(No Model.) 2 Sheets—Sheet 1.

G. BEEKMAN.

FLEXIBLE SHAFTING.

No. 497,905. Patented May 23, 1893.

Fig. 1.

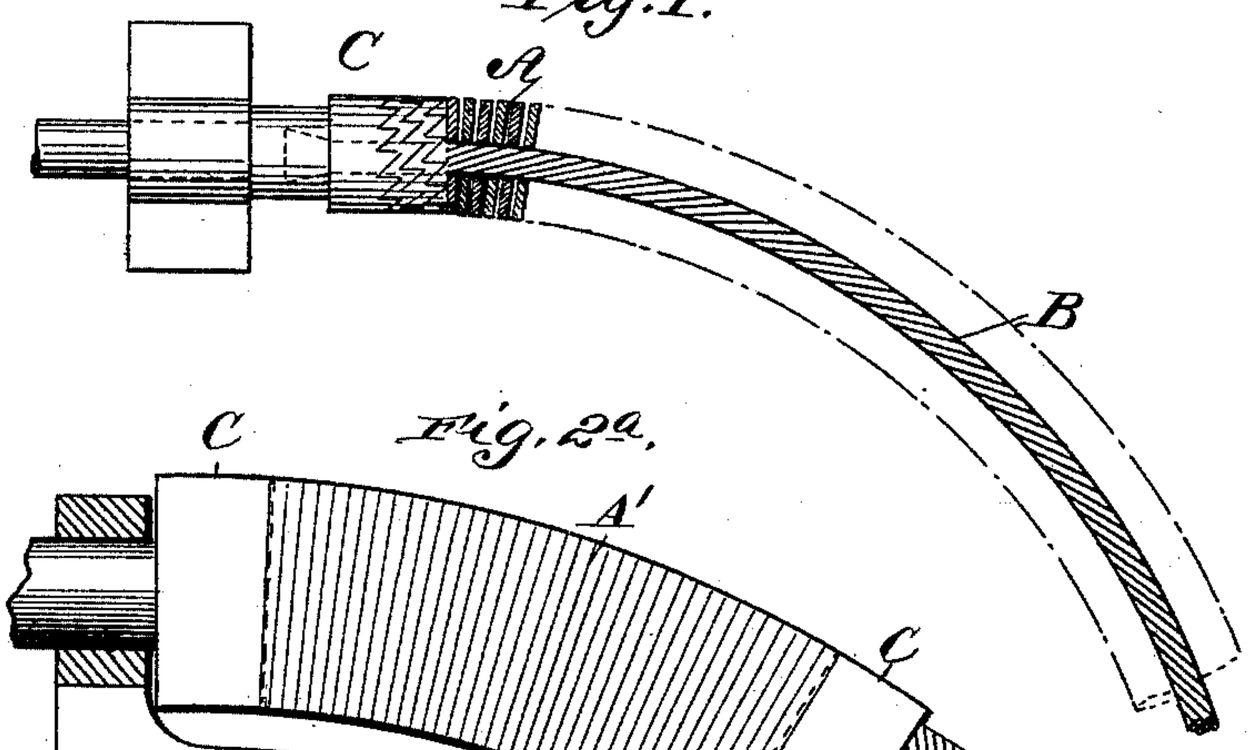


Fig. 2a.

