

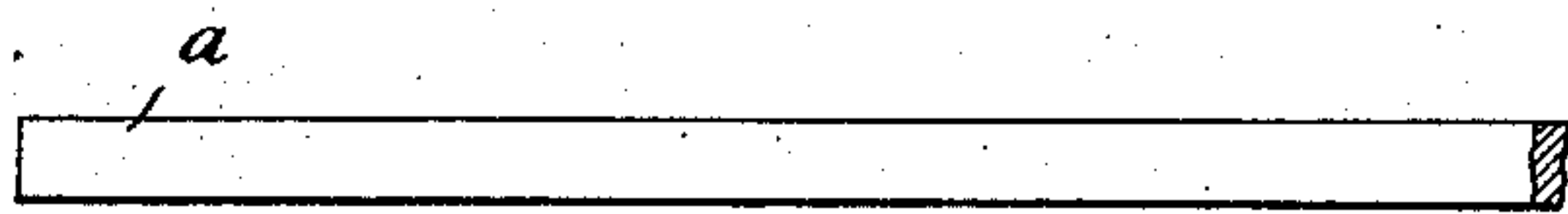
(No Model.)

T. GARE.  
FLEXIBLE SHAFT.

No. 401,881.

Patented Apr. 23, 1889.

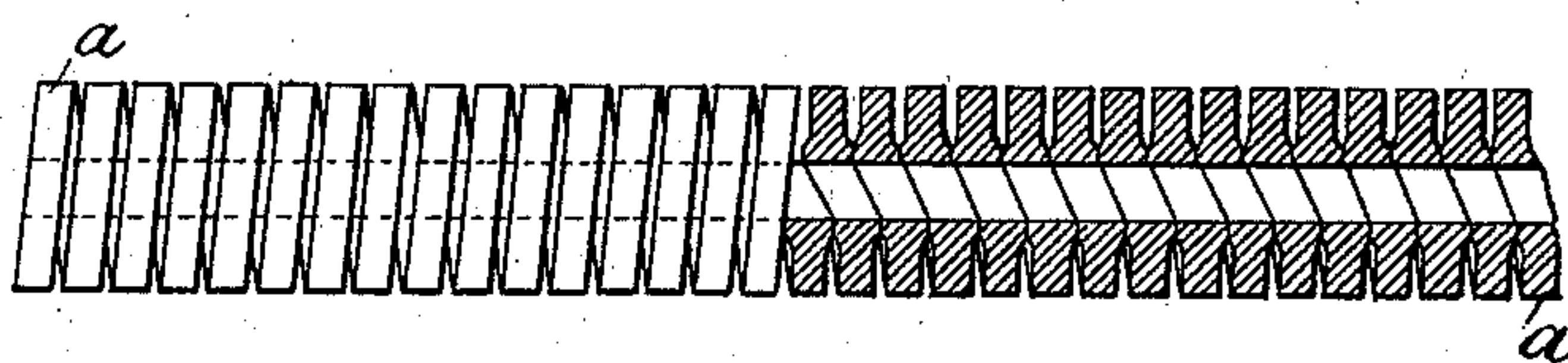
*Fig. 1.*



*Fig. 2.*



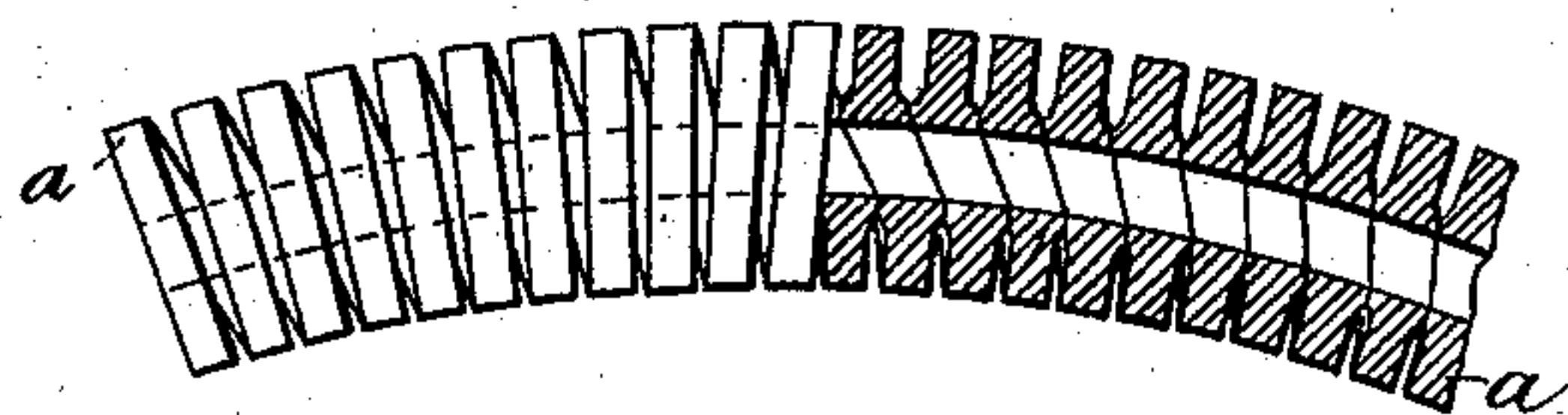
*Fig. 3.*



*Fig. 5.*



*Fig. 4.*



Witnesses.

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# UNITED STATES PATENT OFFICE.

THOMAS GARE, OF STOCKPORT, COUNTY OF CHESTER, ENGLAND.

## FLEXIBLE SHAFT.

SPECIFICATION forming part of Letters Patent No. 401,881, dated April 23, 1889.

Application filed May 1, 1888. Renewed February 25, 1889. Serial No. 301,165. (No model.) Patented in England November 3, 1887, No. 14,895.

*To all whom it may concern:*

Be it known that I, THOMAS GARE, a subject of the Queen of Great Britain, and residing at Stockport, in the county of Chester, Kingdom of Great Britain, have invented new and useful Improvements in Flexible Shafts, (for which I have obtained provisional protection, partly relating thereto, in Great Britain, No. 14,895, dated November 3, 1887,) of which the following is a specification.

My invention relates to improvements in flexible shafts employed for the transmission of rotary power, and has for its objects, first, to produce a flexible shaft in which simplicity, strength, flexibility, and durability are combined; secondly, which will be free from axial elasticity and run very steadily at a high speed and acute curvature. I attain these objects by the construction illustrated in the accompanying drawings, in which—

Figure 1 is a side elevation, and Fig. 2 a cross-section, of the bar from which the flexible shaft is formed. Figs. 3 and 4 are partly side elevations and partly longitudinal sections of the improved flexible shaft, and Fig. 5 an end view of the same.

In carrying out my invention, and referring to Figs. 1 and 2, I take a metal rod or bar, *a*, of suitable length, flat in section, (see Figs. 1 and 2,) and coil the same cylindrically on its edge or narrower side as closely and tightly as possible, so as to leave a small core and be free from any axial elasticity. (See Figs. 3 and 5.)

