March 15, 1960 M. COHN 2,928,621

MANDREL AND ACTUATOR

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FIG. 1.

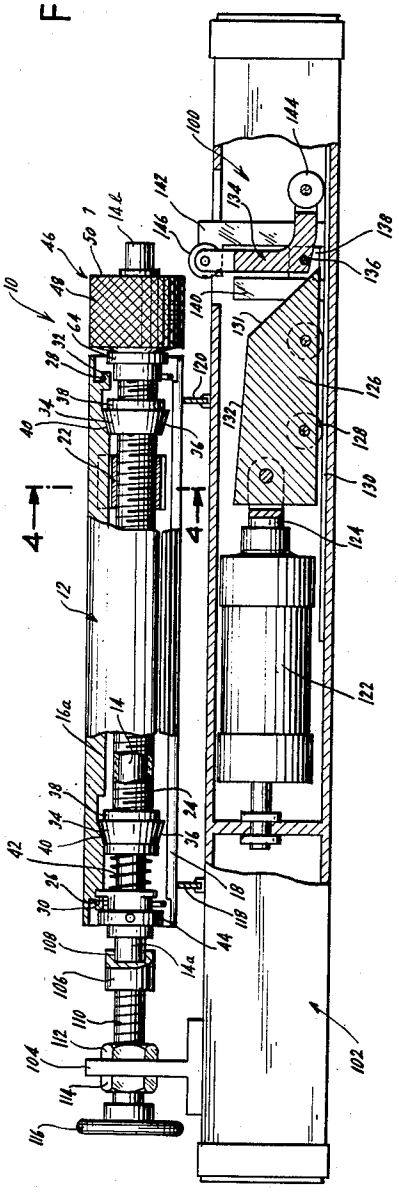

FIG. 3.

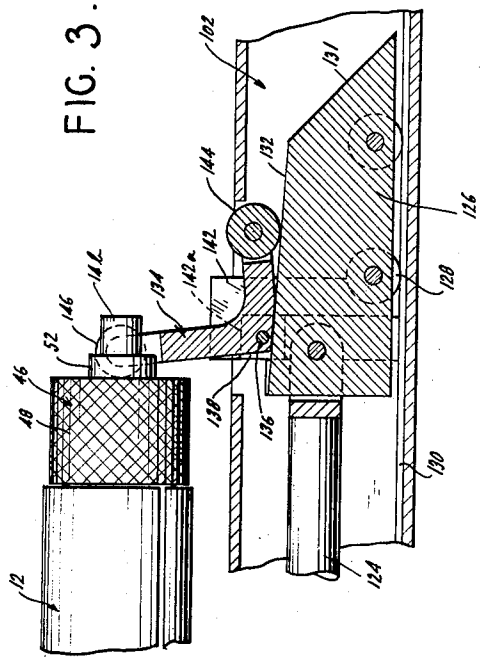

FIG. 2.

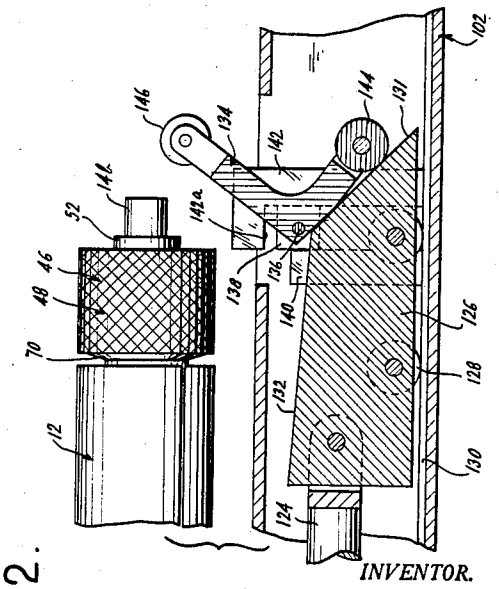

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FIG. 4.

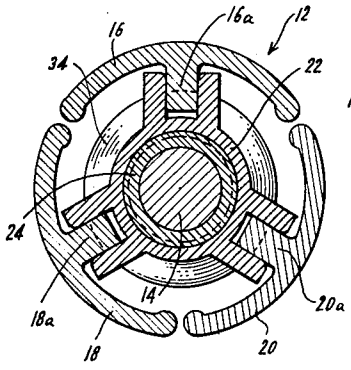


FIG. 5.

