Aug. 2, 1966 D. S. CHISHOLM 3,263,516

MECHANICAL LINKAGE FOR GENERATING A CURVED SURFACE

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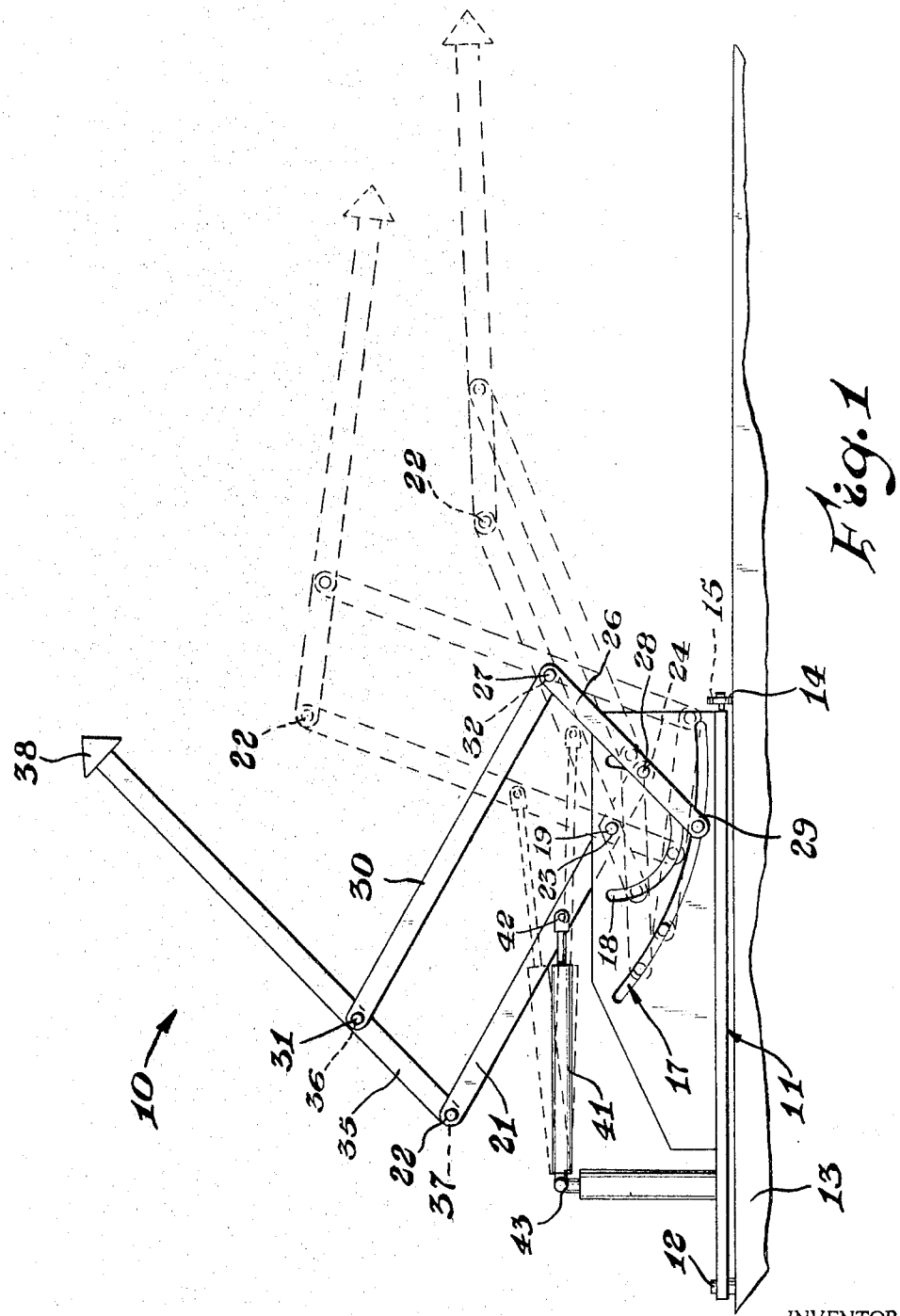



