Jan. 26, 1960 J. I. GREENBERGER 2,922,593

REEL STRUCTURE

Filed May 31, 1955 3 Sheets-Sheet 1

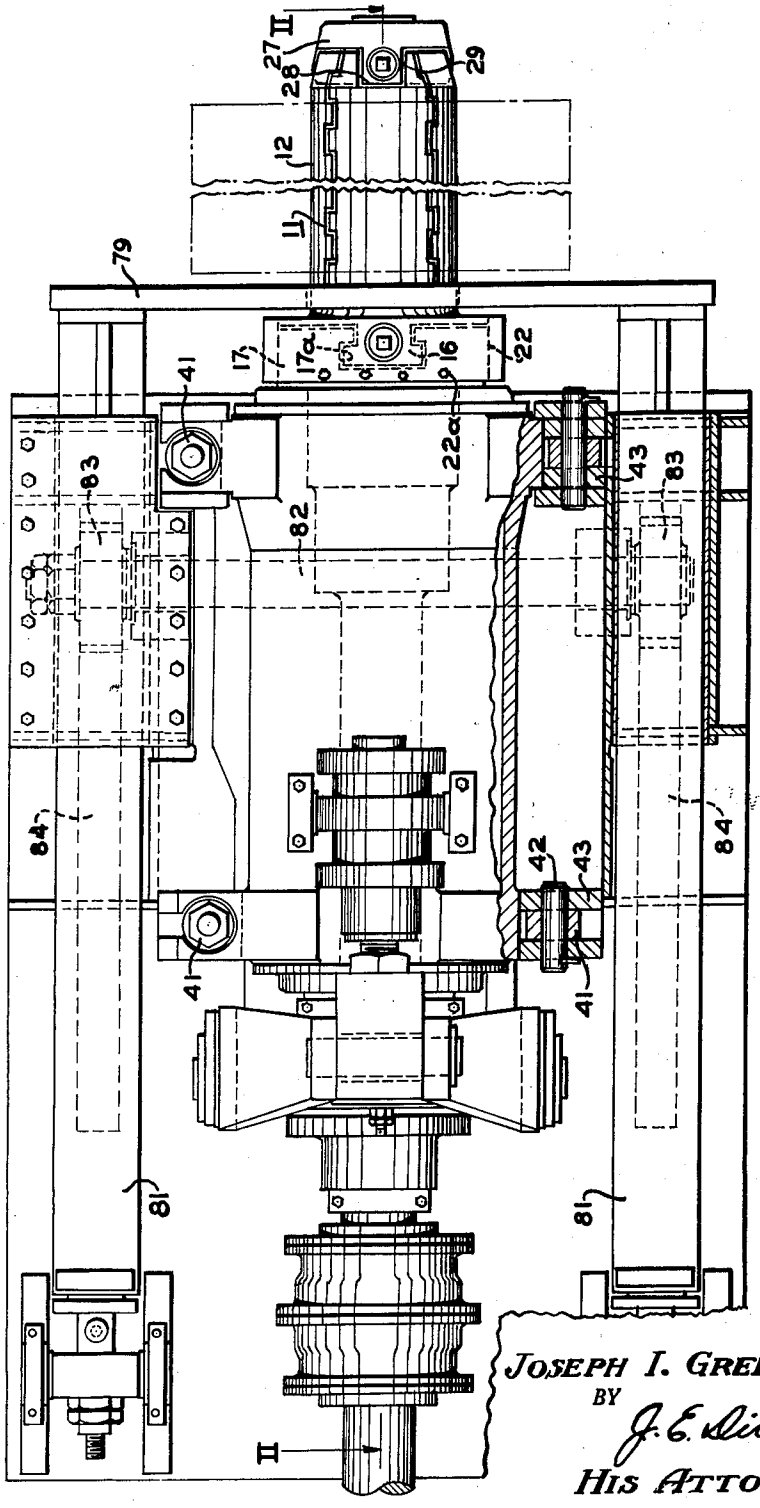