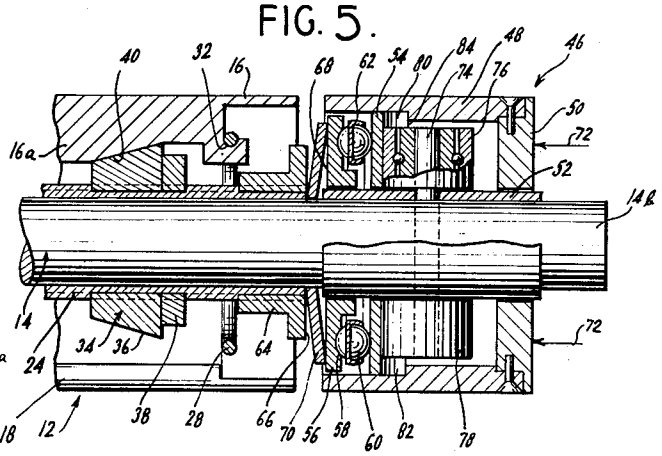


FIG. 8.

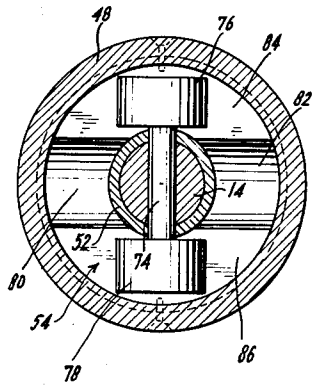
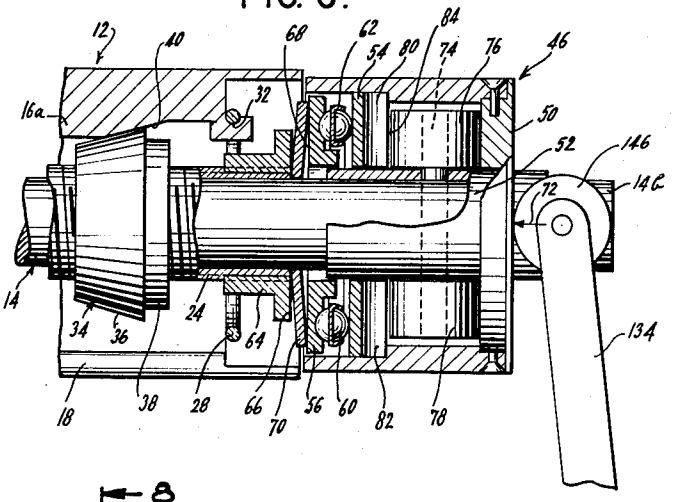


FIG. 6.



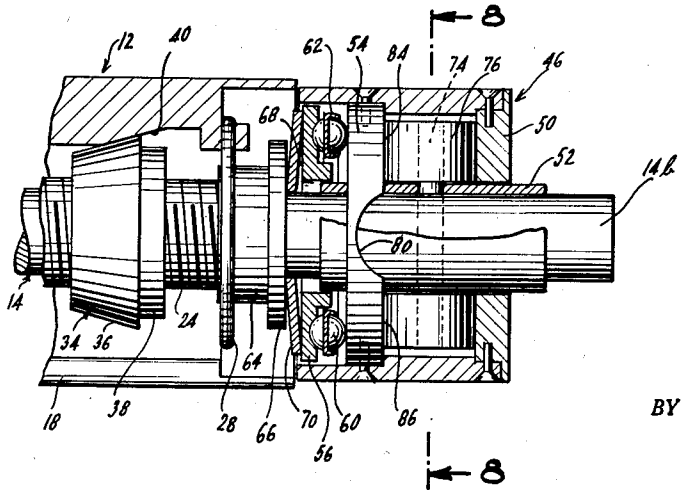


FIG. 7.

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MANDREL AND ACTUATOR

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Application November 21, 1955, Serial No. 547,965

13 Claims. (Cl. 242—72.1)

The present invention relates to mandrel constructions, and in particular to an improved expandable mandrel and actuating mechanism for expanding said mandrel.

There are innumerable industrial applications for mandrels of the type including an essentially cylindrical body having one or more segments which may be expanded to effectively increase the cross section of the body. A typical application for such mandrels is as a windup shaft where a number of spaced apart cores, usually of pressboard or cardboard are to be fixed at spaced locations along the windup shaft and each arranged to receive tape or other similar strip material. Conventionally for this application, a core holder box is provided which is formed with a number of side by side spaced annular semi-cylindrical seats which receive the respective cores to maintain the same in a desired spaced relationship. With the spaced cores in the core holder box, the expanding mandrel is inserted into the cores and expanded to grip the cores. The unexpanded diameter of the mandrel is selected such that the mandrel may be readily inserted within the cores; and the expanded diameter of the mandrel is selected such that the cores are rigidly secured to the mandrel so that each individual core may be effectively gripped for windup of its length of strip material.

