

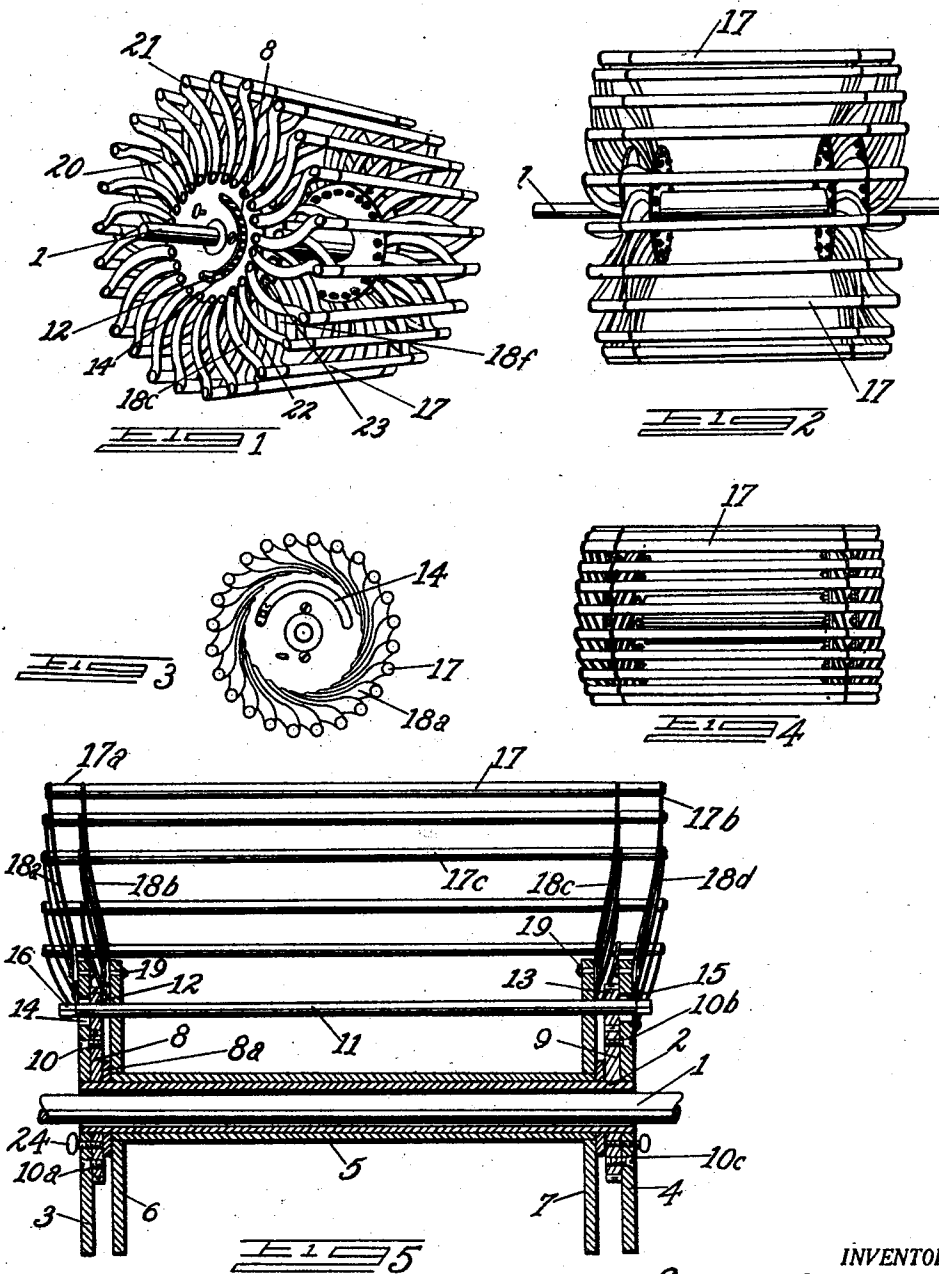
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EXPANSION MANDREL

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# UNITED STATES PATENT OFFICE

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## EXPANSION MANDREL

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My invention is addressed to expansion mandrels having great expansibility combined with rigidity and durability. Expansion mandrels are used for many purposes and my invention is capable of wide application. In the ensuing specification, I shall describe it in but one embodiment—namely, an expansion mandrel for curved plate routing machines—it being understood that my invention is not restricted thereto and is applicable to other types of mandrels as will hereinafter be more fully pointed out.