On coiling a rod or bar *a* of flat section on its edge or narrower side and leaving a core comparatively small to the diameter of the shaft, as described, the edges of the coil internally swell a little and join each other tightly by reason of the acuteness of the curve which the rod or bar is caused to describe, (see Figs. 3 and 5,) thus preventing any axial elasticity, while externally the edges are a little apart and provide space for compensating for the different curvatures without causing any axial elasticity, the coil remaining always tight internally, as represented by Fig. 4.

The proportions or sections of rod or bar and size of core of the shaft which in practice I have found to answer best for most driving purposes, as regards strength and flexibility, are the following: width of rod or bar, one-fourth inch; thickness of rod or bar, one-eighth inch; core of shaft, one-eighth inch; but it will be understood that such proportions may be varied according to the various requirements by respectively increasing or decreasing the flatness of the rod or bar *a*.

By the use of a rod or bar *a* of flat section and coiling the same on its edge or narrower side, in the manner described, I attain in the shaft great strength and flexibility, at the same time freeing it from any axial elasticity, which is objectionable, as it interferes with the steady running of the shaft and does not give strength enough.

The degree of flatness of the rod or bar *a* renders the shaft also more or less flexible and strong. The greater the degree of flatness is the greater will be the degree of resistance, and vice versa, while the pitch of the coil will decrease and allow the necessary curvature without being subject to axial elasticity.

The flexible shaft described may for some purposes be furnished internally the whole length or a certain portion thereof with another shaft of a like construction fitting tightly or with a solid core or with hoops externally.

I am aware that prior to my invention flexible shafts have been made of one or more coils of wire or rods of flat section wound in the same or opposite directions. I therefore do not wish to claim such construction, broadly; but

What I claim as my invention, and desire to secure by Letters Patent, is—

A flexible shaft consisting of a metal bar of flat section coiled on its edge or narrower side, the coils of which internally are close to and externally a little apart from each other, substantially as and for the purpose specified.

THOMAS GARE.

Witnesses:

FERDINAND BOSSHARDT,  
THOS. A. FOULKES.