Mandrels are known in the prior art which include one or more mandrel segments which are expanded by appropriate cam and wedge mechanisms internally of the mandrel. However, it has been found difficult to manipulate these mandrels particularly from the standpoint of expanding the same and effecting ready release after the use of the mandrel with a particular group of cores. Further, difficulty has been experienced in obtaining a mandrel construction which is effective throughout its length to grip the cores. It will be appreciated that an improperly gripped core on the mandrel represents a source of faulty operation in the windup equipment and is a marked deterrent to the acceptance of a particular type of mandrel structure for commercial use.

It is broadly an object of the present invention to provide an improved mandrel including one or more expandable segments. Specifically, it is within the contemplation of the present invention to provide an improved mandrel and actuator therefor which is constructed to be expanded by air under pressure whereby a high order of gripping force may be exerted by the mandrel on surrounding cores.

In accordance with an illustrative embodiment demonstrating features of the present invention there is provided an expanding mandrel including a shaft and mechanical air-operated expanding unit including a part shiftable longitudinally of the shaft which is effective to expand one or more segments of the mandrel body. The expanding unit includes a disk spring which is loaded in response to shifting of the part relative to the shaft and mechanism arranged to be locked in the position corresponding to expansion of the mandrel through

simple manual manipulation. Operation of the expanding mechanism is achieved by an air-operated actuator which is constructed to impart the requisite thrust to the shiftable part, bringing about the requisite expansion and enabling locking of the mandrel in its expanded condition. The arrangement of the locking structure is such that by a further simple manual manipulation it is possible to release the expanding mechanism and restore the mandrel to its unexpanded condition.

The above brief description, as well as further objects, features and advantages of the present invention will be best appreciated by reference to the following detailed description of a presently preferred mandrel and air-operated actuator, when taken in conjunction with the accompanying drawings wherein:

Fig. 1 is an elevational view with parts broken away and sectioned for the sake of clarity, showing an improved mandrel and actuator according to the present invention with the mandrel supported on the actuator and preparatory to expansion of the mandrel, cores being removed for clarity;

Fig. 2 is an enlarged fragmentary elevational view of the right end of the mandrel illustrated in Fig. 1 and the associated actuating structure, the actuator being shown in a position of travel during advance toward the adjacent end of the mandrel;

Fig. 3 is a view similar to Fig. 2 but showing the actuator in engagement with the adjacent end of the mandrel, the parts being illustrated in their relative position after expansion of the mandrel;

Fig. 4 is a sectional view on an enlarged scale taken substantially along the line 4—4 of Fig. 1 and looking in the direction of the arrows;

Fig. 5 is a fragmentary longitudinal section of the right end of the mandrel illustrated in Fig. 1, showing the details of the expanding and locking mechanisms with the mandrel in its unexpanded condition;

Fig. 6 is a view similar to Fig. 5 but showing the expanding mechanism after loading by the actuator (see Fig. 3) and before locking of the mandrel in its expanded position;

Fig. 7 is a view similar to Fig. 6 but showing the parts of the expanding and locking mechanism after the mandrel is locked in its expanded condition; and

Fig. 8 is a sectional view taken substantially along the line 8—8 of Fig. 7 and looking in the direction of the arrows.

Referring now specifically to the drawings, there is shown in Fig. 1 an expandable mandrel **10** in accordance with the present invention which is supported on an air-operated actuator, generally designated by the reference numeral **100**. The details of the mandrel **10** will be described in conjunction with Figs. 1 and 4–8 inclusive, while the details of the actuator **100** will be described in conjunction with Figs. 1–3 inclusive.

Referring first to the structure of the mandrel **10**, the same is seen to include a body **12** supported on a main shaft **14** having end portions **14***a*, **14***b* projecting beyond the opposite ends of the body **12**. The body **12**, as seen in Fig. 4, includes three segments **16**, **18**, **20** which together cooperate to define a generally cylindrical outer surface. The segments **16**, **18**, **20** are mounted by inwardly projected ribs **16***a*, **18***a*, and **20***a* confined for radial sliding movement on appropriate spiders **22** which are disposed at spaced locations along the length of the shaft **14** and are supported on a sleeve **24**. The sleeve **24** is concentric with and slidably supported on the shaft **14**. Although only one spider **22** is seen in the drawings for supporting the mandrel segments for radial adjustment, it will be appreciated that a number of such spiders are disposed along the length of the sleeve **24**, depending of course upon the length of the mandrel,

Additionally, it should be appreciated that the mandrel may be constructed with a main body part and one or more expandable segments, in lieu of the illustrated structure wherein the body 12 is entirely made up of expandable segments. When constructing small diameter mandrels it may be structurally necessary to have but a single expanding segment and accordingly the disclosure in this respect should be afforded a latitude of interpretation and substitution.