Heretofore expansion mandrels have in general possessed only a comparatively limited expansibility. They have for the most part operated upon the wedge principle; and in such devices where greater expansibility is desired, the width of the wedges must be increased, thereby increasing the initial diameter of the mandrel. Certain types of mandrels sometimes called expansion mandrels have not been so in the true sense, but on the contrary, have comprised a mandrel of a fixed size, operative only when fully expanded, but collapsible for a given purpose. My invention is addressed to mandrels which are truly expansible in the sense that they are fully operative at a variety of effective diameters and are adjustable. A type of mandrel has been proposed in which bars forming the mandrel surface have been mounted upon arms lying in a plane passing through the axis of the bar, and these arms have been mounted upon members which ride along a threaded shaft so that by operating the shaft with respect to the members, the distance of the bars from the shaft axis might be varied. Such an expansion device possesses greater expansibility than the wedge type, but is nevertheless somewhat restricted and lacks rigidity because the bars are not braced, but are connected to the shaft merely by radial members.

It is an object of my invention to provide an expansion mandrel with greater expansibility than has hitherto been possible.

It is an object of my invention to provide an expansion mandrel in which the mandrel

surface is made up of a plurality of members rigidly braced in all positions.

It is an object of my invention to provide an expansion mandrel in which the feature of adjustability is embodied in means which are very easily actuated and which are not liable to accidental variations of adjustment.

These and other objects of my invention which will be set forth hereinafter or will be apparent to one skilled in the art upon reading this specification, I accomplish by that certain construction and arrangement of parts of which I shall now describe (but without limitation thereto), an embodiment which comprises an expansion mandrel for a curved plate routing machine, reference being had to the drawings which accompany and form a part of this specification.

In the drawings:

Figure 1 is a perspective view of my mandrel in expanded position.

Figure 2 is a sidewise view of my mandrel in expanded position.

Figure 3 is an end plan of my mandrel when contracted.

Figure 4 is a sidewise view of the contracted mandrel of Figure 3.

Figure 5 is a partial section through my mandrel showing the operative parts thereof.

Generally, in my mandrel, I provide pairs of oppositely revoluble plates which are arranged for rotation about a shaft though they are not necessarily journaled upon a shaft. I provide also a series of bars or equivalent members, the axes of which are parallel to the axis of the shaft and which are adapted to form the surface of the mandrel; and I connect each bar by a toggle to each plate so that when the plates are rotated oppositely to each other, the distance of the bars from the shaft axis will become greater or less due to the action of the toggles, as will hereinafter be more fully explained.

In the embodiment of the invention which I shall now describe, it is my object to provide an expansion mandrel which may rotate about a shaft and be removed therefrom, the expansibility of the mandrel being independent of the position of the shaft. The shaft is indicated by the numeral 1 in Fig-

ure 5. Overlying this shaft I provide a tube 2 on either end of which I fasten circular plates 3 and 4. Over the tube 2 I place another shorter tube 5 on the ends of which are fastened circular plates 6 and 7. I provide also concentric gears 8 and 9 which are fastened by screws 10, 10a, etc. to the plates 3 and 4 respectively. I journal a small shaft 11 in the plates 6 and 7 and upon this shaft I provide pinions 12 and 13 meshing with the gears 8 and 9. The plates 3 and 4 are provided with concentric slots indicated in Figure 5 at 14 and 15 but shown somewhat more clearly in Figures 1 and 3. The purpose of these slots is to clear the shaft 11; and the ends of this shaft extend therethrough so as to be accessible. They may be squared if desired as at 16 for the engagement of a key, not shown. It will now be clear that if a key is engaged with the shaft 11 and this shaft rotated, the effect will be to revolve the plates 3 and 4 (together with the tube 2) with respect to plates 6 and 7 (together with the tube 5) to the limit of the motion permitted by the slots 14 and 15. These slots I prefer to make very nearly 180° in length so as to get the maximum expansibility in my mandrel. For greater expansibility I may use toggles of greater length and a longer slot. The toggles in the embodiment shown are approximately a quarter of the outside circumference of the toggle plates in length. Hence the provision of a slot nearly 180° in length.