Fig. 1

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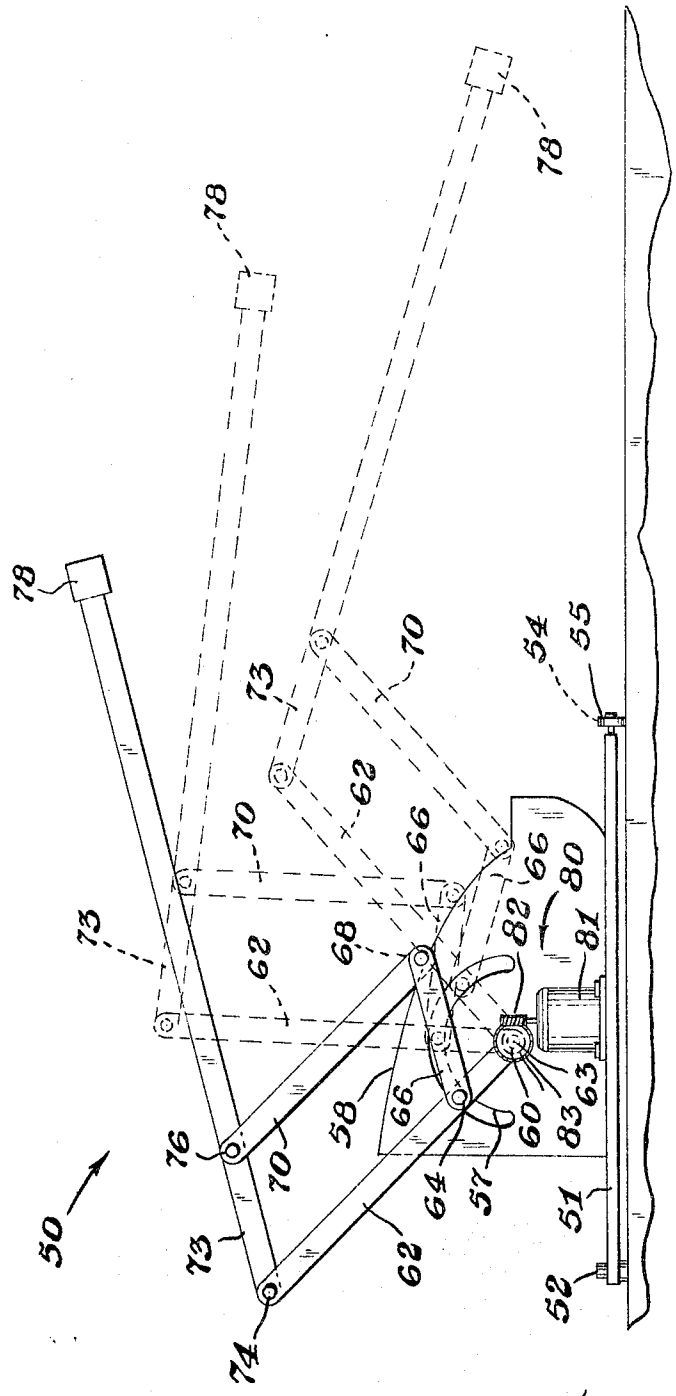



Fig. 2

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# MECHANICAL LINKAGE FOR GENERATING A CURVED SURFACE

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7 Claims. (Cl. 74—105)

This invention relates to an improved mechanical linkage. It more particularly relates to an improved mechanical linkage capable of positioning a point on a predetermined curved line or surface.

Frequently in the construction of buildings having curved surfaces it is desirable to provide a guide or a tool which is readily positionable on or adjacent to the building structure in such a manner that the required design is adhered to. In cases of circular or spherical structures this is readily accomplished, for example, by pivoting an arm on the center of the desired structure. However, oftentimes it is desirable to generate structures wherein there is no ready access to the center. For example, in a spherical or spheroidal dome often a suitable geometric center is not available or in the case of a dome having an elliptical cross sectional configuration the centers of generation may be remote and inaccessible such as being positioned well within the earth. Oftentimes it is desired to support a construction unit such as a bricklaying machine or the like at the end of a boom or arm and positioned the terminal portion of the boom in such manner that it serves as a guide and determines the final form of the structure. Such a technique is particularly advantageous when buildings are constructed from strips or portions of synthetic resinous foam which are adhered together to form the desired configuration.

It is an object of this invention to provide an improved mechanical linkage adapted to position an arm on a desired curved surface.

A further object of this invention is to provide a mechanical linkage which will generate a spherical or non-spherical surface of rotation.

A further object of this invention is to provide an apparatus for the positioning of an operating mechanism in a guided pattern capable of generating a dome-like surface.