Fig. 1

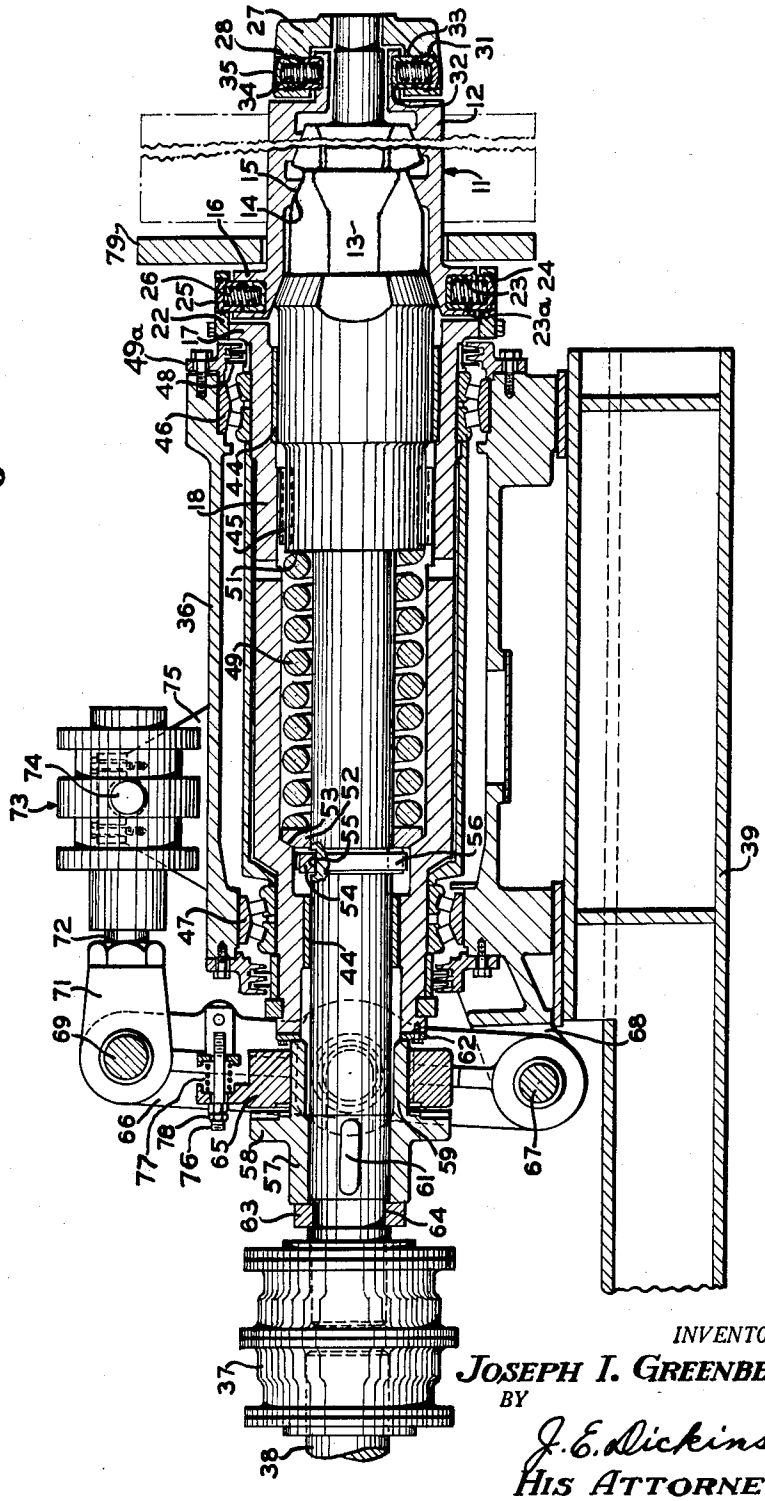
INVENTOR.
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Fig. 2



