

June 8, 1943.

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2,321,146

EXPANDING AND CONTRACTING MANDREL FOR COIL HOLDERS, REELS, OR THE LIKE

Filed Dec. 22, 1941

5 Sheets-Sheet 1

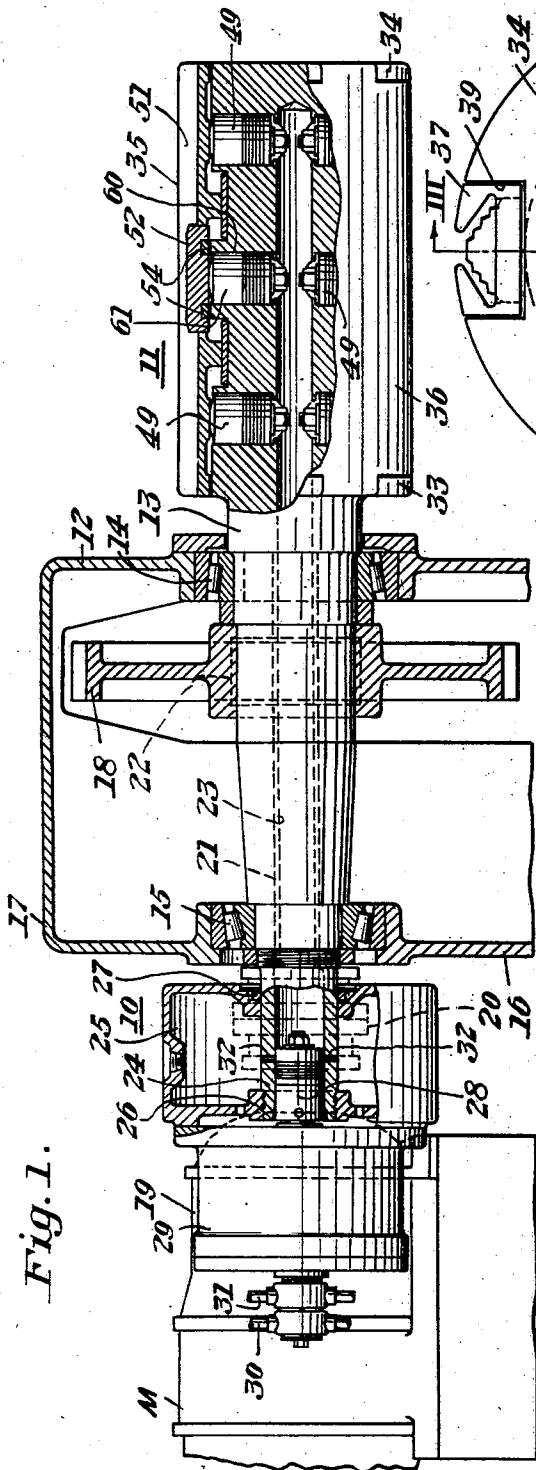


Fig. 1.

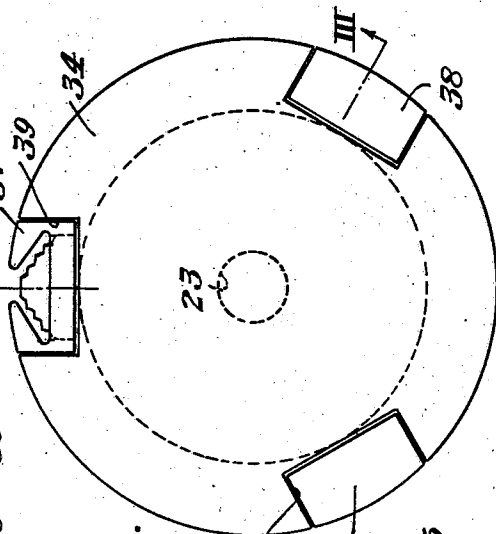


Fig. 2.

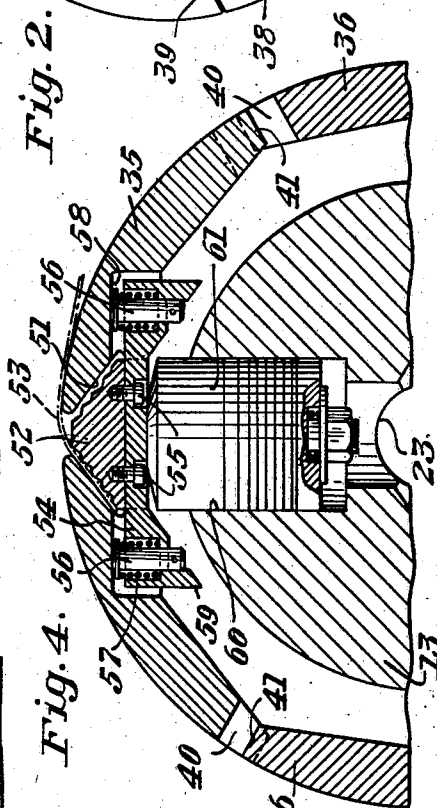


Fig. 4.