These benefits and other advantages in accordance with the present invention are achieved by an apparatus adapted to position an arm on a curved surface of rotation, the apparatus comprising in cooperative combination a base member having a fixed pivot point, the fixed pivot point having means to secure the base rotatably to a reference surface, the base member so constructed and arranged so as to rotate about the pivot point in a plane generally normal to the axis of the pivot, the base defining a model surface, the model surface being a model of the curvature of at least a portion of the curvature of the cross sectional configuration of a radial section of the desired surface, a first arm, a second arm, a third arm and a fourth arm, the first arm being pivotally connected to the second and fourth arms, the third arm also being pivotally connected to the second and fourth arms at positions remote from the pivotal connections of the first arm to form a quadrilateral figure of a four bar linkage, the first arm pivotally connected to the base member and adapted to pivot in a plane containing the axis of the base member fixed pivot, the first and second arms being disposed generally adjacent the base member, the third and fourth arms being disposed generally remote from the base member, a model surface follower secured to the second arm and positioned to engage the model surface of the base, the pivotal connections between the four arms having generally parallel axes which



are parallel to the axis of the pivotal connection of the first arm to the base member.

Further features and advantages of the present invention will become more apparent when the following specification is taken in connection with the drawing wherein:

FIGURE 1 depicts one embodiment of the invention and in

FIGURE 2 there is illustrated an alternate embodiment of the invention.

In FIGURE 1 there is illustrated a linkage or apparatus in accordance with the invention generally designated by the reference numeral **10**. The apparatus **10** comprises a base member **11** having a pivot **12** affixed to a reference surface or plane **13**. A pair of wheels **14** and **15** are affixed to the base **11** and adapted to rotate about an axis passing through the pivot **12** and essentially radially disposed thereto. The wheels **14** and **15** engage the reference surface **13** and provide support for the base **11**. The base **11** defines a model surface **17**. The model surface **17** is a model of the curvature of a radial section of at least a portion of the radial surface to be generated. A generally circular guide groove or means **18** is also defined by the base **11**. A pivot **19** is affixed to the base **11** and centered on the circular arc of the guide **18**. A first arm **21** is pivotally affixed to the pivot **19**. The first arm **21** has a first pivot point **22**, a second pivot point **23** which is in operative engagement with the pivot point **19**, and a third pivot point **24** comprising a follower **28** which is in operative engagement with the guide **18**. A second arm **26** has a first pivot point **27**, and a second point pivotally attached to the first arm **21** at the location of the follower **28**. The second arm **26** also has affixed thereto a model surface follower **29** in operative engagement with the model surface **17**. A third arm **30** having a first pivot point **31** and a second pivot point **32** is pivotally attached to the pivot point **27** of the second arm **26** by the second pivot **32** of the arm **30**. A fourth arm or boom **45** having a first pivot point **36** and a second pivot point **37** is pivotally attached to the first pivot **22** of the arm **21** by the pivot point **37** and to the first pivot point **31** of the third arm **30** at the pivot point **36**. Remote from the pivot points **36** and **37** is disposed an operating means **38** such as a brick laying machine or similar constructional device. Thus the arms **21**, **26**, **30** and **35** effectively form a four bar linkage or trapezoid and as illustrated in FIGURE 1 a parallelogram. A positioner **41** such as a hydraulic cylinder is pivotally affixed to the first arm **21** by a piston rod end **42**. The cylinder **41** is pivotally affixed to the base **11** by the pivot means **43**. In operation of the apparatus **10** of FIGURE 1, movement of the first arm **21** causes positioning of the operating means **38** along a curve which is an enlarged reproduction of the model surface **17** engaged by the follower **29** of the second arm **26**. Rotation of the base **11** about the pivot **12** permits the operating means **38** to be positioned on a surface of rotation having a curvature of the model surface. Thus, for example, in the construction of a building the operating means **38** would be positioned initially at the periphery, building elements deposited, the base member **11** rotated about the pivot **12** and a spirally generated structure results when bricks or stripping are secured to each other.

