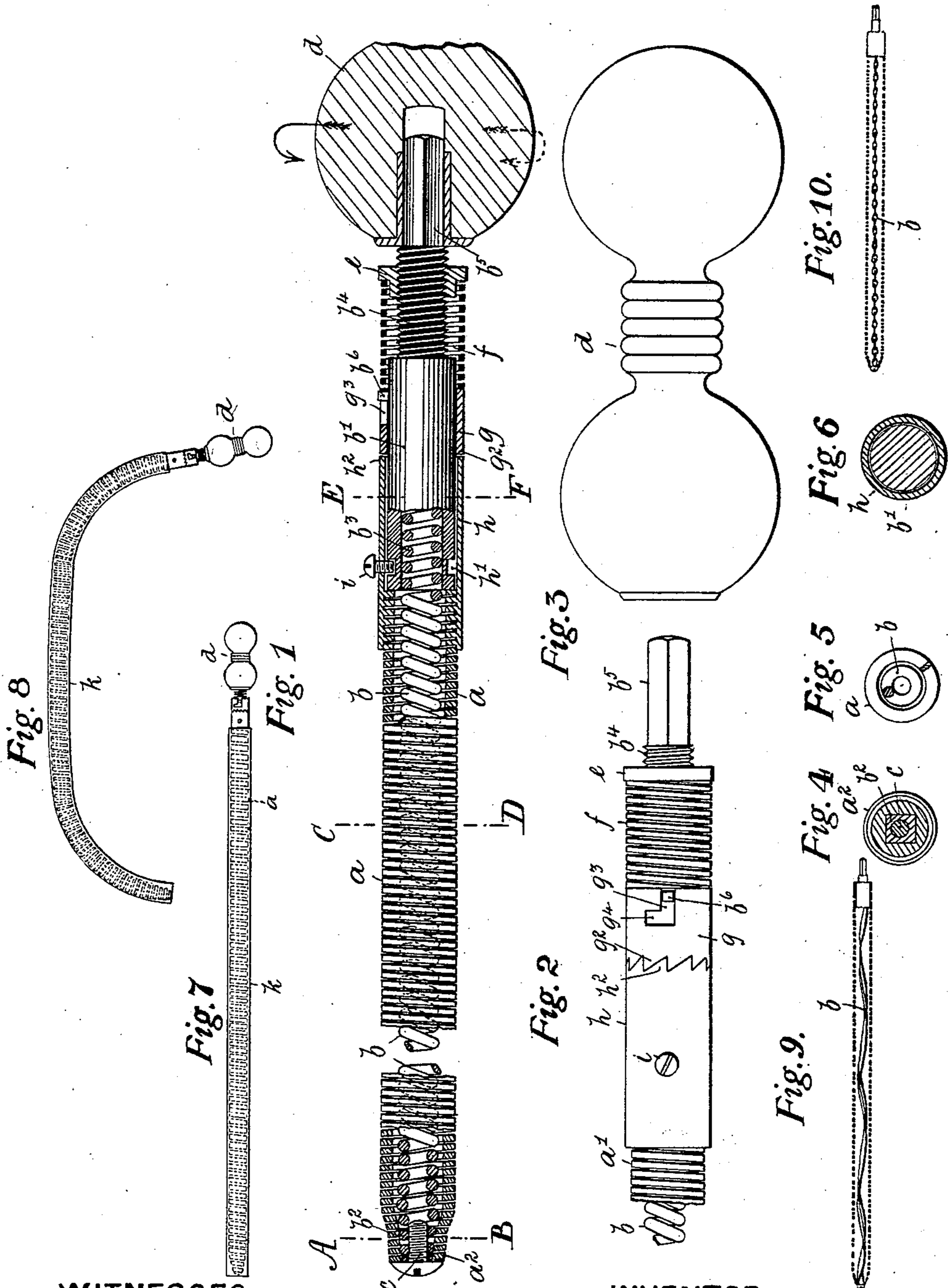


(No Model.)

J. M. SMITH.  
FLEXIBLE MANDREL.

No. 538,555.

Patented Apr. 30, 1895.



WITNESSES  
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# UNITED STATES PATENT OFFICE.

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## FLEXIBLE MANDREL.

SPECIFICATION forming part of Letters Patent No. 538,555, dated April 30, 1895.

Application filed June 8, 1894. Serial No. 513,952. (No model.) Patented in England December 16, 1892, No. 23,172.