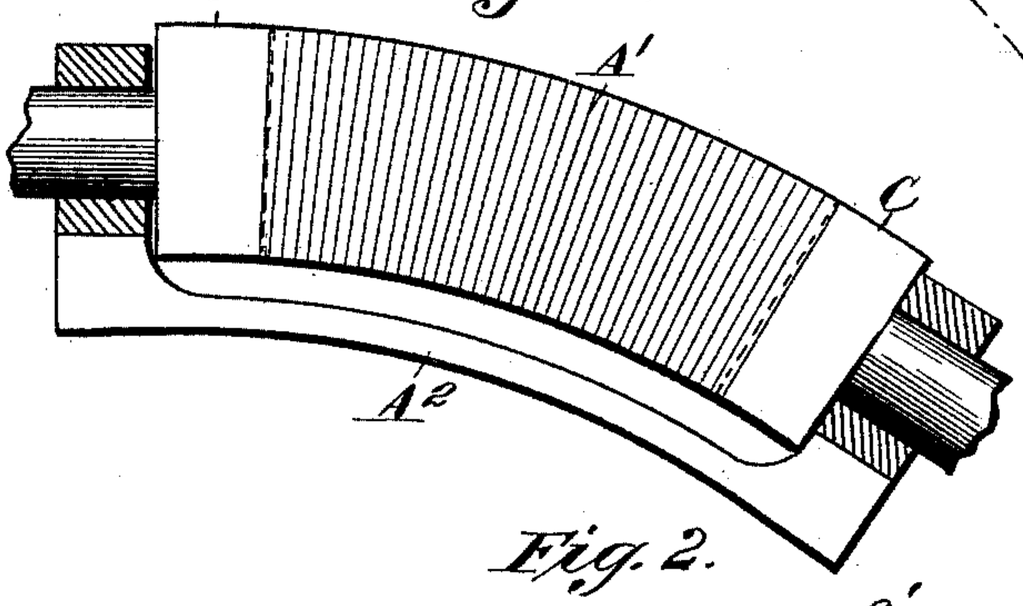


Fig. 2.

Fig. 3.

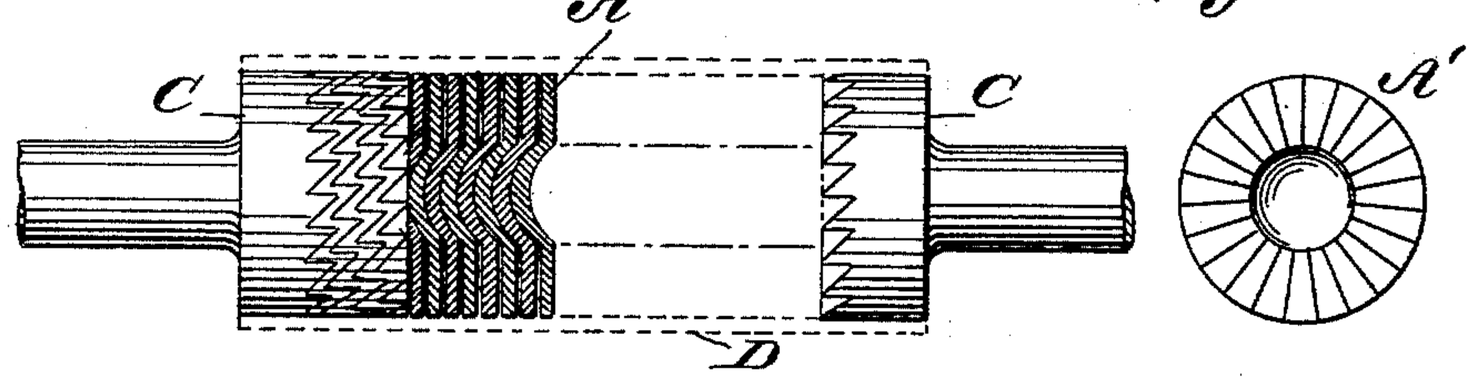


Fig. 4.

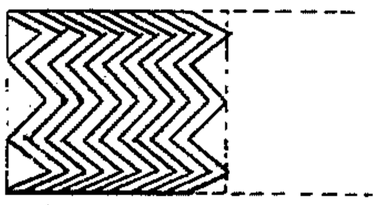


Fig. 5.

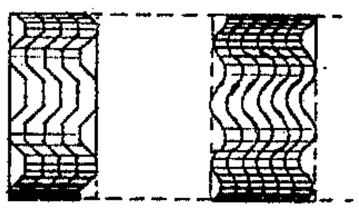
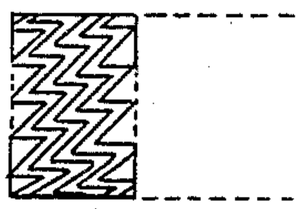


Fig. 6.



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(No Model.) 2 Sheets—Sheet 2.

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FLEXIBLE SHAFTING.

No. 497,905. Patented May 23, 1893.

Fig. 7.

