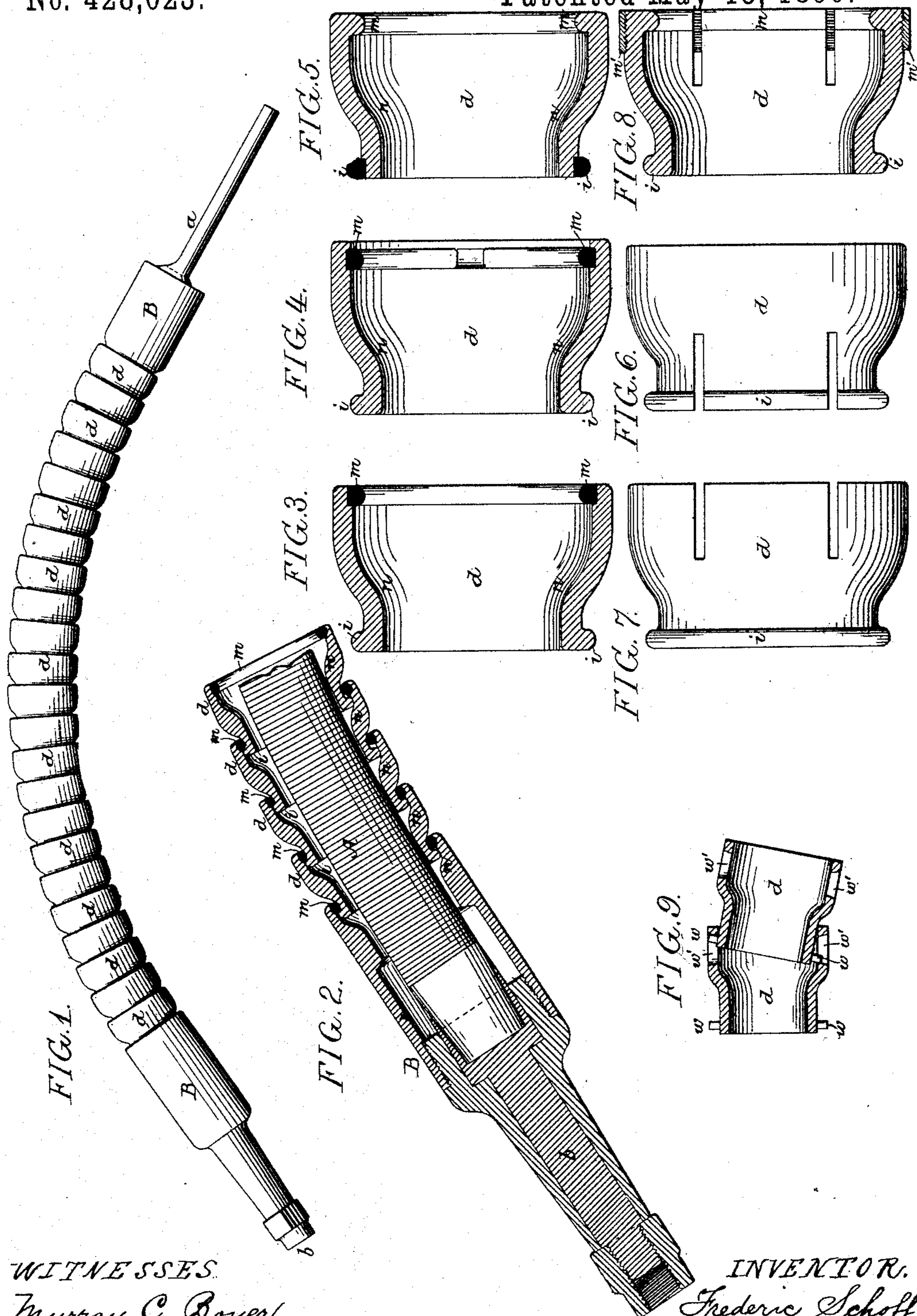


(No Model.)

F. SCHOFF.
CASING FOR FLEXIBLE SHAFTS.

No. 428,023.

Patented May 13, 1890.



WITNESSES.
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CASING FOR FLEXIBLE SHAFTS.

SPECIFICATION forming part of Letters Patent No. 428,023, dated May 13, 1890.

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To all whom it may concern:

Be it known that I, FREDERIC SCHOFF, a citizen of the United States, residing at Philadelphia, Pennsylvania, have invented certain
5 Improvements in Casings for Flexible Shafts, of which the following is a specification.

The object of my invention is to provide a flexible shaft with a flexible outer casing or covering of such character as will restrict the
10 bending of the shaft beyond a predetermined limit, and this object I attain by providing the flexible shaft with what may be termed a "vertebrate" casing or envelope, the joints,
15 sections, or vertebrae of which are so constructed that they will bind one upon another when the flexible shaft has reached the predetermined limit of flexion, and will thus prevent any further bending of the shaft in that direction.

20 In the accompanying drawings, Figure 1 is a side view representing a flexible shaft having a casing or envelope constructed in accordance with my invention. Fig. 2 is a section, on a larger scale, showing an end portion of the flexible shaft, its hand-piece and
25 fittings, and a number of the sections of the vertebrae casing or envelope for the shaft; and Figs. 3 to 9 are views illustrating various methods of constructing the sections or vertebrae of said casing or envelope.