The segments 16, 18, 20 are limited in their expanding movement relative to the shaft 14 by the provision of split lock rings of springy material 26, 28 which are arranged at opposite ends of the mandrel body 12. As seen in Fig. 1, at the left end of the mandrel there is provided an annular internal seat 30 which accommodates the lock ring 26; similarly at the right end of the mandrel, and as seen best in Figs. 5 to 7 inclusive, there is provided a further annular seat 32 for the lock ring 28. The lock rings 26, 28, in conjunction with the spreading or expanding mechanisms to be described keep the several mandrel parts in assembly, yet allow for the expansion of the mandrel.

The sleeve 24 which is slidably supported on the shaft 14 carries on it a number of wedge members 34 each of which has a conical camming surface 36. The respective wedge members 34 are adjustable along the length of the sleeve 24 which is externally threaded; the individual wedge members may be locked in various positions of adjustment through provision of follower nuts 38. The interior of the respective mandrel segments 16, 18 and 20 are provided with camming surfaces 40 which are complementary to the surfaces 36 of the respective wedging or spreading members 34 and in contact therewith.

The assembly of the sleeve 24 and the several wedging members 34 are maintained in a normal position relative to the associated camming surfaces 40 and axially of the shaft 14 through provision of a coil spring 42. The spring 42 bears against the shoulder of a collar or stop 44 fixed to the shaft 14 and against the adjacent wedge member on the sleeve 24. It will be appreciated that as the sleeve 24 and the associated wedge members 34 are displaced to the left in Fig. 1 relative to the shaft 14 as a reference, the segments 16, 18, and 20 will be expanded. The degree of expansion will of course be determined by the lengthwise travel or stroke of the sleeve 24 relative to the shaft 14. Adjustment of the respective wedge members 34 relative to the associated camming surfaces 40 in a group allows for greater or lesser expansion for a given thrust or stroke; further, adjustment of the individual wedge members relative to their associated camming surfaces allows for different expansions of the mandrel along its length in situations where the mandrel is not of exactly the same dimensions throughout its length, for example, due to manufacturing tolerances. In this connection, the several sections or segments of the mandrel may be fabricated of extruded magnesium or aluminum to allow for the slight differences in expansion throughout their length, if necessary. Although the outer peripheral surfaces of the mandrel segments or sections 16, 18, and 20 are illustrated as being smooth and continuous, it will be appreciated that these surfaces may be provided with integral ridges or projections to enhance their gripping qualities.

On the right end portion of the shaft 14 and in end to end alignment with the mandrel body 12 is an expanding and locking unit, generally designated by the reference numeral 46, which may be displaced along the shaft 14 to urge the sleeve 24 axially and to the left along the shaft 14 (as viewed in Fig. 1) through a prescribed thrust for expanding the mandrel. The unit 46 includes a locking means, which in the expanded position of the mandrel, is turnable about the shaft 14 to lock the sleeve against return movement through the prescribed thrust, thus maintaining the mandrel in expanded condition. Specifically, the unit 46 includes a rotatable shell or housing 48 appropriately knurled on its outer surface to facilitate easy gripping and mounted to be turnable about the shaft 14 and shiftable along the shaft 14. Specifically, the housing 48 includes an end member or abutment 50 which is in bearing contact with and journaled on an enlarged sleeve 52 on the shaft 14; a lock plate 54 is likewise secured to the housing 48 and journaled on the sleeve 52 carried by the shaft 14. Thus, the assembly of the housing 48, the end member or abutment 50, and the lock plate 54 are turnable as a unit about the fixed assembly of the shaft 14 and the sleeve 52 and to a limited extent is shiftable along the shaft 14 toward the mandrel body 12.

