(No Model.) 4 Sheets—Sheet 1.

J. S. CAMPBELL.

FLEXIBLE DRIVING SHAFT.

No. 459,152. Patented Sept. 8, 1891.

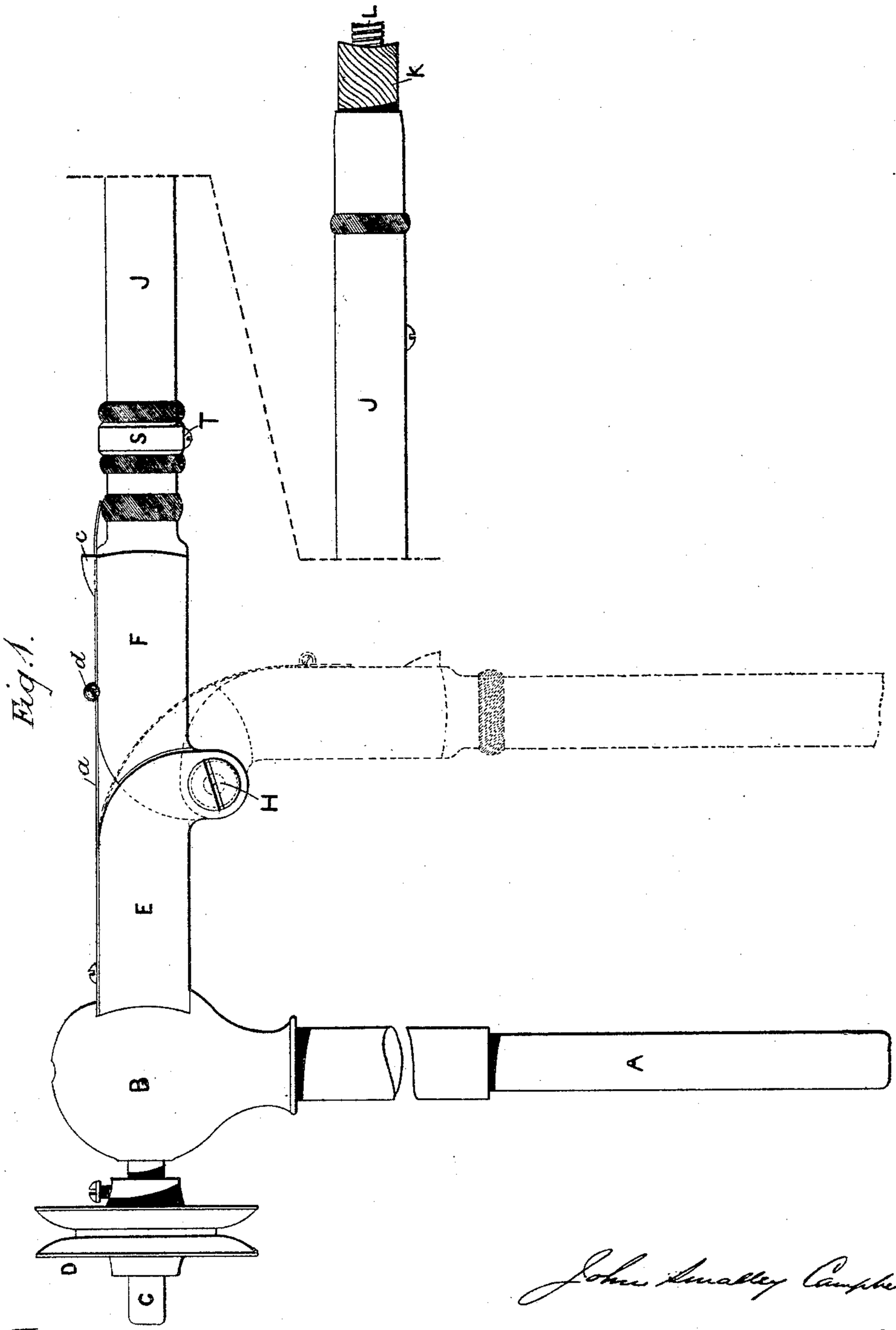

Fig. 1.

Witnesses
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Wm. Clabaugh

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(No Model.) 4 Sheets—Sheet 2.