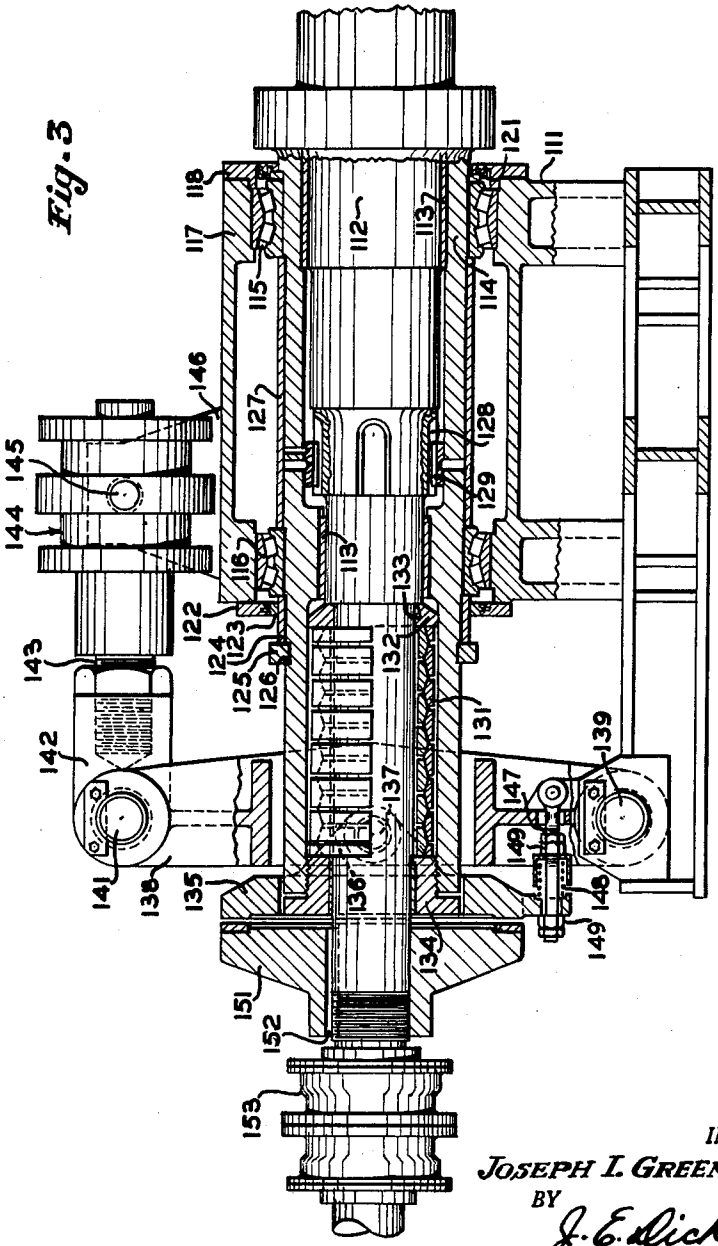
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Fig. 3



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REEL STRUCTURE

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3 Claims. (Cl. 242—72.1)

This invention relates to an improvement in a reel of the collapsible type and, in particular, to a reel in which novel means are incorporated for expanding the reel and maintaining it in its expanded condition in such a manner that the thrust forces incidental to expansion are self-contained and not imposed upon the bearing elements as is normally the case in reels as presently employed for coiling metallic strip.

Reels of the expansible and collapsible type have many design limitations and for driving them usually employ either a motor which is directly connected to the reel shaft or a motor and a reducing gear unit which are connected thereto. In the first instance, a large thrust bearing is mounted on the reel shaft to which the power means for expanding and collapsing the reel is connected so that during operation of the reel the thrust forces incident to expanding the reel are taken up by the bearings thereby resulting frequently in bearing failure when operating at high speeds. In the other instance, the motor is offset from the reel shaft and an hydraulic piston-cylinder assembly is mounted on the end of the reel. The piston rod is extended through the reel shaft and is connected to the reel segments in such a fashion as to cause the reel to be expanded on axial movement of the rod and to impose upon the shaft the thrust forces incident thereto. However, the use of a rotating cylinder in reel mechanisms is strongly objected to so that reels of this type are not so readily received by the trade.

It is, therefore, an object of this invention to provide an improved reel of the collapsible type having novel means for providing the force necessary to expand and to maintain the reel in the expanded condition while at the same time relieving the reel supporting bearings of thrust forces which are normally present in reels as commonly employed.

It is another object of this invention to provide a self-contained reel and pressure means for expanding and maintaining the reel in the expanded condition and yet not subject the bearings of the reel to heavy thrust forces during the coiling operation.

It is still a further object of this invention to eliminate the objectionable features of the present day reels by providing a highly effective unitary system for expanding and maintaining the reel in its expanded condition.

These objects, as well as the various other novel features and advantages of this invention, will become apparent from the following description and accompanying drawings in which:

Figure 1 is a plan view of a reel in its expanded condition incorporating the features of the present invention;

Figure 2 is a longitudinal sectional view taken on lines II—II of Figure 1, and

Figure 3 is a longitudinal sectional view showing a modification of the reel expanding and collapsing mechanism.

With reference to these drawings the preferred illustrative form of the present invention is employed in conjunction with a collapsible tension reel of the type

normally employed in the coiling of cold rolled metallic strip, although it will be apparent to those skilled in the art that the present invention may be employed in any collapsible coiling apparatus other than the specific form illustrated and described herein. In this particular embodiment, a reel head **11** is shown comprising a plurality of radially movable segments **12** which are mounted upon a circular reel shaft **13**, the outer surfaces of the shaft and the inner surfaces of the segments being provided with inclined surfaces **14** and **15** respectively so that on axial movement of the shaft to the right the segments **12** will move radially outward for expanding the reel head **11**.