Within the open end of the housing 48 which faces toward the mandrel body 12, there is provided a thrust bearing which includes a raceway part 56 loosely journaled on the sleeve 52 and having an annular raceway 58 which accommodates a plurality of ball bearings 60 carried in a ball bearing cage 62. The ball bearings 60 bear against the adjacent face of the lock plate 54. Secured to the sleeve 24 at the right end of the mandrel body 12 is a collar 64 having an abutment surface 66 facing the surface 68 of the thrust part 56 which is remote from the raceway 58. Between the abutment surfaces 66, 68 there is disposed a "Belleville" disk spring 70 which is loosely supported on the shaft 14 and in its unloaded condition is of generally dished configuration, as illustrated in Fig. 5. In response to the application of load to the expanding and locking unit 46, as indicated by the directional arrows 72, a spreading force is provided to the respective mandrel sections or segments 16, 18, 20 through a flat disk spring 70 and the associated components. The disk spring 70 as well as the coil spring 42 provide a reacting force to the loading 72. The parts are arranged such that the longitudinal shifting of the unit 46 toward the mandrel body 12, as may be appreciated by progressively inspecting Figs. 5 and 6, causes expansion of the mandrel. The degree of expansion may be observed by noting the relationship of the outer periphery of the mandrel 12 relative to the outer periphery of the unit 46 as a reference in Fig. 5, and the somewhat expanded position of the outer periphery of the mandrel 12 relative to said reference surface in Fig. 6.

On the main shaft 14 there is carried a transverse stub shaft 74 which has its opposite ends projecting into the housing or enclosure 46. Supported on the shaft 74 are rollers 76, 78 each of which is journaled by ball bearings. The rollers 76, 78 are arranged to cooperate with the locking plate 54 for the purpose of fixing the sleeve 24 relative to the shaft 14 in the expanded condition of the mandrel body 12. As seen best in Fig. 8 the face of the locking plate directed toward the rollers 76, 78, that is the face remote from the ball bearings 60 is provided with opposed arcuate depressions 80, 82 which are complementary to the curvature of the rollers 76, 78. These depressions 80, 82 extend inwardly from the flats 84, 86. The parts are initially dimensioned and assembled in the unexpanded condition of the mandrel, as shown in Fig. 5, with the rollers 76, 78 resting in the corresponding arcuate depressions 80, 82. Upon axial shift of the locking plate 54 to the left with the housing part 48 of the unit 46, the locking plate is moved into a position wherein the flats 84, 86 lie substantially in the plane of the adjacent peripheral surface of the rollers 76, 78. As seen in Fig. 6, in this position the rollers 76, 78 are cleared from their respective depressions and are free to ride onto the corresponding flats 84, 86, as seen in Figs. 7 and 8. This is achieved by a simple turning of the housing 48, the abutment member 50 and the lock plate 54 as a unit in the counterclockwise direction about the shaft 14, as viewed in Fig. 8, or from the right of Figs. 5, 6 and 7. When turned to the position of Figs. 7 and 8, the rollers 76, 78 cooperate with the rise portions or flats

84, 86 of the locking plate 54 to maintain the sleeve against return motion through the predetermined thrust corresponding to loading, and against the reaction force of the disk spring 70 which is seen in Figs. 6 and 7 to be somewhat flattened as compared to the condition illustrated in Fig. 5. When the rollers 76, 78 are on the flats 84, 86, the "Belleville" spring 70 urges the mandrel segment or segments outwardly, with a high order of live loading, and into contact with the cores arranged at spaced locations along the mandrel; and if the cores, which usually are of paper tend to stretch or expand during the loading or the winding operation, the "Belleville" disk spring exerts the requisite live loading force to urge the mandrel segments into tight gripping contact with the cores to preclude any possibility of slippage.

Reference will now be made to Figs. 1–3 and the details of the air-operated actuating mechanism 100 which is employed to engage the unit 46 and shift the same through the requisite thrust for expansion of the mandrel as described. Specifically, the actuator 100 includes a hollow base 102 having an upstanding bracket 104 at one end thereof. The bracket 104 carries an end stop 106 formed with a socket 108, the end stop 106 being adjustable in relation to the bracket 104 through provision of a threaded supporting shaft 110, lock nuts 112, 114 and a hand wheel 116. Further the end stop 106 with its socket 108 is mounted for vertical adjustability by means of an appropriate thrust bearing (not shown) to automatically accommodate the shaft position when the mandrel is expanded. The base 102 carries appropriate upstanding cradle members 118, 120 upon which the mandrel 10 may be supported with the end portion 14*a* in the socket 108.

Within the hollow base 102, there is arranged an air cylinder 122 connected to an appropriate source of air under pressure through valving, as is well understood in the art. Within the air cylinder 122 is a piston (not shown) which is operatively connected to a piston rod 124 in turn pivotally connected to a movable carriage 126 mounted on rollers 128 riding on appropriate tracks 130 on the floor of the base 102.