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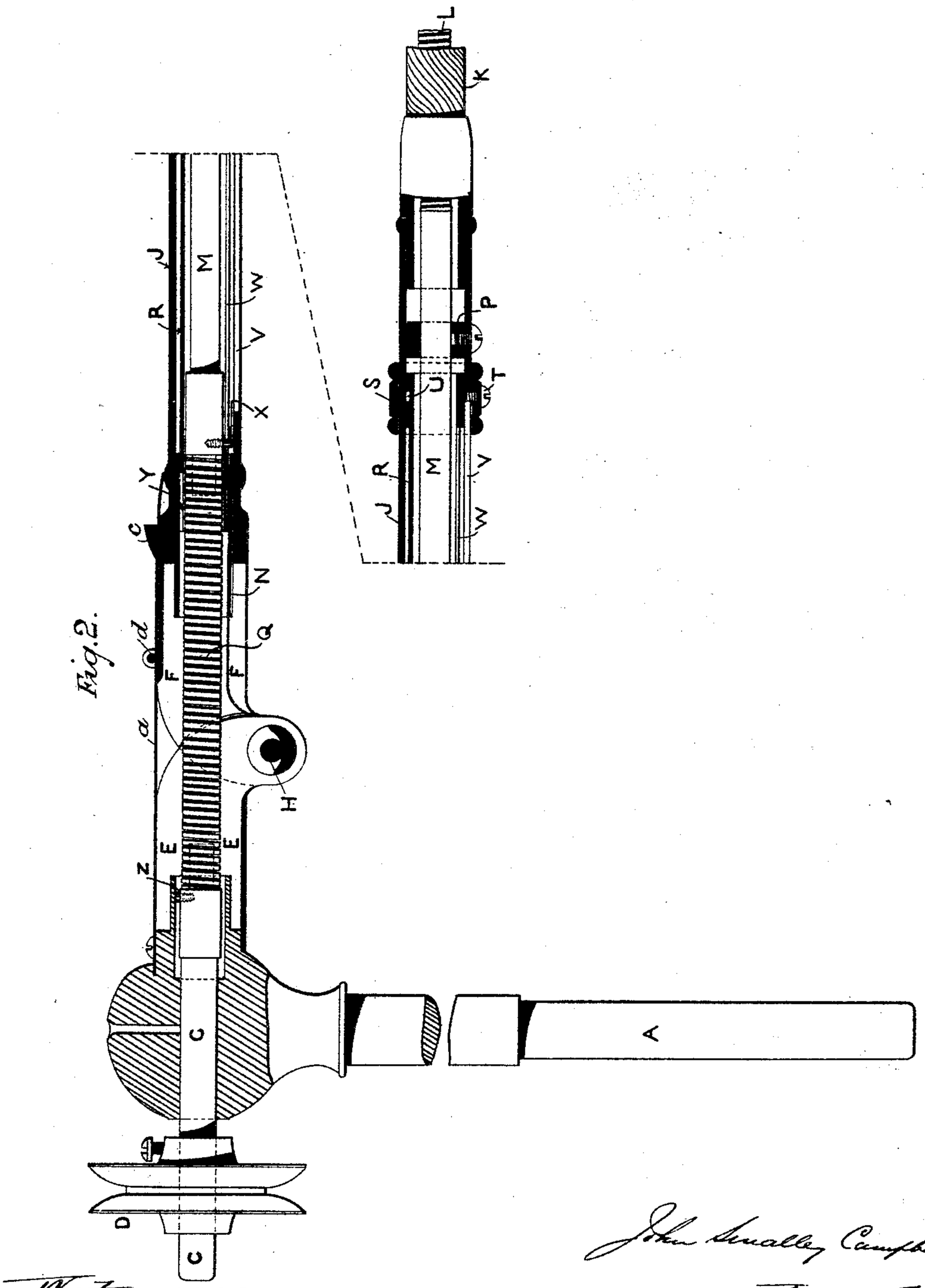

Fig. 2.

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(No Model.) 4 Sheets—Sheet 3.

J. S. CAMPBELL.

FLEXIBLE DRIVING SHAFT.