It will also be clear that the entire device may rotate upon the shaft 1 in this embodiment irrespective of the relative adjustment between the plates. Here the shaft is the shaft of a curved plate routing machine, and it is contemplated that the worm gear used to revolve the mandrel will be attached to the mandrel itself. However, the gear may be attached to the shaft, and the mandrel also non-rotatively affixed thereto, as by a collar, by keying the inner tube to the shaft, or in any other way desired.

In the construction which I have shown, there is a space between the gear 8 and the plate 6, and between the gear 9 and the plate 7. These spaces are filled by brass bushings 8a and 9a, and I provide through the plates 3 and 4 and their respective gears, thumb-screws 24 and 24a which serves to lock the plates in a desired relative position by clamping the inner plates 6 and 7 between the bushings. Other ways of maintaining a fixed relationship between the plates after adjustment may be substituted, if desired.

The surface of my mandrel is formed of a series of members which in the embodiment shown, constitute bars indicated generally by the numeral 17. The shape and characteristics of these bars are not important and they may be varied by those skilled in the art to meet the requirements of special uses without departing from the spirit of my invention.

They may, for example, comprise forgings or castings with lugs upon one side for the pivoting of the toggles and they may be provided on the other side if desired with attachment devices, with cutting edges or with such other configurations as may be found desirable. They may be provided with adjustable clamps for holding plates to be routed. In the particular embodiment shown, they comprise a rod upon which the toggles are pivoted, and sections of tube 17a, 17b, etc. surrounding the rods and serving to space the toggles.

Each bar is connected to each plate by a toggle. These toggles I have indicated as 18a, 18b, etc. It will be seen that the series of bars 17 will be connected by toggles 18a to plate 3, by toggles 18b to plate 6, by toggles 18c, to plate 7, and by toggles 18d to plate 4. The toggles as indicated are pivoted upon the bars and are also pivoted upon the plates by means of bolts 19. The shape of the toggles is preferably arcuate over the greater portion of their length as is shown at 20 in Figure 1. This provides a toggle construction such that when the toggles are nested upon contraction of the mandrel as in Figure 3, they will lie approximately circumferentially of the plates and leave the centers thereof clear. The toggles have turned up ends (21 in Figure 1) the purpose of which is to permit the bars 17 to be carried outside the toggles when nested, upon contraction. The toggles preferably do not lie in the plane of a continuation of the plates but rather are offset therefrom so as to facilitate nesting upon contraction, and to give a more rigid structure, endwise. All of this is very clearly shown in the figures. It is intended that each toggle shall overlie the one next preceding and underlie the one next succeeding. It may in some instances be necessary to turn up one edge of each toggle to facilitate its riding over the next preceding toggle upon contraction, as will be clearly understood.

It will also be clearly understood how the opposite rotation of the toggle plates 3 and 4, 6 and 7 will expand the effective diameter of the mandrel from that shown in Figure 3 to that shown in Figure 1. The length of the toggles will in large measure determine the amount of that expansibility; but I am, by the arrangement of parts herein described, able to achieve a degree of expansibility in my mandrel which has not, so far as I am aware, been obtainable with other types of structure. I desire also to point out that the bars 17, even in the expanded position, are braced with reference to the mandrel proper and do not depend for transverse rigidity upon the flatwise stiffness of thin arms. Thus in Figure 1, it will be seen that the bar 17 is held by toggles 18e and 18f, having pivotal points 22 and 23 so that there is effectively formed a three-point suspension for the