At the inboard end of the reel segments there are provided radially extending T-shaped projections **16** which are slidably received in vertical T-slots **17***a* machined in a flanged portion **17** formed on an annular cartridge **18**, as best shown in Figure 2, so that on expansion or contraction of the reel the projections **16** slide radially in the slots **17***a*. Surrounding the projections **16** and the flange **17** there is a retaining ring **22** which is secured to the flanged portion **17** by suitable studs **22***a*. The projection **16** of each segment is provided with a radially extending cavity **23**, the lower portion of which is of a reduced diameter to form a shoulder **23***a*. The ring **22** has four openings **24** axially aligned with the cavities **23** which are threaded for a portion of their depths to receive in threaded relationship a cartridge **25** having a compression spring **26** confined therein. To limit the arrangement by which the reel may be expanded, the lower end of the cartridge acts as a stop by striking against the shoulder **23***a*.

On the outboard end of the reel head there is a similar arrangement for securing together the ends of the segments. Instead of a ring at the outer end of the reel, a cap **27** is provided which is slidably received on the end of the reel shaft. There are four longitudinally extending projections **28** spaced diametrically around the inner end of the cap which extend into slots **29** machined into the outer end of each of the reel segments. The projections **28** are provided with partially threaded openings **31** which are aligned with cavities **32** in the reduced end portion of the segments. A cartridge **33** is positioned within each of the cavities **32** and extends up into the lower portion of the threaded openings **31**. Within the cartridges **33** there are confined compression springs **34** which are held in place by additional cartridges **35** threadably secured within the openings **31** and which are adjustable for compressing the spring to the extent as may be desired. The cartridges **33** serve not only as seats for the springs contained therein but also serve as a means for securing together the cap **27** and the reel segments **12** thereby preventing endwise as well as relative rotary movement therebetween. When the reel is expanded to the extent desired, the cartridges **25** are tightened until the lower portions thereof bear upon the shoulders **23***a* and the cartridges **35** tightened to cause the lower ends thereof to strike against the upper portions of the cartridges **33** and then backed away to provide a very slight clearance between the cartridges. This adjustment is necessary to provide for absorbing the centrifugal forces of the reel segments which would otherwise be imposed upon and unduly stress the compression springs **26** and **34**. When the reel shaft is displaced axially, then, for collapsing the reel, the force of the springs **26** and **34** will cause the segments **12** to move radially inward.

With reference to Figure 2 the reel shaft **13** extends longitudinally through openings in a frame **36** and into a suitable heavy duty coupling **37** which, in turn, is connected to a drive shaft **38**. The end of the shaft **13** is free to slide axially for a certain distance within the coupling **37** for a purpose to be defined hereinafter. The frame **36** is secured to a suitable extended platform **39**. Suitable eye bolts **41** are secured to the corners of the

frame and they extend downward with the eye at the bottom for receiving a pin 42, the pins 42 being supported in openings provided in brackets 43 secured to the frame. To remove the reel assembly from the platform, it is simply necessary to remove the nuts from the ends of the eye bolts 41 and by means of a crane lift the entire assembly off the platform.

The cartridge 18 is provided with bushings 44 for permitting the shaft 13 to slide freely therein and with a splined connection 45 between the sleeve and shaft for preventing relative rotation between the two. The ends of the cartridge 18 are rotatably supported in suitable bearings 46 and 47 carried by the frame 36. For preventing the front bearing 46 from being displaced axially, retainers 48 encircle the cartridge and engage the inner ring of the bearing while the outer race is held in place by a ring 49*a*. The inner bearing 47 is so mounted that it floats freely with any movement of the cartridge 18. A compression spring 49 encircles the shaft 13 along a reduced diameter portion and at one end engages a shoulder 51 formed on the shaft. The opposite end of the spring 49 makes contact with a loosely mounted washer 52 tapered at the outer surface to seat firmly within the tapered seat 53 of the cartridge 18. For purposes of assembly, the spring is placed upon and compressed on the shaft and a split ring 54 is inserted in a groove 55 provided on the shaft. A second ring 56 is then placed over the split ring 54 and welded thereto, thereby positively securing the ring 54 within the groove 55 and the spring 49 upon the shaft. The ring 56 is slightly less in diameter than the opening at the end of the cartridge so that when the shaft 13 is inserted in the cartridge and secured thereto the ring will pass freely therethrough while the washer seats itself in the tapered seat and the spring will be compressed slightly more than when in its preset condition. This, then, results in a self-contained unit since the force of the spring is taken up between the washer 52 and the cartridge 18 at one end and by the shoulder 51 of the shaft 13 at the other end.