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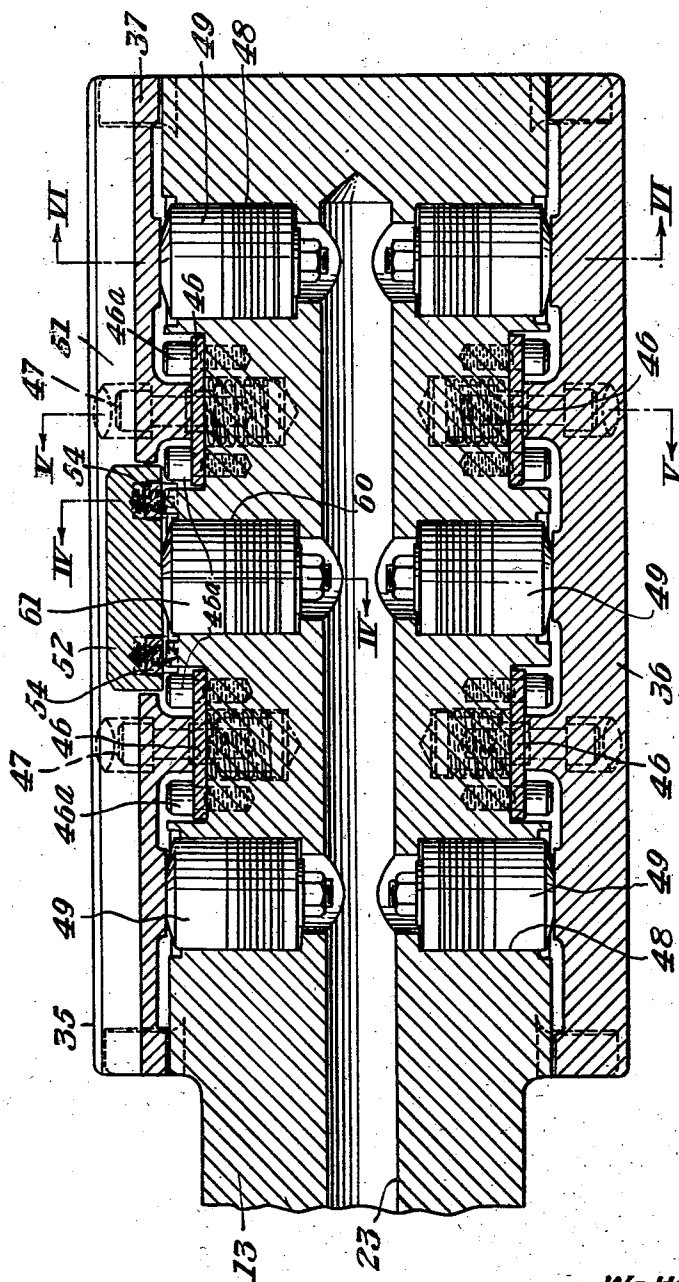
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Fig. 3.



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Fig. 5.