*To all whom it may concern:*

Be it known that I, JOHN MILBROWE SMITH, cycle-manufacturer, a subject of the Queen of Great Britain, residing at High Street, West Bromwich, in the county of Stafford, England, have invented certain new and useful Improvements in Flexible Mandrels; 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, and for which invention Letters Patent of Great Britain have been granted to me bearing date December 16, 1892, No. 23,172.

This invention relates to an improvement in, or additions to, flexible mandrels for the bending or fashioning of tubes, or tubular or hollow articles, and particularly for the cold bending of light metallic tubes of any cross section for cycle work, and has for its object, a mandrel capable of being readily introduced into, expanded and contracted within, and withdrawn from, an article under manipulation.

Figure 1 of the accompanying drawings represents, partly in longitudinal vertical section and partly in elevation, an adjustable and flexible mandrel constructed and arranged and fitted and provided with improvements made according to my invention. The middle part of the said mandrel is shown broken away. Fig. 2 shows the shank or inner end portion of the said mandrel in elevation. Fig. 3 represents the handle separately. Fig. 4 is a cross-section upon the dotted lines A B, Fig. 1. Fig. 5 is a cross-section upon the dotted lines C D of the said figure, while Fig. 6 is a cross-section upon the dotted lines E F, Fig. 1. Fig. 7 shows upon a reduced scale the mandrel within a length of tubing about to be bent, and Fig. 8 represents the said tube bent and prior to the withdrawal of the mandrel.

The same letters of reference indicate corresponding parts in the several figures of the drawings.

$a$  is an outer and closely wrapped open coil, made from square sectioned wire, and so organized as to admit of the coils or convolutions of the same being either wound up or closed lengthwise upon each other and the

diameter thereby reduced, or unwound or twisted in an opposite direction, and the convolutions expanded, and hence an increase of diameter, and which winding up and unwinding is performed by or through the medium of a flexible axial or inside coil  $b$ , with the coils as represented wound in an opposite direction to those of the mandrel coils  $a$ . The fore or contracted nose end  $a^2$ , of the outer coil  $a$ , is preferably made square upon its inside, and within which inside square part, the fore end  $b^2$ , of the inner and motioncommunicating axial coil  $b$ , fits, and is thereby prevented from rotating other than bodily with the coil  $a$ . The union or connection of the said ends is made by a screw  $c$  (or by brazing the said end parts  $a^2$ ,  $b^2$ , together) taking into the wormed inside of the end of the inner coil, so that as the coil  $b$ , is rotated, through the medium of the handle  $d$ , the convolutions of the outer coil are contracted or expanded, according to the direction in which the flexible axis is turned by the handle.

Made fast to the back end  $b^3$ , of the inner coil  $b$ , is a barrel or stalk  $b'$ , carrying at its rear end, a screw  $b^4$ , and at its extreme end, an angular shank  $b^5$ , upon which the attachable and detachable handle  $d$ , takes, for the winding up for expanding or contracting the said coil. Surrounding the said screwed part  $b^4$ , is a traversing nut or screw collar  $e$ , coming against or at the back of a locking or spring coil or coiled spring  $f$ , disposed between the said nut  $e$ , and the back of a ratchet or crown pawl-sleeve  $g$ , sliding upon the barrel or stalk  $b'$ , and with the teeth  $g^2$ , of it, adapted to engage with the opposed ratchet teeth  $h^2$ , of a fixed casing  $h$ , made fast to the inner end  $a'$ , of the outer and adjustable coil  $a$ , and connection is made between the inner coil and the outer coil, with the former capable of twisting or turning within the latter, by a screw pin  $i$ , taking through the walls of the casing  $h$ , and with the stem passing into the annular groove  $h'$ , made circumferentially around the fore part of the barrel  $b'$ .

The sleeve pawl or crown ratchet  $g$ , has a bayonet slot  $g^3$ , wherethrough a stud  $b^6$ , on the barrel  $b'$ , takes, so that the opposed teeth of the one part can be removed from the opposed teeth of the other part, and the said movable

ratchet part held back by the said stud  $b^6$ , taking into the part  $g^4$ , of the said bayonet slot  $g^3$ .

The screwing up of the screw collar  $e$ , closes up the coils  $f$ , into a solid or compact tubular length, and forms a stop or block against the movement of the ratchet catch part  $g$ ; hence the affixing of the outer coil in its wound up and expanded or contracted state.