The carriage 126 is provided with an inclined runup track 131 which continues onto an inclined camming surface 132. Cooperating with the movable carriage 126 is an actuating member 134 which is in the form of a bell crank lever pivoted at 136 on a slide block 138. The block 138 is appropriately confined by the guide members 140, 142 for sliding movement along a predetermined vertical path from the base to an upper limit, as determined by the surface 142*a* of the bracket or guide member 142. On the rearwardly-projecting arm of the bell crank actuating member 134 there is provided a cam follower or roller 144 which is adapted to ride up the runup track 131 and onto the cam surface 132, as may be appreciated by progressively inspecting Figs. 1–3 inclusive. The upwardly-extending arm of the member 134 is bifurcated and carries a pair of rollers 146 which, as seen in Fig. 6, engage the abutment member 50 to provide the requisite shifting force, as designated by the arrows 72 in Fig. 5.

The operation of the actuator will now be described in conjunction with Figs. 1–3:

Upon application of air through the valving system to the cylinder 122, the piston 124 is displaced toward the right urging the carriage 126 to the right and causing the follower 144 to ride up the surface 131 and onto the cam surface 132. An intermediate position of the actuating member 134 is illustrated in Fig. 2 with the roller 144 on runup surface 131. When the roller 144 reaches the beginning of the camming surface 132 the slide block 138 reaches its limit position in contact with the stop 142*a* and continued displacement of the carriage to the right causes the bell crank 134 to be pivoted about its axis 136 in the counterclockwise direction. The degree of pivoting is of course determined by the slope of the camming surface 132. During the counterclockwise rocking of the actuating member 134, the rollers 146 straddle the adjacent end 14*b* of the shaft and contact the end member 50 of the unit 46. The degree of thrust imparted to the unit 46 is selected to expand the mandrel and bring the locking plate 54 into the position of Fig. 6 wherein it is ready to receive the locking rollers 76, 78, as previously described in detail. With the mandrel loaded into its extended or expanded condition and while still held in the actuator (as shown in Fig. 3), the operator grasps the knurled casing or housing 48 and rotates the same in the counterclockwise direction to bring flats of the locking plate 54 into contact with the adjacent peripheral surfaces of the rollers 76, 78 to lock the mandrel in the expanded condition. Thereupon, the air pressure may be released permitting the expanded mandrel to be removed from the actuator for use. Turning of the unit 46 to achieve locking while loaded does not require an inordinate amount of strength due to the rolling contact between the rollers 146 and the member 50 and the provision of the thrust bearing for the locking plate 54.

After the mandrel has been used in the expanded condition, the mandrel may be restored to its normal condition by turning the head end or unit 46 in the clockwise direction to bring the cylindrical depressions 80, 82 into registry with the respective rollers 76, 78. When the locking is released, the unit automatically restores itself to its unlocked condition.

In lieu of providing ridges on the peripheral surfaces of the mandrel to enhance gripping, it is equally within the contemplation of the invention to provide a multiplicity of apertures in the peripheral surfaces of the mandrel body. Upon expansion with this type of mandrel body, there is a tendency for the cores to embed into the apertures to lock the cores to the mandrel body.

From the foregoing detailed description it will be appreciated that numerous modifications may be made without departing from the spirit and scope of the invention, and accordingly the appended claims should be construed broadly and as is consistent with the disclosure herein. In some instances certain features of the invention will be used without a corresponding use of other features.

What I claim is:

1. An expandable mandrel comprising a shaft, a sleeve on said shaft slidable relative to said shaft, a multiple segment mandrel body surrounding said shaft, means operatively connected to at least one of said segments and mounting said one segment for limited radial movement relative to said shaft, said one segment being formed with a camming surface, means on said sleeve in urged engagement with said camming surface and arranged to expand said one segment in response to movement of said sleeve in one direction through a prescribed thrust, spring means resisting movement of said sleeve in said one direction, cooperating locking means operatively connected to said shaft and engageable when said sleeve is urged through said prescribed thrust, said cooperating lock means including rollers on said shaft and a lock plate rotatably mounted on said shaft and shiftable into position to receive said rollers in response to movement of said sleeve through said prescribed thrust, said lock plate being turnable about said shaft in said position to engage said rollers and to lock said sleeve against return movement through said prescribed thrust, and means operative to drive said sleeve through said prescribed thrust.

2. An expandable mandrel comprising a shaft, a sleeve on said shaft slidable relative to said shaft, a multiple segment mandrel body surrounding said shaft, means operatively connected to at least one of said segments and mounting said one segment for limited radial movement relative to said shaft, said one segment being mounted in movable relation to said shaft and to the other segments

of said mandrel body along the entire length of said one segment, said one segment being formed with a camming surface, means on said sleeve in urged engagement with said camming surface and arranged to expand said one segment in response to movement of said sleeve in one direction through a prescribed thrust, spring means resisting movement of said sleeve in said one direction, locking means operatively connected to said shaft and engageable when said sleeve is urged through said prescribed thrust, and means operative to drive said sleeve through said prescribed thrust.