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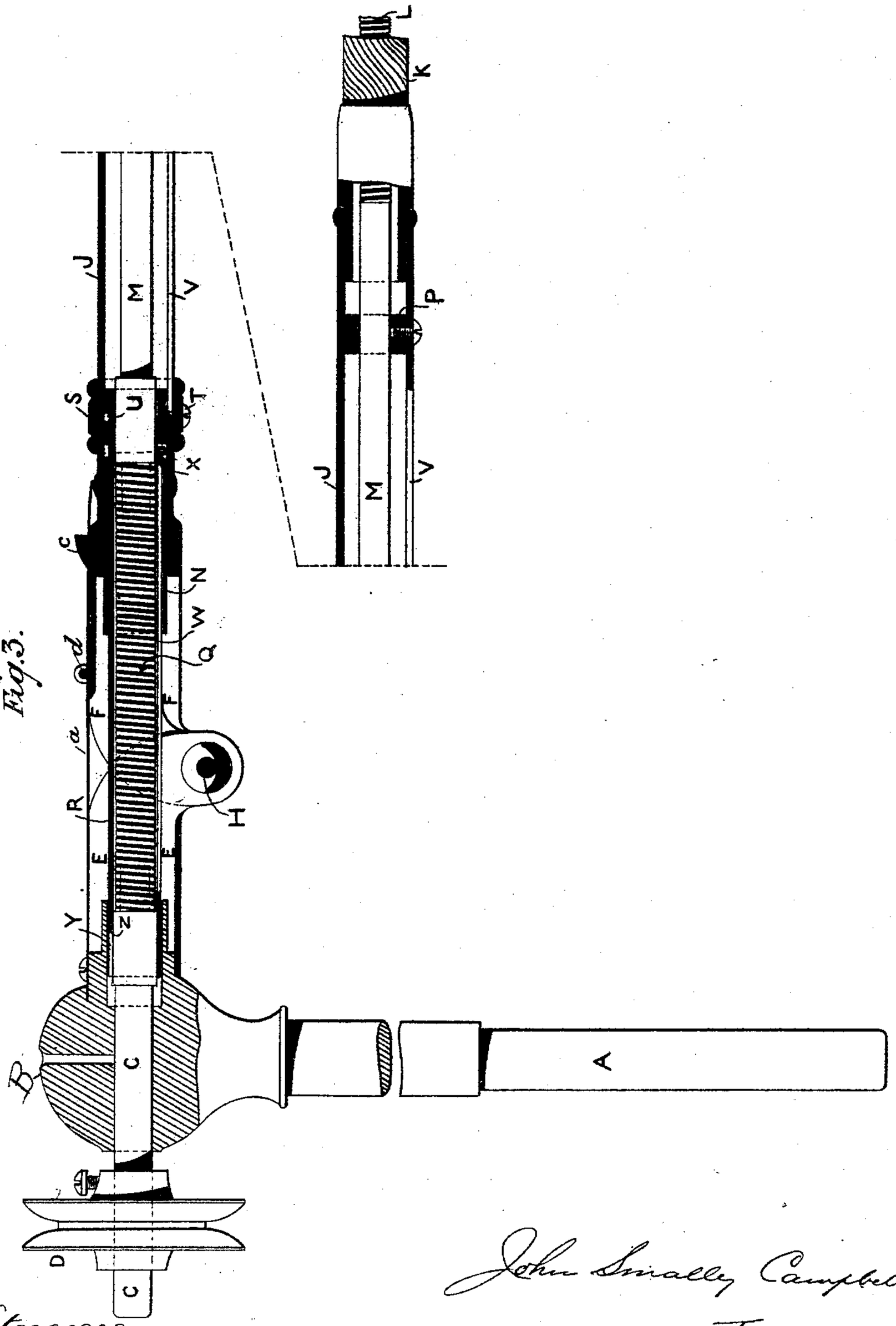

Fig. 3.

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(No Model.) 4 Sheets—Sheet 4.

J. S. CAMPBELL.

FLEXIBLE DRIVING SHAFT.

No. 459,152. Patented Sept. 8, 1891.

Fig. 4.

