A. S. McCASKEY.

FLEXIBLE SHAFT.

APPLICATION FILED APR. 10, 1916.

1,258,233. **Patented Mar. 5, 1918.**

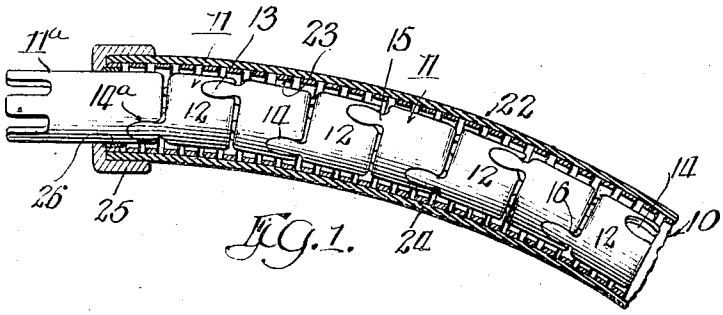

FIG. 1.

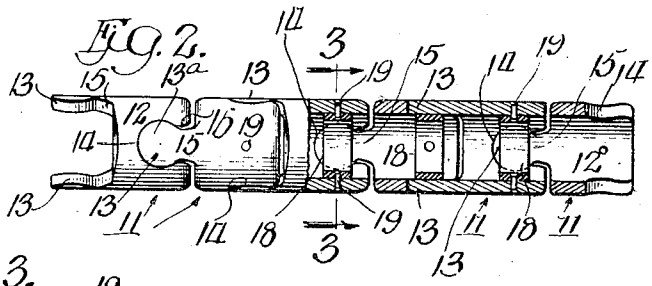

FIG. 2.

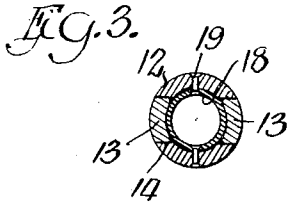

FIG. 3.

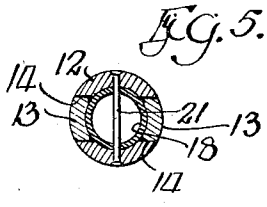

FIG. 5.

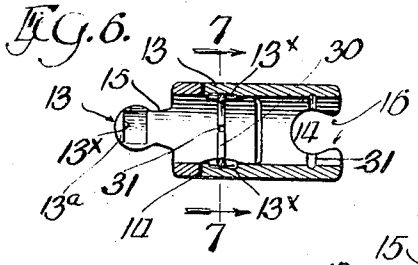

FIG. 6.

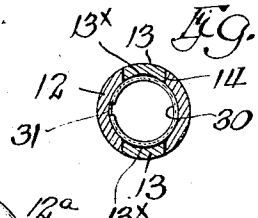

FIG. 7.

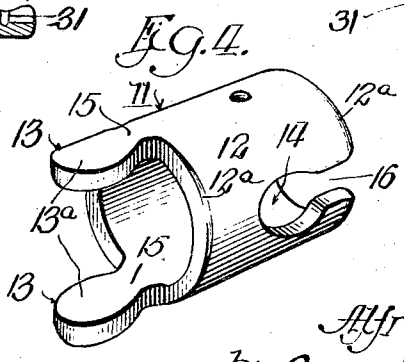

FIG. 4.

Witnesses:
Karl N. Doll.
A. F. MacDonell

Inventor
Alfred S. McCaskey
by Brown & Mehlhope Attys

UNITED STATES PATENT OFFICE.

ALFRED S. McCASKEY, OF CHICAGO, ILLINOIS, ASSIGNOR TO CLARE P. McCASKEY, OF CHICAGO, ILLINOIS.

FLEXIBLE SHAFT.

1,258,233. Specification of Letters Patent. Patented Mar. 5, 1918.

Application filed April 10, 1916. Serial No. 90,029.

To all whom it may concern:

Be it known that I, ALFRED S. McCASKEY, a citizen of the United States, and a resident of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Flexible Shafts; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to improvements in flexible shafts and it consists of the matters hereinafter described and more particularly pointed out in the appended claims.

