surface of roll 42 measured from one edge of relieved portion 46 to the other is approximately equal to the entire circumference of article 10. Pressure roll 42 is preferably made of a resilient, flexible, rubber-like material or is provided with a resilient flexible mounting so as to be yieldingly urged against the surface of article 10 with sheet printing element 40 and its supporting member 32 disposed between the pressure roll 42 and article 10. Accordingly, as article 10 is rotated about its longitudinal axis by rotation of supporting disk 12, roll 42 is rotated and printing element 40 is advanced along a circular path in a clockwise direction, as seen in Fig. 1, by frictional engagement with article 10 until the relieved or cut-away portion 46 of roll 42 is reached, whereupon the pressure between roll 42 and article 10 is released. It will be understood that equivalent results may be obtained by fixing supporting member 32 at its center and mounting article 10 and pressure roll 42 for rotation together about the center of member 32, although the arrangement shown in Figs. 1 and 2 of the drawing is preferred.

As soon as each article is printed and pressure roll 42 has rotated so that the cut-way portion 46 is uppermost, the suction within tube 30 is released by manipulation of three-way valve 31, whereupon article 10 may be removed from its mounting disk 12 and replaced by a new article.

Printing elements 40 and their supporting member 32, being of resiliently flexible sheet material, are readily deformed as they pass between pressure roll 42 and article 10 so that the printing element comes into uniform contact with the surface of article 10 which is to be printed. Since support member 32 is inextensible when made of sheet metal, curvature of the support in the direction of the longitudinal axis of the article, as shown in Fig. 2, precludes curvature of the support in a direction at right angles to the longitudinal axis, thus preventing "wrap around" of the printing element and ensuring that the printing element contacts the article only along a very narrow longitudinal zone (substantially line contact) at any given time. The elastic compressible nature of the rubber-like printing element mounted on the inextensible sheet metal support member enables the device to accommodate itself to any minor surface irregularities in the article and ensures a satisfactory print. As soon as the printing element 40 and member 32 pass beyond article 10, they are free from restraint and resume their normally flat condition.

A conventional inking roller 50 is mounted on a reciprocating arm 51 arranged to move the inking roller across the face of each printing member 40 as it advances in its normally flat condition. Consequently, it is possible to use a conventional cylindrical inking roller to apply a uniform ink coating to each printing member.

It will be understood that while four separate printing elements have been shown in the embodiment described above, it is possible to employ any suitable number of printing elements so arranged in circular array.

In the embodiment shown in Figs. 4 and 5, element 60 which supports printing elements 40, 40 is cut away at slots 62, 62, thus making it possible to print upon an article such as a teacup having a portion such as a handle 63 projecting laterally beyond the generally circular periphery of the article, the projecting portion being accommodated within the slot 62. A corresponding slot 64 is provided in the wall of pressure roll 66. This arrangement makes it possible to apply a printed design to the wall of such a cup up to a point closely adjacent to the handle. As soon as the handle enters slots 62, 64 the drive for shaft 18 is stopped, the suction within tube 30 is released, and the cup is removed and replaced with another.

It will be apparent that printing elements 40, 40 may carry raised printing characters or may bear a design in intaglio to be applied to the article. Indeed, these printing elements may have a smooth flat surface serving merely for transferring an ink design made with a silk screen or made from a conventional printing roll (bearing either raised or intaglio characters).

In the embodiment shown in Figs. 6, 7 and 8 of the drawing, a turret-type machine is provided in which a central drive shaft 70 is rotatably mounted, being driven in a clockwise direction from any suitable source of power (not shown). The shaft carries a turret head 72 on which are mounted four pairs of laterally outwardly extending brackets 74, 76, 78 and 80. Each pair of brackets holds a carrier 82 pivotally mounted by means of trunnions 84, 84 for swinging movement about a horizontal axis. Journaled on each carrier 82 is a cup-shaped suction holder 86 of resilient rubbery material having a suction opening 88 in its bottom communicating through flexible conduits 90, 90 with ports 91, 91 in the interior of turret head 72. Suction holders 86 are of suitable shape to engage the article to be printed, as best appears in Fig. 6, and are provided with annular rib 92 which seats against the periphery of the article, such as a bowling pin 94, which is to be printed. A plurality of spaced supporting projections 96, 96 are provided near the bottom of each suction holder 86 in order to keep the bowling pin 94 spaced from the suction passageway 88.