In FIGURE 2 there is illustrated an alternate embodiment of the invention generally designated by the reference numeral **50**. The apparatus **50** comprises in cooperative combination a base member **51** having a fixed pivot **52**. Rotatably fixed to the base member **51** and remote from the pivot **52** are wheels **54** and **55** which are adapted to rotate about axes generally readily extending from the axis of the pivot **52**. The base **51** defines a generally semicircular guide surface or slot **57** lying in

a plane containing the axis of rotation of the pivot **52**. The base **11** also defines a model surface **58** which has the same general configuration as the arc desired to be traced by the apparatus **50**. A pivot **60** is affixed to the base **51** and has an axis generally perpendicularly disposedly to the axis of rotation of the pivot **52** and lies in a plane normal the axis of pivot **52**. A first arm **62** is pivotally connected to the pivot **60** at the location **63**. The first arm **60** has affixed thereto a follower **64** adapted to engage the guide surface **57**. Pivotally attached to the first arm **62** at the location of the first arm follower **64** is a second arm **66**. The second arm **66** has affixed thereto a model surface follower **68** so constructed and arranged so as to engage the model surface **58**, a third arm **70** is pivotally attached to the second arm **66** at a position generally adjacent the model follower **68**, a fourth arm **73** is pivotally attached to the first arm **62** and at the pivot **74** disposed remotely from the position **63** and to the third arm **70** by the pivot **76** remotely disposed from the model follower **68**. As in the case of the apparatus of FIGURE 1, the first, second, third and fourth arms are pivotally arranged so as to provide a four bar linkage which is essentially a parallelogram. The fourth arm **73** has affixed thereto an operating means **78** which moves in an arc which is a replica of the arc of the surface **58** in a plane containing the axis of the pivot **52**. An operating mechanism generally designated by the reference numeral **80** comprising a motor **81**, a worm **82** and a worm gear **83**, serves to position the first arm **62**, the worm **83** is rigidly affixed to the arm **62** as the motor **81** and the worm **82** are secured to the base **51** providing means for positioning the fourth arm **73** and consequently the operating device **78**.

Beneficially either of the embodiments of the apparatus in accordance with the present invention are advantageously employed for such applications as the construction of buildings having generally circular cross sections, for the rotation of radiating devices such as those emitting high energy ionizing radiation about a center remote from the apparatus. Also beneficially, such radiation devices as radar antennas are rotated without the necessity of providing large circular tracks or bearings.

As is apparent from the foregoing specification, the apparatus of the present invention is susceptible of being embodied with various alterations and modifications which may differ particularly from those that have been described in the preceding specification and description. For this reason, it is to be fully understood that all of the foregoing is intended to be merely illustrative and is not to be construed or interpreted as being restrictive or other limiting of the present invention, excepting as it is set forth and defined in the hereto appended claims.

What is claimed is:

**1.** An apparatus adapted to position an arm on a curved surface of rotation, the apparatus comprising in cooperative combination

a base member having a fixed pivot point, the fixed pivot point having means to secure the base rotatably to a reference surface, the base member constructed so as to rotate about the pivot point in a plane generally normal to the axis of the pivot, the base defining

a model surface, the model surface being a model of the curvature of at least a portion of the curvature of the cross sectional configuration of a radial section of the desired surface, the base member further defining a guide means,

a first arm, a second arm, a third arm and a fourth arm, the first arm being pivotally connected to the second and fourth arms, the third arm also being pivotally connected to the second and fourth arms at positions remote from the pivotal connections of the first arm to form a quadrilateral figure of a four bar linkage,

the first arm pivotally connected to the base member to pivot in a plane containing the axis of the base member fixed pivot, the first and second arms being disposed generally adjacent the base member, the third and fourth arms being disposed generally remote from the base member,

a guide means follower secured to the pivotal connection between the first and second arms and positioned to engage the guide means, a model surface follower secured to the second arm and positioned to engage the model surface of the base, the pivotal connections between the four arms having generally parallel axes which are parallel to the axis of the pivotal connection of the first arm to the base member.

**2.** The apparatus of claim **1**, wherein the base member is supported by wheel members rotating about axes generally radially extending from the axis of the fixed pivot.

**3.** The apparatus of claim **1** including means to position at least one of the arms relative to the base member.

**4.** The apparatus of claim **1** wherein the guide means and model surface are generally disposed adjacent the fourth arm.

**5.** The apparatus of claim **1** wherein the guide means and model surface are disposed remote from the fourth arm.

**6.** The apparatus of claim **1** wherein an operating means is attached to the fourth arm and remotely disposed from the pivots thereof.

**7.** The apparatus of claim **6** wherein the model surface is a circular arc and the operating means is a source of electromagnetic radiation.


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