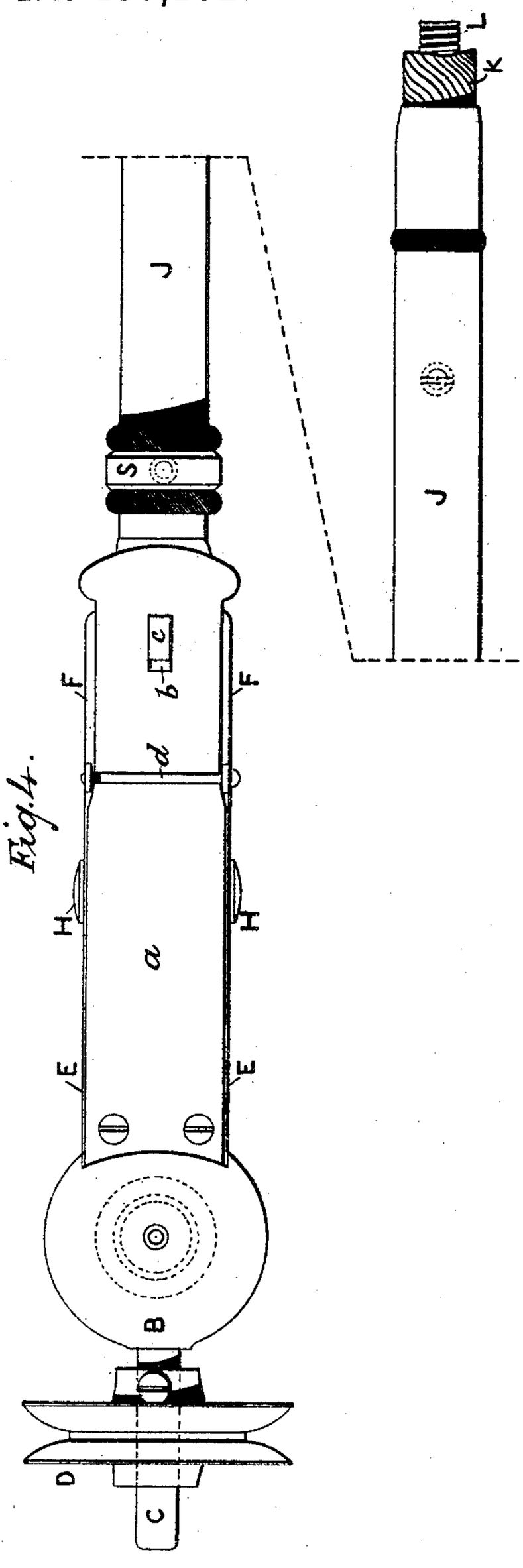
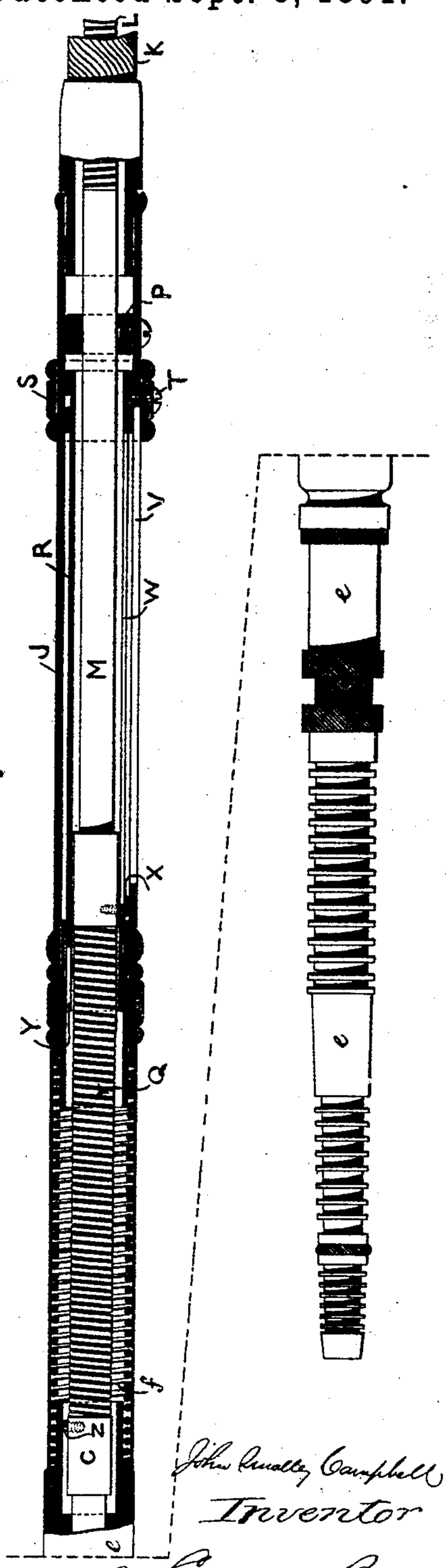


Fig. 5.