Mounted in the nine o'clock position with respect to turret head 72 as seen in Fig. 6 is an annular supporting member 100 of thin, resiliently flexible material such as spring sheet metal provided with an aperture at its center to accommodate the top 102 of bowling pin 94 and secured around its margin to a cylindrical drive member 104. Drive member 104 is mounted for rotation on shaft 106 secured to main frame 108 and is provided along its lower periphery with gear teeth 110 which engage with pinion 112 driven from any suitable source of power (not shown). Fixed to shaft 106 within the interior of drive member 104 are a pair of support arms 114, 116 on which are mounted respectively a stub shaft 118 on which is journaled a resilient rubbery pressure roll 120 and on leg 116 a supporting roll 122. As shown in Fig. 7, the axis of rotation of roll 120 and the axis of rotation of suction holder 86 in the nine o'clock position both intersect at the center of annular supporting member 100, and the latter coincides with the theoretical apex of the conical surface of pin 94 which is being printed and with the theoretical apex of roller 120. Both pressure roll 120 and supporting roll 122 are disposed immediately beneath and in contact with resilient supporting member 100, the shape of roll 120 mating with the shape of the conical portion of bowling pin 94. Secured to the upper face of resilient supporting member 100 are two arcuate, thin, resiliently

flexible sheet printing elements **124**, **126** of rubber-like material, each printing element having an arcuate length sufficiently long to accommodate all of the printing which is to be applied to the conical neck portion of the bowling pin. In a case where the printing is to appear about the full extent of the periphery of the bowling pin, the length of each printed element **124**, **126** must be at least as great as the periphery. A conical inking roll **128** is mounted for rotation above table **122** in position to ink printing elements **124** as they pass therebeneath.

Mounted within turret head **72** adjacent the bottom thereof and fixed to main frame **108** is a porting plate or valve member **130** through which ports **91**, **91** communicate with main suction pipe **132**. Accordingly, as turret head **72** is rotated in a clockwise direction, as seen in Fig. 6, the suction cups mounted on the several brackets **74**, **76**, **78**, **80** will successively be brought into communication with a source of suction as they reach the six o'clock position and will remain in communication with the source of suction until the twelve o'clock position because of the 180° arcuate extent of control slot **134** in the porting plate **130**.

In operation of the device, a bowling pin is inserted into a suction cup **86** at the six o'clock position while the cup is in a horizontal or upwardly inclined position. The turret is then driven to advance the cup and its bowling pin to the nine o'clock position where it is tilted downwardly by hand to the position shown in Fig. 7. Pinion **112** is then actuated to rotate drive member **104**, supporting element **100**, and printing element **124**. Because of the frictional contact between bowling pin **94** and the printing element **124**, the former, together with suction holder **86**, is rotated about its own longitudinal axis while receiving the imprinted design. Simultaneously the printing element **126** is being inked by rolling contact with inking roll **128**. When the printing operation has been completed, bowling pin **94** in its holder **86** is raised to horizontal position, turret head **72** is again rotated in a clockwise direction 90° and the freshly printed pin is maintained at the twelve o'clock position to dry it while a second pin is being printed. Upon further rotation to the last station in the three o'clock position, the suction is released to permit pin **94** to be removed from holder **86**.

Although specific embodiments of this invention have been described herein, it is not intended to limit the invention solely thereto, but to include all of the obvious variations and modifications within the spirit and scope of the appended claims.

What is claimed is:

1. Apparatus for printing on articles having a generally conical shape comprising a pressure roll mounted for rotation about a first axis, a holder for said article mounted for rotation about a second axis intersecting said first axis, said holder being adapted to hold said article with the axis of the article coinciding with said second axis and with the point defined by the converging sides of the article disposed at said intersection, a flexible resilient sheet printing element adapted to apply an ink design to the surface of said article arranged for movement relative to said holder and pressure roll through a generally circular path, the center of which path is disposed at said intersection, said sheet printing element being arranged to pass between said presusre roll and said article, the surface of said pressure roll mating with the surface of said article and being arranged to press said sheet printing element against said article as the sheet printing element passes therebetween, said sheet printing element being normally flat but resiliently distortable to conform to the mating outline of said article and said pressure roll.

2. Apparatus as defined in claim 1 in which means is provided for applying ink to said sheet printing element while said element is in flat condition.

3. Apparatus for printing on an elongated article having one end larger than the other so that its sides converge toward one end, said apparatus comprising a resiliently flexible sheet printing element mounted for movement in a generally circular path about a first axis, a holder for holding said article adjacent the printing side of said sheet printing element with its smaller end toward said first axis and with the point defined by said converging sides disposed at the center of said circular path, said holder being mounted for rotation of said article about a second axis which coincides with the axis of the article and which intersects said first axis at the center of said circular path, a pressure roll mounted adjacent the side of said sheet printing element opposite said article with said sheet printing element disposed between said article and said roll, said roll being mounted for rotation about a third axis intersecting the first two said axes at the center of said circular path and having a surface mating with the surface of said article whereby said sheet printing element is pressed into contact with said article, means for rotating said holder, and means for applying ink to the sheet printing element in advance of its contact with said article while it is in its normally flat condition, said sheet printing element being resiliently distortable to conform to the mating outline of said article and said pressure roll.

4. Apparatus as defined in claim 3 in which a plurality of individual resiliently flexible sheet printing elements are mounted in annular array on a resiliently flexible sheet supporting member, the center of said annular array coinciding with said intersection of the first and second axes.

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