The object of the invention is to provide a hollow flexible shaft, which is cheap to manufacture, easy to assemble, efficient in operation for its intended purpose, and which is strong and durable, thus insuring greater amount of service than has heretofore been attainable in flexible shafts as now made.

Other objects and advantages will appear as I proceed with my specification.

In the drawings:

Figure 1 is a view in side elevation of my improved flexible shaft as it appears within its sheath or covering.

Fig. 2 is a view on a somewhat enlarged scale showing a portion of a flexible shaft made in accordance with my invention, partly in side elevation and partly in section.

Fig. 3 is a transverse sectional view through my improved flexible shaft, the plane of the section being indicated by the line 3—3 of Fig. 2.

Fig. 4 is a perspective view on an enlarged scale of one of the units or links forming my improved flexible shaft.

Fig. 5 is a view similar to that illustrated in Fig. 3 and shows a slightly modified form of connection between the units.

Fig. 6 is a longitudinal detail sectional view through a further modified form of my invention.

Fig. 7 is a transverse sectional view through the structure shown in Fig. 6, the plane of the section being indicated by the line 7—7 of said Fig. 6.

Referring now to that embodiment of my invention as illustrated in the drawings and more particularly to that form shown in Figs. 1 to 4 inclusive thereof, 10 indicates as a whole a short section or length of my improved flexible shaft. Said shaft comprises a plurality of substantially short tubular units or links 11 which are coupled or connected together in a manner preventing relative displacement in any direction between them, but permitting of a range of flexible movement between each adjoining unit. Each unit or link has a tubular body part 12 which is preferably made of a length approximating its diameter but of course this proportion could be materially changed without departing from the spirit of the invention.

The tubular body 12 of each unit 10 is provided at one end with a pair of longitudinally extending, diametrically opposite lugs 13—13 and at its other end with complementary shaped bearing notches 14, in which the lugs 13—13 of an adjoining unit are adapted to engage in a manner coupling said units together. The diametric plane of the lugs 13 of one unit is arranged at right angles to the corresponding plane of the bearing notches 14 in the same unit, and the advantage of such an arrangement will appear later.

Each lug 13 consists of a head 13ª which is connected to the end of the associated body 12 by means of a neck 15, the lateral edges of which diverge outwardly as they approach said body. Each bearing notch 14, formed in the opposite end of said body is of a contour corresponding to and adapting it to receive the lugs 13 of an adjoining unit and each bearing notch opens into the free end of said body by means of a somewhat restricted passage or throat 16, through which the neck 15 of an associated lug 13 extends when said units are coupled or connected together.

When the lugs 13 of one unit are engaged within the corresponding bearing notches 14 of an adjoining unit, a ring 18 is inserted into the notched end of the last coupled unit and moved coaxially therein until it registers with the lugs 13 engaged in the notches 14. Suitable apertures are provided in the body of each unit, and in each ring, which register with one another when the ring 18 is in its proper locking position in the interior of the body 12. Rivets 19 are inserted through said registering apertures and upset from within the body 12. As shown in

Figs. 2 and 3, two of such rivets are used, thus providing a free passage through all of the inter-connected and coupled units. Said passage may be used for the reception of a lubricant, or if desired, conductor wires or the like may be passed therethrough. Instead of using two of such short rivets for each ring 18 I may find it convenient to make use of a single long rivet 21 as shown in Fig. 5, said rivet extending diametrically through the body and ring and being upset at its ends as shown. This construction possesses advantages and does not materially obstruct the free passage through the shaft.

As shown in Fig. 1 the left hand endmost unit 11 is coupled or connected by means of its lugs 13 in bearing notches 14^a, (which are identical to the bearing notches 14 before mentioned) formed in a terminal unit 11^a. Said terminal unit may be either a tool holding chuck or the like or it may constitute a coupling connection with a suitably driven member.