At the end of the shaft 13 there is a circular block 57, having a flanged portion 58, and a cylindrical portion 59, which is secured to the shaft 13 by a key 61. Normally contacting the end of the cylindrical portion 59 there is a replaceable wearing ring 62 which is secured to the end of the cartridge 18. Adjacent to and in contact with the outer end of the block 57 there is a spacer ring 63 secured within a groove 64 on the shaft 13. Encircling the block cylindrical portion 59 and slidable therealong there is a pressure block 65 which is pivotally secured to a yoke 66. At the lower extremity the yoke 66 is pivotally secured by a pin 67 to an arm extending rearward from the frame. The upper end of the yoke 66 is pivotally secured by a pin 69 to an extension 71 threadably secured to the end of a piston rod 72 of a piston-cylinder assembly 73 pivotally mounted on trunnions 74 supported in brackets 75 secured to the top of the frame 36. When the reel is in the expanded condition for coiling, there will be a slight clearance between the face of the flange 58 and the block 65 thereby avoiding wear between these parts when the reel is being rotated. A stud 76 with a spring 77 thereon confined between the block 65 and a bracket on the yoke and having adjustable nuts 78 thereon acts as a secondary support for the block 65 and yet permits the block 65 to shift somewhat so that the surface thereof will make contact with the surface of the flange 58 of the block 57. A stripper plate 79 encircles the reel and is actuated by two piston-cylinder assemblies 81 connected thereto which are connected together by an equalizing shaft 82 having pinions 83 at either end which traverse racks 84 mounted upon the frame.

A sectional view of a modified form of the mechanism employed for expanding and collapsing the reel is shown in Figure 3. Since the reel segments and portions of the shaft cooperating therewith are of the same type as shown

in the preferred form of invention according to Figure 2, these elements are not shown or described further in detail. In accordance with Figure 3 there is shown therein a frame 111 upon which the reel and its expanding and contracting mechanism are supported. The reel shaft 112 is mounted in bushings 113 which are inserted in a cartridge 114 mounted for rotation in bearings 115 and 116 supported by the frame 111 and enclosed by a cap 117. At the forward end of the cap 117 and to the frame 111 there is secured a split ring 118 which is provided with suitable grooves and fins which cooperate with similar grooves and fins of a spacer ring 121 which engages with the inner race of the bearing 115. To the opposite end of the cap 117 and the frame 111, there is secured a split ring 122 having grooves and fins which cooperate with the grooves and fins of a ring 123 which, in turn, is mounted on a spacer ring 124 surrounding the cartridge 114 and held in place by a keeper ring 125 secured within a circumferential groove 126 machined in the cartridge 114. A sleeve 127 mounted on the cartridge 114 maintains the bearings in their spaced relationship with respect to the cartridge. To permit slidable movement of the shaft within the cartridge 114 and yet prevent relative rotation between the two, the shaft 112 is provided with longitudinally extending grooves 128 within which keys 129, secured within the cartridge 114, are slidably received.

Inboard of and surrounding the shaft 112 there is provided a series of ring springs 131 confined between a washer 132 mounted on and engaging a shoulder 133 of the shaft and an adjustable plug 134 threaded into the end of the cartridge 114. Loosely mounted on the plug 134 there is a pressure plate 135. The pressure plate 135 is provided with a pair of brackets 136 through which a pin 137 is passed for pivotally securing a yoke 138 thereto. At its lower end the yoke 138 is pivotally secured to the frame 111 by a pin 139 and at its upper end there is pivotally secured thereto by a pin 141 a bifurcated piston rod extension 142. The extension 142 is threaded onto the end of a piston rod 143 extending outward from a piston cylinder assembly 144 having a trunnion 145 which is pivotally mounted in upwardly extending spaced brackets 146 secured to the cap 117. To the lower portion of the pressure plate 135 there is secured an eye bolt 147 having a spring 148 mounted thereon, the initial compression of which may be varied by adjusting either of the two sets of lock nuts 149.