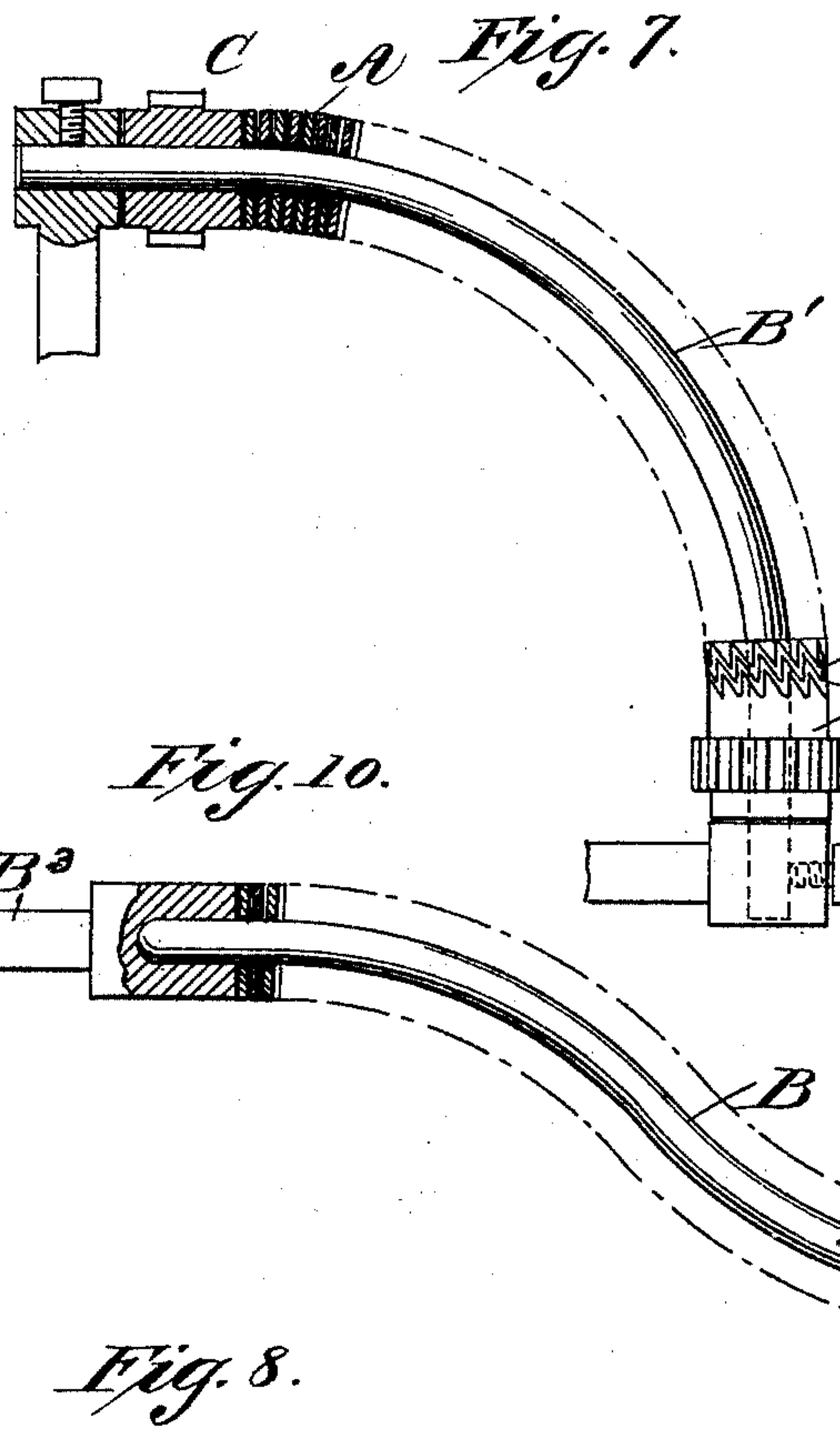


Fig. 10.

Fig. 8.