Now assuming that a length of tubing as in Fig. 7, is required to be bent into a shape alike unto that represented in Fig. 8 and that normal diameter of the mandrel is greater than can be easily introduced, first rotate the handle  $d$  from right to left, as indicated by the full arrow, and by it wind up the coil  $a$ , to a slight extent, whereby its diameter or girth is diminished, and in this state, the said coil, which is the mandrel coil, is retained by the teeth of the part  $g$ , engaging with the teeth of the part  $h$ . This done, then insert the said wound-up mandrel into the interior of the tube  $k$ , wherein it freely slides. Now release the said pent-up coils, by drawing back the ratcheted part or sleeve  $g$ , when the said coils expand themselves or open out to nearly the full inside bore of the tube to be bent. This done, then expand the mandrel coils, by turning the flexible axis by the handle in the direction indicated by the dotted arrow, with the opposed ratchet teeth of the parts clear of each other. Then when the proper expansion has been attained, fix the mandrel coils by making the catch teeth of the parts engage with each other, and be there held by the blocking or closing of the coils of the spring  $f$ , by the propelling forward of the nut  $e$ . The said spring  $f$ , acts ordinarily as a pawl spring when the mandrel coil is contracted, and as a check or block when the said mandrel coil is expanded. Now bend the tube together with and upon the mandrel to the desired figure such as in Fig. 8. Now as the mandrel requires to be removed, the same must have a less girth than the inside of the tube in order to be freely withdrawn, and to accomplish this, contract the diameter or draw into less compass, the coil, and this is accomplished by winding up the mandrel coils  $a$ , again in the direction of the full arrow and thereby contracting its diameter, and which is automatically held in its contracted condition by the teeth of the sliding pawl part wiping over the teeth of the fixed casing part.

It is understood that the motion of the handle is transmitted first through the barrel  $b'$ , then travels down the coil or flexible axis  $b$ , and as torsion progresses then to the end  $b^2$ , and from thence traveling up from the fore end  $a^2$ , to the inner end  $a'$ , of the outer or mandrel coil  $a$ , and the coiling proceeds first down the inner flexible axis and then up the outer coil, until the convolutions

are brought sufficiently together or apart to make the necessary reduction or enlargement in its diameter. It is further understood that the pent up coils are kept in one state by the rack teeth automatically engaging with each other, and in the other state by the propelling of the nut  $e$ , and the compressing of the spring coils  $f$  forward of it.

My invention is particularly applicable to the bending of cycle tubes, refrigerator coils, plumbers lead bend, musical instrument tubular articles, bedstead tubings, and other tubular articles composed of various materials.

It is obvious that any flexible axis, such as chain, a jointed rod, links or other flexible medium may be employed as the means of transmitting motion from the handle to the mandrel coil in lieu of the inner coil represented.

It is obvious that the mandrel coil may be contracted only, then placed within a tube, and then allowed to expand to its normal state, which is the full sized bore of the tube to be bent.

Instead of employing the securing means of the ratchet teeth, I may employ crown teeth or clutch teeth, or instead of employing a single inner mandrel coil, I may employ a compound one, and instead of employing a flexible axis as described, I may employ strands or strips of flexible metal or a universally flexible chain as the means for communicating motion to the mandril coils.

Fig. 9 represents such a flexible mandrel with an inner and motion-communicating core  $b$ , composed of a strip of flexible steel, which has the same function and operates in the same manner as the coil  $b$ , in Figs. 1 to 8.

Fig. 10 represents a further modified form of my invention in which a chain  $b$ , is substituted for the motion-communicating coil in Figs. 1 to 8, and the strip of flexible metal in Fig. 9.

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

In a flexible mandrel, the combination with the outer coil  $a$ , the inner coil  $b$ , the barrel  $b'$ , attached to the inner coil and formed with the screw thread  $b^4$ , of the toothed casing  $h$ , attached to the inner end of the outer coil, the screw collar  $e$ , working on the barrel  $b'$ , the spring  $f$ , and the pawl sleeve engaging with the casing  $h$ , substantially as described.

In testimony that I claim the foregoing I have hereunto set my hand this 18th day of May, 1894.

JOHN MILBROWE SMITH.

Witnesses:

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ARTHUR T. SADLER,

Both of Birmingham.