30 A represents part of the flexible shaft, consisting of a number of spiral coils wound tightly one upon another, as usual, *a* being the power-receiving fitting connected to one
35 end of said shaft, and *b* the stem or spindle to be rotated, or through which the power is to be imparted to any suitable implement. At each end of the shaft are non-rotating sleeves or ferrules *B*, and these ferrules must
40 be connected by a flexible tube forming a casing or envelope for inclosing the flexible shaft, restricting the bending of the same, and preventing injury to the shaft or to the person handling the tool or implement which
45 is being driven. Usually this flexible casing or envelope consists of a single coil of special wire and an outer covering of leather, rubber, or equivalent material; but the objection to a casing or envelope of this character is that
50 it soon becomes more flexible than the shaft itself, and consequently does not restrict the

bending of the shaft to a greater extent than is compatible with its economical and safe working. In carrying out my invention, therefore, I make the casing or envelope for
55 the flexible shaft in vertebrae form, each of the sections or vertebrae *d* fitting into one and onto the other of the adjoining sections, and having such play as will permit the flexion of the shaft and its casing or envelope to
60 any desired predetermined extent, the sections or vertebrae binding one upon another when this degree of flexion has been reached, so that further movement of the shaft in that
65 direction is prevented.

As shown in Fig. 2, each of the sections or vertebrae of the casing or envelope consists of a shell having two cylindrical portions, one of which is of somewhat greater diameter than
70 the other, so that the small cylindrical portion of one shell may enter the large cylindrical portion of an adjoining shell, the small portion having at the end an external rib *i*, and the large portion having at the end an
75 internal rib *m*, so that when the sections or vertebrae are once fitted together longitudinal separation of the vertebrae is effectually prevented by these ribs, but the vertebrae can
80 yield upon each other to an extent permitted by the contact of the rib *i* with the rib *m* and with the internal shoulder *n*, formed where the internal diameter of the shell is reduced.

In order to permit the fitting of the vertebrae together, the rib *m* may be independent of the shell of the vertebra, and may be in
85 the form of a split ring to be slipped over the small end of an adjoining vertebra and screwed into place after the latter has been inserted; or the rib *m* may be secured in place by soldering, brazing, or other means,
90 or it may be of an elastic character, and may be sprung into a groove formed in the large end of the shell, as shown in Fig. 4, for instance; or the rib *i* may be detachable, as in
95 Fig. 5, if desired, the rib being in the form of a split ring, which can be first contracted, so as to be passed through the ribbed end of the shell, and then allowed to expand inside the same for the reception of the small cylindrical end of the next section, to which it may
100 be secured by brazing, soldering, or otherwise, access being had to it through the open

end of the preceding section; or both ribs *i* and *m* may be detachable, in which case neither of them need be split. Detachable ribs, however, are not absolutely essential to the proper carrying out of the invention, as the ribs may be integral with each shell, and the small portion of the latter may be slotted longitudinally, so as to form a series of ribbed fingers, which may be sprung together, so as to permit the ribs *i* to pass the ribs *m* of the adjoining section, and may then be allowed to expand, so as to confine the two sections together, an instance of this construction being shown in Fig. 6; or the large portion of the shell with its internal rib may be slotted in the same manner, as shown in Fig. 7, the spring-fingers being expanded to permit the ribbed end of the adjoining section to pass the same. In this case, however, it is advisable to provide an outer contracting ring *m'*, preferably screwed onto the large end of the shell, as in Fig. 8, so as to properly contract the internal rib and prevent the same from yielding to the strains to which it is subjected in the subsequent use of the tool.

When it is not desired that the sections or vertebrae of the casing or envelope shall be permitted to turn independently of each other, the ribs may be dispensed with altogether, Fig. 9 showing a construction of this character in which the entering end of one section has radial pins *w*, adapted to slots *w'*, cut in the covering end of the adjoining section, so as to permit the desired flexion of one section upon the other without permitting the separation of the sections, and a like pin and slot may be used in connection with the other forms of joint shown when it is desired to prevent turning of the sections independently of each other.

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

1. The within-described casing or envelope for a flexible shaft, the same consisting of a series of sections or vertebrae, each consisting of a tube having one end of larger diameter than the other, the small end of one tube entering the large end of the adjoining tube, and said tube-sections being provided with stops, whereby the extent of flexion of the casing is limited, substantially as specified.

2. The within-described casing or envelope for a flexible shaft, the same consisting of a series of articulated sections or vertebrae, each consisting of a tube having one end of larger diameter than the other, the small end of one tube entering the large end of the adjoining tube, and the enlarged end of each section having an internal rib and the small end having an external rib, whereby when the sections are fitted together stops are formed for preventing separation of the sections and limiting the flexion of the casing, substantially as specified.

3. The within-described casing or envelope for a flexible shaft, the same consisting of a series of articulated sections or vertebrae, the entering end of one section having an external rib and the receiving end of the adjoining section having an internal rib, one of which ribs is independent of the shell of the vertebrae, substantially as specified.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

FREDERIC SCHOFF.

Witnesses:

R. SCHLEICHER,
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