3. An expandable mandrel comprising a shaft, a sleeve on said shaft slidable relative to said shaft, a round mandrel body having plural segments surrounding said shaft, means operatively connected to said segments mounting said segments for limited radial movement relative to said shaft, each of said segments being mounted in movable relation to said shaft and to the other segments of said mandrel body along the entire length of said segments, said segments being formed with camming surfaces, wedge means on said sleeve in urged engagement with the respective camming surfaces and arranged to expand said segments in response to movement of said sleeve in one direction through a prescribed thrust, spring means resisting movement of said sleeve in said one direction, cooperating locking means operatively connected to said shaft and engageable when said sleeve is urged through said prescribed thrust, and means operative to drive said sleeve through said prescribed thrust.

4. In combination, an expandable mandrel comprising a shaft, a sleeve on said shaft slidable relative to said shaft, a multiple segment mandrel body surrounding said shaft, means operatively connected to at least one of said segments mounting said one segment for limited radial movement relative to said shaft, said one segment being formed with a camming surface, means on said sleeve in urged engagement with said camming surface and arranged to expand said one segment in response to movement of said sleeve in one direction through a prescribed thrust, spring means resisting movement of said sleeve in said one direction, cooperating locking means operatively connected to said shaft and engageable when said sleeve is urged through said prescribed thrust, said cooperating lock means including rolling contact members on said shaft and a lock plate rotatably mounted on said shaft and shiftable into a locking position to receive said contact members in response to movement of said sleeve through said prescribed thrust, said lock plate being turnable about said shaft in said locking position to engage said contact members and to lock said sleeve against return movement through said prescribed thrust, and air-actuated means operative to drive said sleeve through said prescribed thrust, said air-actuated means including an actuating head arranged to drive said lock plate into said locking position wherein said lock plate may be manually turned.

5. An expandable mandrel comprising a shaft, a sleeve on said shaft shiftable longitudinally of said shaft, a multiple segment mandrel body surrounding said shaft, means operatively connected to at least one of said segments mounting said one segment for limited radial movement relative to said main shaft, said one segment being formed with a camming surface, wedge means on said sleeve in engagement with said camming surface and arranged to expand said one segment in response to longitudinal movement of said sleeve relative to said shaft in one direction through a prescribed thrust, spring means resisting movement of said sleeve in said one direction, a turnable housing on said shaft and shiftable longitudinally of said shaft, cooperating locking means operatively connected to said shaft and engageable when said sleeve is urged through said prescribed thrust, said cooperating lock means including rollers on said shaft and a lock plate connected to said housing and shiftable into position to receive said rollers in response to movement of said sleeve through said prescribed thrust, said lock plate being turnable about said shaft in said position to engage said rollers and to lock said sleeve against return movement through said prescribed thrust, and air-actuated means engageable against said housing and operative to drive said sleeve through said prescribed thrust.

6. In combination, an expandable mandrel comprising a shaft, a sleeve on said shaft movable relative to said shaft, a multiple segment mandrel body surrounding said shaft, means operatively connected to at least one of said segments mounting said one segment for expansion relative to said shaft, said one segment being formed with a camming surface, means on said sleeve in engagement with said camming surface and arranged to expand said one segment in response to movement of said sleeve in one direction through a prescribed thrust, means including a flat spring resisting movement of said sleeve in said one direction, cooperating locking means operatively connected to said shaft and engageable when said sleeve is urged through said prescribed thrust, and air-actuated means operative to drive said sleeve through said prescribed thrust, said air-actuated means including an end stop adapted to engage against one end of said shaft, an actuating head, means mounting said actuating head for movement into alignment with the other end of said shaft and for movement in a direction to shift said sleeve longitudinally of said shaft, and means including a cylinder and a piston operating therein for moving said actuating head.

7. An expandable mandrel comprising a shaft, a sleeve on said shaft slidable relative to said shaft, a mandrel body having an expandable segment surrounding said shaft, means operatively connected to said segment and mounting said segment for limited radial movement relative to said shaft, said segment being formed with camming surfaces all facing in the same direction, means on said sleeve all facing in a direction to engage said camming surface and arranged to expand said segment in response to movement of said sleeve in one direction through a prescribed thrust, spring means resisting movement of said sleeve in said one direction, cooperating locking means operatively connected to said shaft and engageable in a prescribed position of adjustment when said sleeve is urged through said prescribed thrust to lock said sleeve against return movement through said prescribed thrust, and actuating means operative to drive said sleeve through said prescribed thrust.