22 indicates a suitable sheath or covering for the shaft which comprises an inner metallic member of coiled wire 23 and an outer member of flexible material 24 such as rubber or textile tubing. A collar 25 is fixed to the terminal end of said sheath, and a bearing ring 26 is placed within said collar to provide the proper bearing for the terminal unit 11^a. To prevent any tendency of the several coupled together or connected units to pinch or cut into the sheathing and to prevent binding between the adjoining ends of the several units, especially when the shaft as a whole is arranged on a curve or arc, I prefer to round off the sharp edge at the ends of the body of each unit as indicated at 12^a—12^a in Fig. 4.

In Figs. 6 and 7 is illustrated a modified form of my invention and such form is as follows:

Instead of using the ring 18, and rivets or pins 20—21 before mentioned, to prevent lateral displacement between the several units, I may prefer to use (and especially in flexible shafts of smaller diameter) split spring rings 30. When using this type of ring, each unit will be provided on its interior with an annular groove 31 arranged in the plane of the center of the bearing notches 14. The inner face of each head 13 will be provided with a wider groove or recess 13^x which will permit of a pivotal movement of said head within an associated bearing notch 14 without binding against said ring 30. To insert one of such rings in place after one of said units has been coupled to an adjacent unit, said split spring ring is compressed until its spaced ends engage each other, when the ring as a whole is then inserted into the notched open end of the last coupled unit. Said ring may now be moved inwardly toward its complemental grooves by means of any suitable implement such as, for example, a short piece of tubing, until it registers with said grooves, when said ring will expand and seat within said grooves.

It is apparent that my improved flexible shaft possesses many advantages over shafts as now used for similar purposes. It may be made from short odds and ends of tubing which have hitherto been scrapped as waste, or it may be stamped from flat sheet metal and formed into tubular shape afterward (the seam of course being brazed or welded) or said units may be made of cast metal.

On account of the units being made tubular in form, torsional strain such as is imposed upon said units will not produce crystallization and breakage in said units. Furthermore, the tubular sections are not apt to become heated by friction of the parts, as they may be coated inside as well as outside with suitable lubricant. My improved flexible shaft affords substantially unobstructed space or passageway which may be used for the reception of current or other conductors, or should it be desired said passageway may be used to convey oil or water to the operating tool driven by said shaft. My improved shaft possesses another advantage which is quite important, and that is, it is lighter in weight than is a shaft composed of solid units of the same cross sectional diameter.

While in describing my invention I have referred to certain details of mechanical construction, and arrangement of parts, I do not wish to be limited thereto except as may be pointed out in the appended claims.

I claim as my invention:

1. A flexible shaft comprising a plurality of units, each of said units comprising a tubular body part having at one end diametrically opposite bearing notches and at its other end longitudinally extending diametrically opposite bearing lugs arranged at right angles to said notches, said lugs being adapted to engage within the bearing notches of the adjoining unit in a manner permitting of a flexible movement between said units and rings fixed within said units and adapted to retain said lugs within said bearing notches.

2. A flexible shaft comprising a plurality of units, each of which comprises a tubular body of a length approximating its diameter, said tubular body having at one end diametrically opposite bearing notches and at its opposite end longitudinally extending diametrically opposite lugs arranged at right angles to said notches, said lugs being adapted to engage within the bearing notches of the adjoining unit in a manner permitting of a flexible movement between said units, and a ring within each unit arranged in the plane of the axis of said recesses, said ring and unit having coacting means for preventing

relative movement between them, said ring preventing lateral movement between adjoining units.

3. A flexible shaft comprising a plurality of units, each of which comprises a tubular body having at one end diametrically opposite bearing notches and at its other end longitudinally extending diametrically opposite lugs which are adapted to engage within the bearing notches of an adjoining unit in a manner permitting of a flexible movement between them, said body also having on its interior, longitudinally spaced annular grooves, which register together when said lugs are engaged in said bearing notches and an expansible split ring adapted to be inserted into said body through the recessed end thereof and to enter and expand into said registered grooves, said ring preventing relative lateral movement between said units.

In testimony that I claim the foregoing as my invention I affix my signature in the presence of two witnesses, this 8th day of March, A. D. 1916.

ALFRED S. McCASKEY.

Witnesses:
T. H. ALFREDS,
KARL W. DOLL.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents. Washington, D. C."