bar 17 comprising the points 22 and 23 and the bar itself, which serves as the pivot for the other ends of the toggles 10c and f. I proportion my slot 14 so that even in the fully expanded position, the points 22 and 23 are not in alignment in a plane passing through the axis of the shaft 1, so that this feature of rigidity may always be obtained; but my invention is not restricted thereto. My invention is of course, capable of modification within the province of those skilled in the art without departing from the spirit thereof. In the embodiment described, I have shown two pairs of toggle plates; but the number of these pairs may be increased as desired or as may be necessary to secure a desired degree of rigidity in a mandrel of any length. My device is capable of use not only as a mandrel but as an expansion member for a multitude of other uses including but without limitation, an expansion reamer, an expansion reel, and the like.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent, is:—

1. An expansion mandrel comprising a pair of oppositely rotatable plates, circumferentially arranged elements, and pairs of toggles connecting each of said elements respectively to said two plates and pivoted respectively upon said elements and said plates, whereby upon rotation of said two plates, said elements will be moved radially.

2. An expansion mandrel comprising a shaft, bars parallel to said shaft, pairs of oppositely rotatable toggle plates upon said shaft and pairs of toggles respectively pivotally connected to each of said bars and each of said plates whereby upon rotation of said plates, said bars are moved radially, and means for effecting the relative adjustment of said plates.

3. In an expansion mandrel, pairs of oppositely rotatable plates, pairs of toggle arms pivoted on said plates, a plurality of circumferentially arranged elements, said toggles pivoted thereon and connecting each of said elements to each of said plates, whereby upon the opposite rotation of said plates, said elements will be moved toward or away from said plates radially, and means for effecting the adjustment of said plates.

4. In an expansion mandrel, pairs of oppositely rotatable plates, pairs of toggle arms on said plates, a plurality of circumferentially arranged elements, said toggles pivoted thereon and connecting each of said elements and each of said plates, whereby upon the opposite rotation of said plates, said elements will be moved toward or away from said plates radially, and means for effecting the adjustment of said plates, said toggles curved so that they lie approximately circumferentially around said plates upon contraction of said mandrel.

5. In an expansion mandrel, pairs of oppositely rotatable plates, pairs of toggle arms on said plates, a plurality of circumferentially arranged elements, said toggles connecting each of said elements to each of said plates by pivotal connections, whereby upon the opposite rotation of said plates, said elements will be moved toward or away from said plates radially, and means for effecting the adjustment of said plates, said means comprising a gear upon one set of plates and a shaft journaled in the other set of said plates and bearing a pinion meshing with said gear.

6. In an expansion mandrel, a tube bearing a set of toggle plates, a second tube concentric with the first and revolvably mounted thereon bearing a second set of toggle plates, elements substantially parallel with said tubes to form the mandrel surface, and pairs of toggles connecting each of said elements with each of said plates, whereby upon opposite rotation of said plates, said elements are caused to move radially and means for adjusting said plates relative to each other.

7. In an expansion mandrel, a tube bearing a set of toggle plates, a second tube concentric with the first and revolvably mounted thereon bearing a second set of toggle plates, elements substantially parallel with said tubes to form the mandrel surface, and pairs of toggles connecting each of said elements with each of said plates, whereby upon opposite rotation of said plates, said elements are caused to move radially and means for adjusting said plates relative to each other, said toggles curved so that they lie approximately circumferentially around said plates upon contraction of said mandrel.

8. In an expansion mandrel, a tube bearing a set of toggle plates, a second tube concentric with the first and revolvably mounted thereon bearing a second set of toggle plates, elements substantially parallel with said tubes to form the mandrel surface, and pairs of toggles connecting each of said elements with each of said plates, whereby upon opposite rotation of said plates, said elements are caused to move radially and means for adjusting said plates relative to each other, said means comprising a gear upon one set of plates and a shaft journaled in the other set of said plates and bearing a pinion meshing with said gear.