Witnesses
H. C. Ewart
Wm. Clabaugh

John Smalley Campbell
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UNITED STATES PATENT OFFICE.

JOHN SMALLEY CAMPBELL, OF LONDON, ENGLAND, ASSIGNOR TO J. OTIS COX, OF BROOKLYN, AND EDWARD A. PEIRCE AND THE CARROLL ALUMINUM MANUFACTURING COMPANY, OF NEW YORK, N. Y.

FLEXIBLE DRIVING-SHAFT.

SPECIFICATION forming part of Letters Patent No. 459,152, dated September 8, 1891.

Application filed November 5, 1889. Serial No. 329,347. (No model.) Patented in England August 1, 1889, No. 12,245.

To all whom it may concern:

Be it known that I, JOHN SMALLEY CAMPBELL, a citizen of the United States, at present residing at 10 Park Square West, Regents Park, N. W., London, in the county of Middlesex, England, have invented certain new and useful Improvements in Flexible Driving-Shafts or Cables; and I do hereby declare the following to be a full, clear, and exact description of the invention, reference being had to the accompanying drawings, which form part of this specification.

This invention also forms the subject of British Patent No. 12,245, of August 1, 1889.

My invention relates more particularly to the flexible driving-shaft or cable used in dental engines; but it is also applicable to flexible shafts or cables of larger size—such, for example, as those used in engineer's shops for drilling holes in boiler-plates or other like heavy work. The flexible shafts or cables ordinarily employed are not capable of being bent to and working at a curve of very short radius, and in dental engines it has been customary, in order to overcome the inconvenience caused thereby, to provide the cable or arm at one or both ends or in the center with a short length formed of a single coil of spring-wire, which is extremely flexible and will bend and work at a sharp curve. These coils are, however, not sufficiently strong to drive such tools as grinding-wheels and others which require extra power without jarring and unpleasant vibration; and the main object of my invention is to provide means for converting such flexible coils into rigid shafts when required, and thus overcoming the above objection. The latter means consist in mounting the driving-shaft in two bearings, one flexible and the other moving, and connecting these bearings by a movable rigid connection, which, when the two bearings are locked thereby, will render that part of the spindle practically a continuous rigid one, as hereinafter described.

The accompanying four sheets of drawings represent the form in which I apply my invention to a dental engine. The engine itself, which may be of any of the usual forms, is not shown.

Figures 1, 2, 3, and 4 represent my arrangement as applied to the engine end of the driving-cable, Fig. 1 being a side elevation, Figs. 2 and 3 sectional side elevations showing the parts in different positions, and Fig. 4 a plan. Fig. 5 is a sectional view showing the arrangement applied to the handle or tool end of the cable.

Similar letters of reference denote similar parts throughout the drawings.

Referring to Figs. 1, 2, 3, and 4, A is a shank fitting into the top of the pillar-post of the engine and having a spherical or other suitably-shaped head B, which constitutes a fixed bearing, in which is journaled a short spindle C, carrying a pulley D, driven from the main wheel of the engine in the usual manner.

E E is a hollow box or bracket affixed to or formed in one piece with the head B, and F F is a similar hollow box jointed to E E by the pin H. A tube J is affixed to F F, carrying at its outer end the sheath K of the ordinary flexible shaft or cable L. A spindle M is journaled in movable bearings N and P within the tube J and has the cable L affixed to one end. The spindles C and M are connected by the flexible coiled spring Q, which transmits the motion of the spindle C to the spindle M and cable L, and at the same time permits the box bracket-joint E E F F to be turned down into the position shown by dotted lines in Fig. 1, so that the arm and cable can hang down against the pillar-post of the engine.

R is a tube which encircles the spindle M, and can be slid forward over the spring Q when the said spring and bracket-joint are extended out in the horizontal position. A ring S is provided to slide on the tube J, and the inner end of the set-screw T in the said ring enters the annular groove U in the end of the tube R, so that the said tube can be slid back and forth by means of the ring S, while at the same time it is free to rotate. A slot V is formed in the tube J, through which the screw T passes to allow the ring S to slide. A slot W is formed in the tube R for the greater part of its length, and a pin X in the spindle M engages with the said slot. On the opposite side a short slot Y is formed in the

end of the tube, and when the tube is slid forward to cover the spring-coil Q this slot engages with a pin Z on the spindle C, and the said spindle is then connected by means of the pins and slots with the cable-spindle M, so that the two spindles become practically one continuous rigid spindle running in bearings B, N, and P, and the spring Q, although it revolves with the spindles, no longer transmits any power, all the strain of driving being taken by the tube R. The slot W and pin X not only compel the tube R and spindle M to rotate together, but also insure the pin Z always entering the slot Y when the tube R is slid forward.