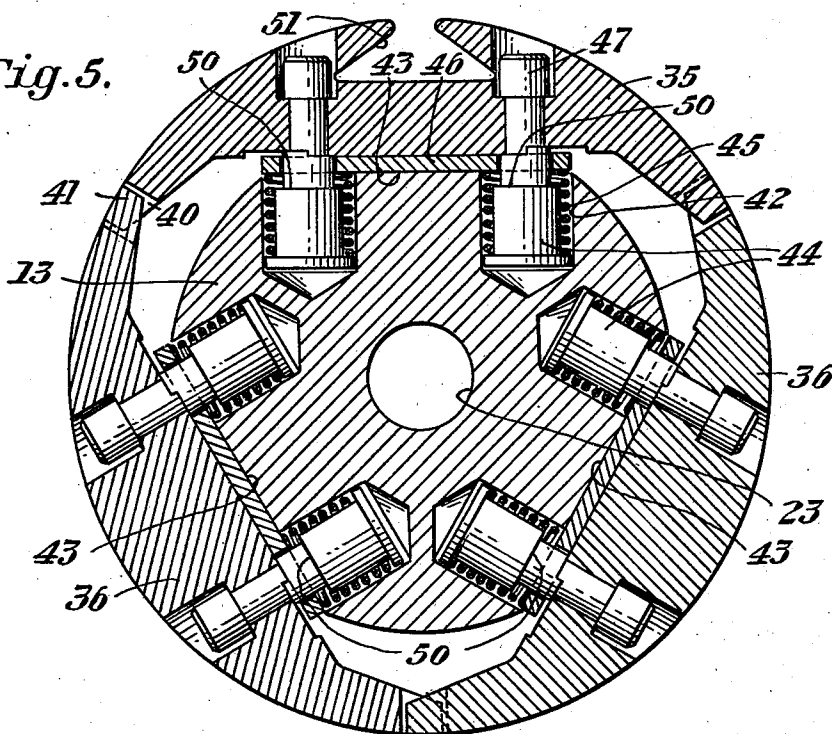
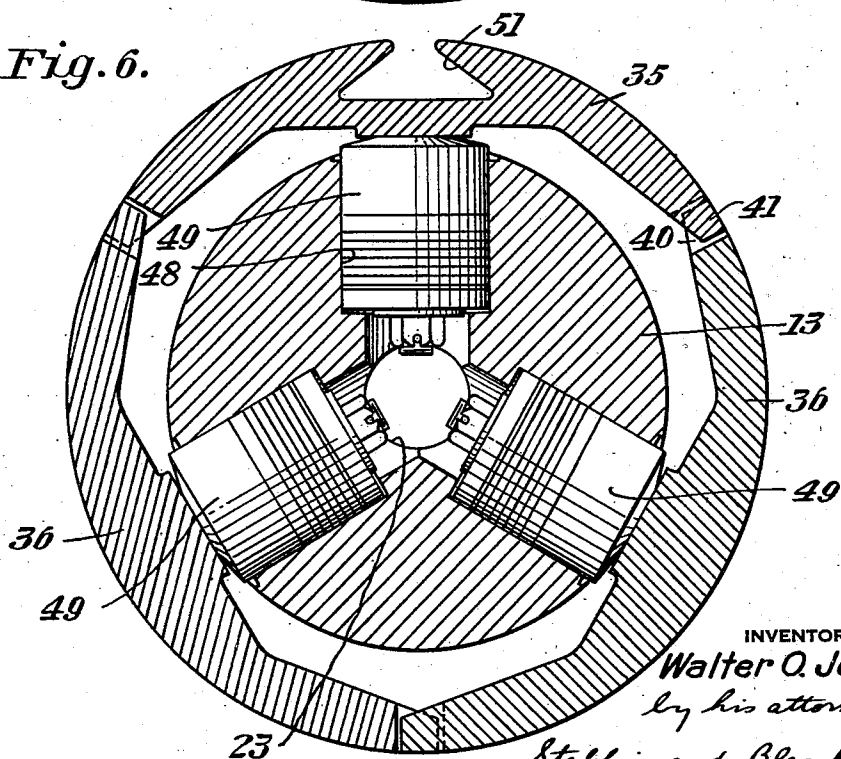


Fig. 6.