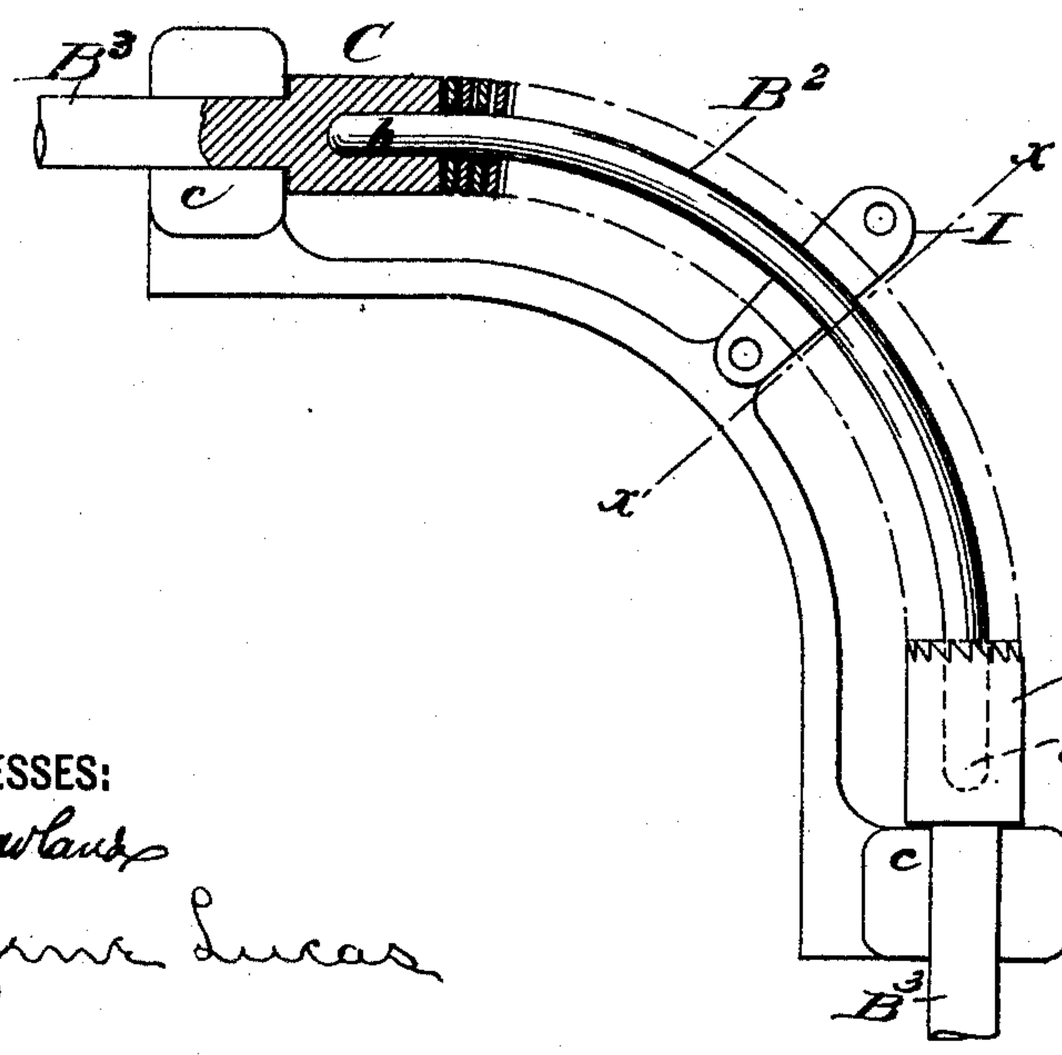
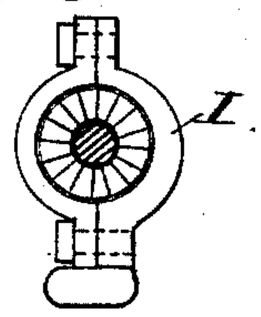


Fig. 9.



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FLEXIBLE SHAFTING.

SPECIFICATION forming part of Letters Patent No. 497,905, dated May 23, 1893.

Application filed November 21, 1892. Serial No. 452,715. (No model.)

To all whom it may concern:

Be it known that I, GERARD BEEKMAN, a citizen of the United States, residing in the city, county, and State of New York, have invented certain new and useful Improvements in Flexible Shafting, of which the following is a specification.

My invention relates to rotary shafting for transmitting motion from one rotary part to another rotary part through a curved axis of rotation; and said invention is applicable whether the curvature of the axis be fixed or changeable.

My invention consists in a flexible shafting composed of a series of interlocking sections, formed of radially corrugated plates, provided with means for holding them together, with such relation as to admit of flexure or curvature in the axis of the shaft. This construction possesses the advantage that the plates, owing to their large number, are so slightly separated by the curving of the shaft, as not to interfere with the perfect transmitting contact or engagement of their radial corrugations or teeth with one another at all positions.

My invention moreover embraces a novel specific means of holding the sections together in shafting having a fixed curvature; consisting in a rigid non-rotary core arranged as hereinafter described and claimed.