a is a flat spring firmly secured to the half E E of the box bracket-joint. A slot *b* is formed in the outer end, which passes over a projecting lug *c* on F F, and makes the joint a rigid bracket when in the horizontal position. A small bolt *d* passes over the said spring and forces it always to engage with the lug *c*, and also holds it against the bracket-joint, so as to form a curve when the arm is turned down, and thus by its resistance to prevent the arm from falling suddenly against the pillar-post of the engine when the spring is released from the lug *c*.

In Fig. 2 the tube R is shown drawn back within the tube J, so that the motion of spindle C is transmitted to spindle M by the coiled spring Q, and in Fig. 3 the tube R is shown slid forward and engaged with spindle C, so that the said spring Q is out of action.

The main advantages of my above-described arrangement are that I obtain the benefit of a flexible spring for the purpose of folding the arm down against the pillar-post when not in use, combined with all the advantages of a strong cable when required.

Referring to Fig. 5, which shows my invention as applied to the handle end of the cable, the arrangement is substantially the same as that shown in the preceding figures, with the exception of the box bracket-joint E E F F, which is not required.

e is the usual tool-handle, having a spindle C, which in this case is connected to a spindle M by a flexible coiled spring Q. The spindle M is carried in the tube J, to the end of which is attached the sheath K of the cable L, this cable being attached to the end of the spindle M. The spring-coil Q is surrounded by a sheath *f*.

R is a tube actuated by a ring S and having a long slot W working on a pin X on the spindle M, and a short slot Y to engage with the pin Z on the spindle C when the tube is slid forward. By this means the spring Q can be thrown out of action when heavier work is required and the driving power be transmitted through the tube R to the spindle C.

In place of converting the spring Q into a rigid arrangement by means of a tube sliding externally thereto I may employ a pin or shaft to slide within the spring; but in practice I prefer the use of the external tube.

Although I have shown and described my invention as applied to the flexible shaft or cable of a dental engine, it is obvious that its use is not confined thereto, but that it may be applied to flexible driving-shafts or cables of any other description.

I wish it to be understood that I make no claim to the use, *per se*, of flexible springs, such as Q, in a flexible driving-shaft or cable, as the employment of such springs at either or both ends or in the middle of the cable is quite old.

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

1. In an apparatus of the character described, the combination, with a fixed bearing and a movable bearing, of a shaft mounted to turn in said bearings, said shaft being flexible between said bearings, and a movable connection between the two bearings, whereby said two bearings may be rigidly locked together, substantially as described.

2. In an apparatus of the character described, a fixed bearing, a movable bearing, and a shaft consisting of a spindle driven from the engine and turning in said fixed bearing, a second spindle turning in said movable bearing, and a flexible coiled spring connecting said two spindles, in combination with a rigid tube encircling the last-mentioned spindle and means for sliding said tube backward or forward on said spindle and over said coiled spring to connect said two bearings, whereby said shaft is rendered rigid throughout its length, substantially as described.

3. The combination, with two spindles connected by a coiled spring, of two tubes, one an outer stationary tube and one an inner sliding and rotating tube, and a slide extending through said outer tube and connecting with said inner tube, whereby the said inner tube is slid over said connecting-spring, but at the same time permitted to rotate, substantially as described.

4. In a flexible driving-shaft or cable, a box bracket-joint consisting of the parts E E F F and a flat spring *a*, confined by a bar *d* and engaging with a lug *c*, in combination with a flexible spring Q, capable of conversion into a rigid shaft, substantially as described.

5. The combination of the two spindles C and M, the connecting coiled spring Q, the hollow-jointed box bracket-joint E E F F, and the tube J, secured to the said bracket and carrying at its outer end a sheath K, substantially as described.

In testimony that I claim the foregoing I have hereunto set my hand this 9th day of August, 1889.

JOHN SMALLEY CAMPBELL.

Witnesses:
AMBROSE MYALL,
EDWARD HAYNES.