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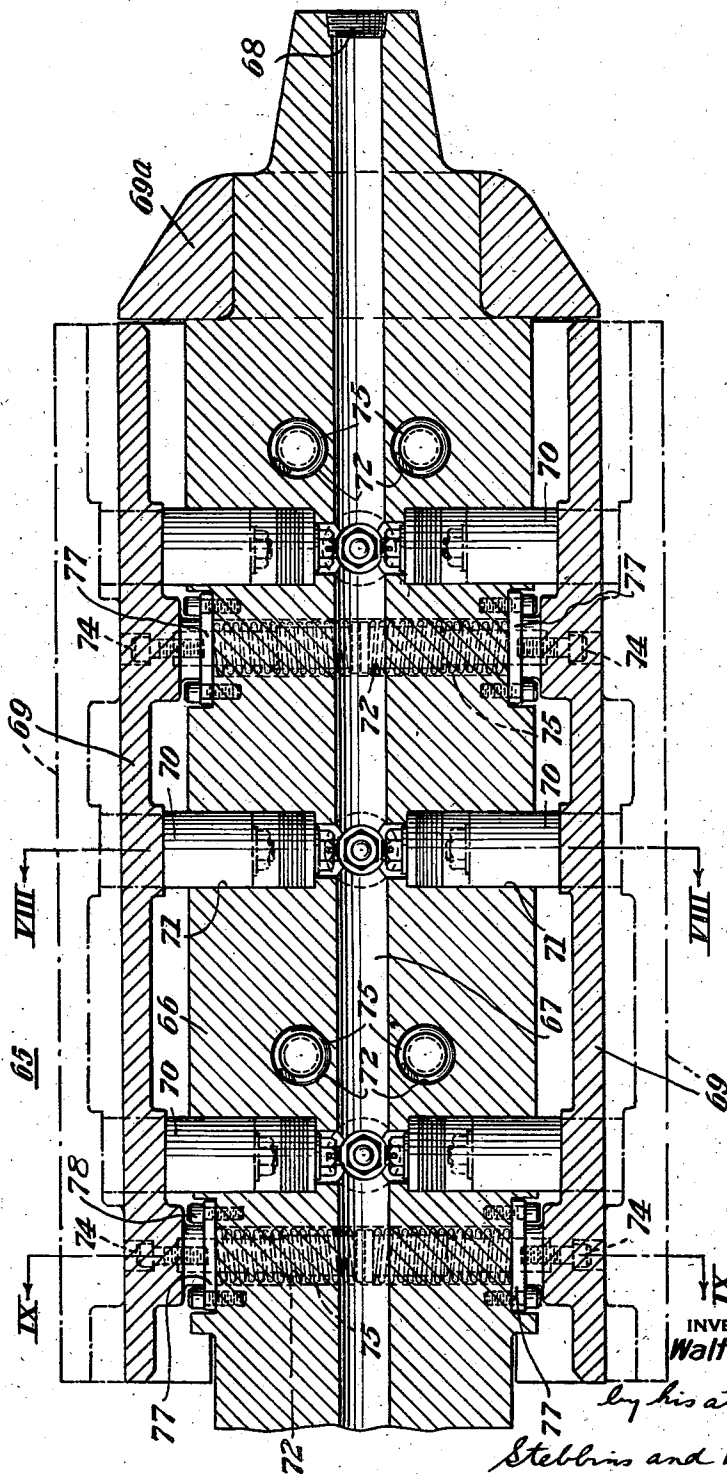
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Fig. 7.



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Fig. 8.

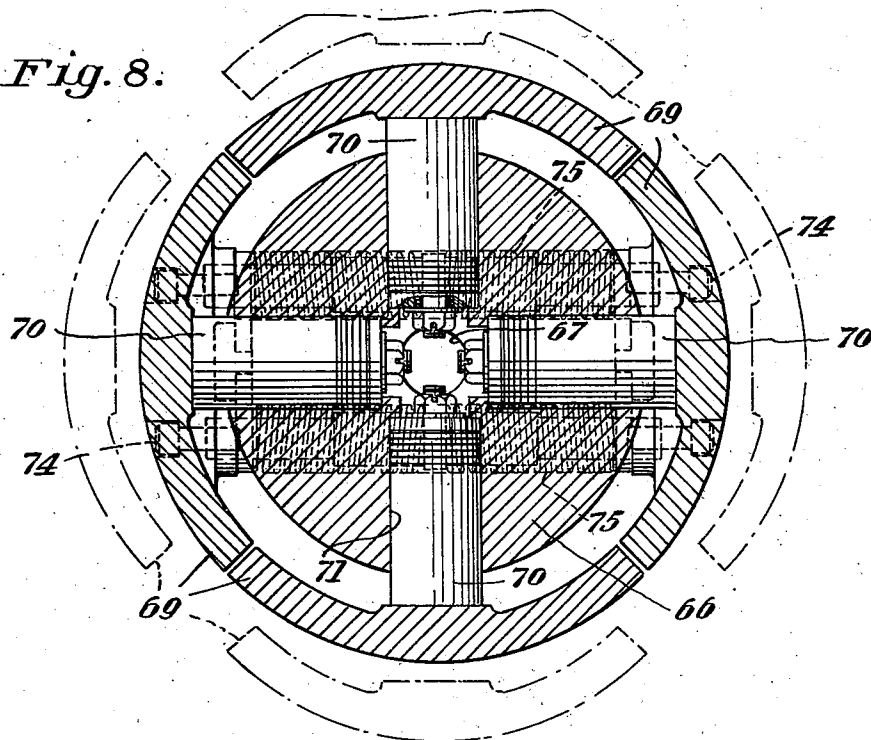
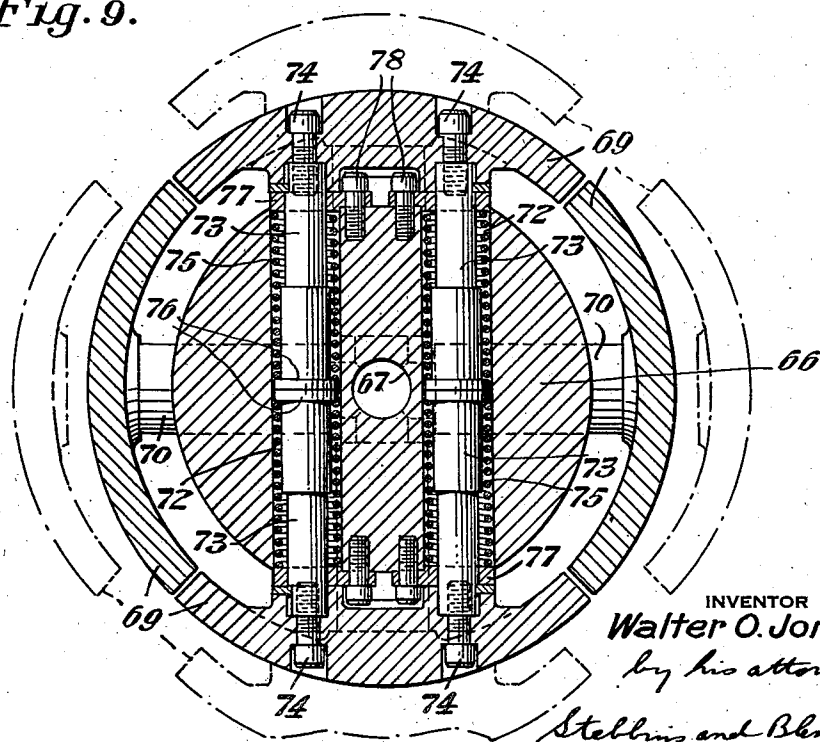