Referring to the accompanying drawings: Figure 1, represents a side elevation partly in section and partly removed, showing my improved shafting in which the sections or plates are held together upon a flexible core. Fig. 2, is a side elevation partly in section with some of the plates removed, showing a modification of my invention; the central dotted lines indicating the line of central portions of the plates. Fig. 2^a, is a side elevation of the shaft shown in Fig. 2, but showing the shaft mounted in a suitable frame; Fig. 3, an end or face view of one of the plates used in Fig. 2. Figs. 4, 5, and 6, are side views showing several of the plates assembled together, constructed in variously modified forms. Fig. 7, is an elevation partly in section and partly removed, showing an additional feature of my invention, namely: a core of fixed curvature and one suitable mode of fastening the same. Fig. 8, is a side view partly in section and partly removed, showing a modification of Fig. 7; Fig. 9, a cross-sectional view of Fig. 8, taken on the line *x—x;* Fig. 10, a side view partly in section and partly removed, showing a further adaptation of the modification in Fig. 8.

A, A′, represent rotary sections of the shaft which are composed of plates of metal or other suitable material having radial corrugations as indicated in Fig. 3. The plates A, are preferably constructed by stamping them from wrought sheet metal, and the radial corrugations formed by embossing them. The plates may, however, be cast or molded, or otherwise formed in any substantially uniform thickness desired.

The plates A, A′, are applicable to shafting capable of flexure as in Fig. 1, or having a fixed curvature as in Fig. 7. In Fig. 1, the plates perforated at the center are assembled upon a flexible core B, composed of wire, cable or other well known device, such as chain.

The plates or sections in Fig. 2, have solid centers embossed into a convex form, and being a little thicker at the center than at the peripheries, the central parts when abutting together, operate practically as ball and socket joints. The plates A′ thus assembled are held together by the longitudinal pressure of the end pieces C, C, which are designed to have a rotary connection with a suitable frame A^2, as shown in Fig. 2^a. In this figure, it will be seen that the shaft of this example has but a slight fixed curvature, and that the plates are held from lateral displacement by their intermeshing parts. The plates A′ may be further supported by means of external flexible tubing D, composed of fabric or other material.

In all the forms indicated the plates A, A′, are revolved by means of end sections, such as C, bearing radially corrugated faces corresponding to the contour of the plates.

In Fig. 7, the fixed core B′, is rigidly supported in a suitable frame as indicated, and the end sections C, receive and impart motion through suitable gearing.

In Fig. 8, the rigid core B^2 is free from attachment to any stationary part, and depends for its support upon the projection of its terminals *b*, *b*, into the rotary end pieces C, C. The core B^2 may be of simple curvature as in

Fig. 8, or compound curvature as in Fig. 10; furthermore the shafting when thus mounted upon a floating core, may be externally supported by means of a collar such as I, indicated in Figs. 8, and 9, and said collar may be extended or prolonged so as to form an enveloping tube of greater or less length.

In Figs. 8 and 10 the end pieces C are shown as having extensions B^3 to rotate in bearings *c*.

Within the novel scope of the invention illustrated in Figs. 7, to 9, inclusive, sections longer than those illustrated may be employed if desired.

The radial corrugations of the plates A, A′, may be variously modified in contour as indicated in Figs. 4, 5, and 6.

In shafting which is used principally to rotate in a given direction, I prefer to employ the ratchet character of teeth shown in the figures, as avoiding lost motion most effectively.

Having thus fully described my invention, what I claim, and desire to secure by Letters Patent, is—

1. The flexible shafting consisting in a series of radially corrugated plates interlocked as described, each plate having a substantially uniform thickness and means for holding the said plates together.

2. A device for transmitting power upon a curvilinear axis, consisting in the combination with a series of rotary sections, each interlocked with the other, of a rigidly curved supporting core upon which the said sections revolve.

3. In a device for transmitting power upon a curvilinear axis, the combination of two rotary end sections, an intermediate series of rotary sections, each interlocked with the other, and an interior supporting core of fixed curvature extending through the intermediate sections, and into the end sections.

4. In a device for transmitting power upon a curvilinear axis, the combination of two rotary end sections, an intermediate series of rotary sections, each interlocked with the other, an interior non-attached supporting core of fixed curvature, and an external guide for regulating the position of one or more of the intermediate sections and the said core contained therein.

5. In a flexible shafting, a series of plates and means for holding them together; each plate having a substantially uniform thickness said plates having radial corrugations adapted to interlock; corresponding in contour to ratchet teeth substantially as described.

GERARD BEEKMAN.

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