Adjacent to the plate 134 and spaced therefrom, there is a second pressure plate 151 which is threaded onto the shaft 112 and keyed in place by a key 152. A coupling 153 is provided for connecting together the shaft 112 and the shaft of a driving motor, not shown. In this embodiment, it is noted that ring type springs 131 have been employed. This same type of spring could be used in the preferred form of invention rather than a helical spring as is shown and it may be found more desirable to do so particularly if a greater shaft diameter is required for purposes of strength.

Although in the modified form of invention the stops for limiting the outward axial travel of the shaft are embodied in the reel itself and hence not specifically shown, an additional stop such as that employed in the preferred form could very readily be incorporated in this embodiment as well. One of the particular advantages for locating the springs in the position as shown in Figure 3 is that they may be removed quite readily simply by disconnecting the coupling 153 and providing clearance at the drive side for removing the pressure plates 151 and 135 and the plug 134 to permit withdrawal of the spring members 131.

The invention now having been described in detail, the operation of the reel embodying the preferred form of invention may be briefly summarized as follows:

It is assumed that no pressure is acting on the piston-cylinder assembly 73 so that the spring 49 is then free

to slide the reel shaft **13** to the right. The reel segments are thereby moved radially outward to expand the reel for coiling. In order to relieve the cartridges **25** and **33** of the direct force of the spring **49** while the reel is expanded, a stop is provided for limiting the axial movement to the right of the shaft **13** which comprises a wear plate **62** secured to the end of the cartridge **18** and against which the cylindrical portion **59** of the block **57** strikes when the shaft reaches its maximum travel. As a strip is coiled on the reel and the coil increases in diameter, the radial forces incident to coiling eventually have a sufficient horizontal component by reason of the angle of the tapered portion **15** of the shaft to cause the shaft to move to the left against the resistance of the spring thereby causing the spring to be compressed slightly so that the segments of the reel are thereby relived of the intense compression forces of the coil and the coil will retain the forces within itself.

After a coil has been built up to the desired diameter, the reel driving motor is stopped and the reel collapsed by actuating the piston-cylinder assembly **73** thereby to move the yoke **65** and the reel shaft **13** to the left, further compressing the spring **49**. If it is desirable to do so before the coil is removed from the reel, the driving motor may be slowly rotated and stopped at a point to place the trailing end of the strip at the top of the coil. To remove the coil from the reel, the piston-cylinder assemblies **81** are actuated to slide the stripper plate **79** to the right thereby to engage the inner coil face and push the coil from the reel and on to a coil car or other conveyor.

After the coil has been stripped from the reel and the stripper plate again brought back to its former position as shown in Figure 2, hydraulic pressure is cut off from the piston-cylinder assembly **73** so as to permit the spring **49** to expand and thereby slide the shaft **13** to the right to cause the segments **12** to move outward into their reel expanded positions. Though some thrust forces may be imposed upon the bearings **46** and **47** when the shaft is being moved toward and away from the reel expanding position, these forces are merely static forces and are adequately provided for in the construction of the bearings. However, during the time the reel is being rotated for coiling a strip thereon, no thrust forces are imposed upon the bearings.

In accordance with the provisions of the patent statutes, I have explained the principle and operation of my invention and have illustrated and described what I consider to represent the best embodiment thereof. However,

I desire to have it understod that within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

1. An expansible mandrel comprising a frame which includes a rotatable cartridge and a non-rotatable member surrounding said cartridge, a shaft mounted in said cartridge with both ends thereof extending longitudinally outward beyond the ends of said cartridge and with one end thereof extending beyond said frame, a plurality of segmental elements mounted upon and spaced circumferentially around the portion of said shaft extended beyond said frame and movable radially outward to an expanded position on axial movement of said shaft in one direction, bearing means mounted in said frame member entirely and rotatably supporting said cartridge, pressure means intermediate the ends of said shaft and engaging said cartridge and said shaft, and a sleeve secured to said shaft adjacent to the end thereof and outward of said cartridge whereby on movement of said shaft by said pressure means in a direction to expand said mandrel said sleeve will engage said cartridge thereby to relieve said bearing means of forces incident to expansion of said mandrel.

2. An expansible mandrel according to claim 1 in which said pressure means comprises a spring surrounding said shaft which is engaged at one end with said shaft and engaged at the other end thereof with said cartridge.

3. An expansible mandrel according to claim 1 including a shoulder on the portion of said shaft within said cartridge and a spring surrounding said shaft and engaging said shoulder at one end and said cartridge at the other.

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