8. An expandable mandrel comprising a shaft, a sleeve on said shaft slidable relative to said shaft, a mandrel body having an expandable segment surrounding said shaft, means operatively connected to said segment and mounting said segment for limited radial movement relative to said shaft, said segment being formed with a camming surface, means on said sleeve in urged engagement with said camming surface and arranged to expand said segment in response to movement of said sleeve in one direction through a prescribed thrust, spring means resisting movement of said sleeve in said one direction, cooperating locking means operatively connected to said shaft and engageable in a prescribed position of adjustment when said sleeve is urged through said prescribed thrust to lock said sleeve against return movement through said prescribed thrust, and actuating means operative to drive said sleeve through said prescribed thrust, said actuating means including a base receiving said mandrel and including an end stop engaging against one end of said shaft, an actuating head, means mounting said actuating head for movement into alignment with the other end of said shaft and for movement in a direction to shift said sleeve longitudinally of said shaft, and means operatively connected to and moving said actuating head to drive said sleeve through said prescribed thrust.

9. An expandable mandrel comprising a shaft, a sleeve on said shaft slidable relative to said shaft, a mandrel body having an expandable segment surrounding said

shaft, means operatively connected to said segment and mounting said segment for limited radial movement relative to said shaft, said segment being formed with a camming surface, means on said sleeve in urged engagement with said camming surface and arranged to expand said segment in response to movement of said sleeve in one direction through a prescribed thrust, spring means resisting movement of said sleeve in said one direction, cooperating locking means operatively connected to said shaft and engageable in a prescribed position of adjustment when said sleeve is urged through said prescribed thrust to lock said sleeve against return movement through said prescribed thrust, and actuating means operative to drive said sleeve through said prescribed thrust, said actuating means including a base receiving said mandrel and including an end stop engaging against one end of said shaft, an actuating head, means mounting said actuating head for movement into alignment with the other end of said shaft and for movement in a direction to shift said sleeve longitudinally of said shaft, and means including an air cylinder and a piston operating therein for moving said actuating head to drive said sleeve through said prescribed thrust.

10. An expandable mandrel comprising a shaft, a sleeve on said shaft slidable relative to said shaft, a mandrel body having an expandable segment surrounding said shaft, means operatively connected to said segment and mounting said segment for limited radial movement relative to said shaft, means on said sleeve in urged engagement with said segment to expand said segment in response to movement of said sleeve in one direction through a prescribed thrust, spring means resisting movement of said sleeve in said one direction, cooperating locking means operatively connected to said shaft and engageable in a prescribed position of adjustment when said sleeve is urged through said prescribed thrust to lock said sleeve against return movement through said prescribed thrust, and actuating means operative to drive said sleeve through said prescribed thrust, said actuating means including a base receiving said mandrel and including an end stop engaging against one end of said shaft, an actuating head, means mounting said actuating head for movement into alignment with the other end of said shaft and for movement in a direction to shift said sleeve longitudinally of said shaft, and means operatively connected to said actuating head for moving said actuating head to drive said sleeve through said prescribed thrust.

11. An actuator for expanding an expandable mandrel having a shaft and a part shiftable relative to said shaft to expand said mandrel comprising a base, cradle means on said base adapted to receive said mandrel, stop means on said base adapted to engage one end of said shaft, a mounting member, means on said base mounting said member for movement through a prescribed linear thrust, an actuating head, means pivotally mounting said actuating head on said mounting member for pivotal movement through a prescribed arcuate thrust, and means engaging said actuating head for moving said member through said prescribed linear thrust to bring said actuating head into an operative position contiguous to the other end of said shaft and for pivoting said actuating head through said prescribed arcuate thrust into engagement with said part for shifting said part relative to said shaft with said stop means providing a reaction force to said actuating head.

12. An actuator according to claim 11 wherein the means which engages said head includes an air cylinder and a piston operating therein.

13. An actuator for expanding an expandable mandrel having a shaft and a part shiftable relative to said shaft to expand said mandrel comprising a base, cradle means on said base adapted to receive said mandrel, stop means on said base adapted to engage one end of said shaft, a mounting member, means on said base mounting said member for vertical movement through a prescribed linear thrust, an actuating head, means pivotally mounting said actuating head on said mounting member for pivotal movement through a prescribed arcuate thrust, and means engaging said actuating head and including a cam and follower for moving said member through said prescribed linear thrust to bring said actuating head into an operative position contiguous to the other end of said shaft and for pivoting said actuating head through said prescribed arcuate thrust into engagement with said part for shifting said part relative to said shaft with said stop means providing a reaction force to said actuating head.

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