9. An expansion mandrel comprising a tube bearing at its ends a pair of toggle plates, an overlying concentric revolvable tube of shorter length bearing at its ends a second pair of toggle plates, elements for expansion arranged circumferentially of said tubes with their axes parallel to the axes of said tubes and pairs of toggles connecting each of said elements with each of said plates whereby upon the opposite rotation of said plates, said elements are caused to move ra-

dially, thus expanding or contracting said mandrel.

10. An expansion mandrel comprising a tube bearing at its ends a pair of toggle plates, an overlying concentric revolvable tube of shorter length bearing at its ends a second pair of toggle plates, elements for expansion arranged circumferentially of said tubes with their axes parallel to the axes of said tubes and pairs of toggles connecting each of said elements with each of said plates whereby upon the opposite rotation of said plates, said elements are caused to move radially, thus expanding or contracting said mandrel and a shaft journaled in the two inner plates and bearing pinions, the two outer plates bearing gears meshing with said pinions, said outer plates slotted to pass said shaft and permit controlled rotation of said outer plates with reference to said inner plates, said shaft having squared ends for the attachment of a key.

11. An expansion mandrel comprising a tube bearing at its ends a pair of toggle plates, an overlying concentric revolvable tube of shorter length bearing at its ends a second pair of toggle plates, elements for expansion arranged circumferentially of said tubes with their axes parallel to the axes of said tubes and pairs of toggles connecting each of said elements with each of said plates whereby upon the opposite rotation of said plates, said elements are caused to move radially, thus expanding or contracting said mandrel and a shaft journaled in the two inner plates and bearing pinions, the two outer plates bearing gears meshing with said pinions, said outer plates slotted to pass said shaft and permit controlled rotation of said outer plates with reference to said inner plates, said shaft having squared ends for the attachment of a key, said elements comprising bars upon which said toggles are pivoted.

12. An expansion mandrel comprising a tube bearing at its ends a pair of toggle plates, an overlying concentric revolvable tube of shorter length bearing at its ends a second pair of toggle plates, elements for expansion arranged circumferentially of said tubes with their axes parallel to the axes of said tubes and pairs of toggles connecting each of said elements with each of said plates whereby upon the opposite rotation of said plates, said elements are caused to move radially, thus expanding or contracting said mandrel and a shaft journaled in the two inner plates and bearing pinions, the two outer plates bearing gears meshing with said pinions, said outer plates slotted to pass said shaft and permit controlled rotation of said outer plates with reference to said inner plates, said shaft having squared ends for the attachment of a key, said elements comprising bars upon which said toggles are pivoted,

and locking means operating through said outer plates for clamping said mandrel in adjusted position.

13. An expansion mandrel comprising a pair of oppositely rotatable members, a plurality of circumferentially arranged elements, and pairs of toggles each pivoted upon said elements, and connecting said elements to said members, one toggle in each pair being pivoted to each member, whereby upon relative movement of said members, said elements will be moved toward or away therefrom.

14. An expansion mandrel comprising a pair of oppositely rotatable members, a plurality of circumferentially arranged elements, and pairs of toggles of equal length, each pair pivoted at one end upon one of said elements, and connecting said elements to said members, one toggle in each pair being pivoted at the other end to each member, whereby, upon relative movement of said members, said elements will be moved radially, but will be held rigidly in a desired radial position when said members are held against relative movement.

15. An expansion mandrel comprising a pair of oppositely rotatable circular members, a plurality of circumferentially arranged elements, and pairs of toggles of equal length, each pair pivoted at one end upon one of said elements, and connecting said elements to said members, one toggle in each pair being pivoted at the other end to each member, whereby upon relative movement of said members, said elements will be moved radially, but will be held in a desired radial position when said members are held against relative movement, said toggles being curved in one direction so as to be able to lie approximately circumferentially of said members, the outward ends of said toggles being curved in the opposite direction so as to cause said elements to lie beyond the circumference of said members when said toggles are in circumferential position.

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