Fig. 9.



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UNITED STATES PATENT OFFICE

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EXPANDING AND CONTRACTING MANDREL
FOR COIL HOLDERS, REELS, OR THE LIKEWalter O. Jones, Warren, Ohio, assignor to The
Wean Engineering Company, Inc., Warren,
Ohio, a corporation of Ohio

Application December 22, 1941, Serial No. 423,988

9 Claims. (Cl. 242—74)

This invention relates to an expanding and contracting mandrel. The specific application of the invention to be described in detail herein is to a coil holder or reel but the invention has other applications as well. Coil holders and reels have their chief utility in the handling of material in strip form, e. g., steel strip during processing.

Various forms of expanding and contracting mandrels have been proposed heretofore for supporting coils of strip material as well as other functions. Such mandrels with which I am familiar, however, have certain objectionable features. In some constructions, the range of expansion and contraction is quite limited and for a given minimum outside diameter permits only a relatively small supporting shaft of correspondingly low capacity. Expanding mandrels known heretofore, furthermore, have been very complicated in construction, involving numerous parts and presenting considerable difficulty in assembly, adjustment and maintenance. Where a mandrel is used on a winding reel for coiling strip, it must necessarily include means for seizing the leading end of the strip. Such means as heretofore constructed have required a special adjustment for various thicknesses of material and the maximum diameter of mandrels known heretofore has been variable, depending on the thickness of the material being coiled. This means that coils of material of different gauges will have different inside diameters which are objectionable in subsequent handling operations.

I have invented a novel expanding and contracting mandrel, particularly suited for use on a coil holder or tension reel which overcomes the aforementioned objections to previous devices of this kind and provides a structure characterized by numerous advantages and novel features. In a preferred embodiment of the invention, I provide a main shaft with radially movable segments extending therealong. The shaft has an axial bore and radial bores communicating therewith and spaced along the shaft. Pistons reciprocable in the radial bores are adapted to force the segments outwardly. Compression springs positioned in transverse sockets normally urge the segments inwardly. The mandrel is expanded by supplying fluid under pressure to the axial bore through the shaft and is contracted by the springs on release of pressure.

One of the segments has a longitudinal slot with a gripper movable therein. The gripper is mounted on the slotted segment for movement radially thereof and has springs normally urging it inwardly of the segment. A piston in a radial bore in the shaft serves to operate the gripper in the same manner as the pistons operate the segments.

Further details of construction as well as the

novel features and advantages will become apparent during the following complete description and explanation which refer to the accompanying drawings illustrating the preferred embodiments of mandrels for a tension reel and coil holder. In the drawings,

Figure 1 is a partial side elevation of an embodiment particularly adapted for use in a tension reel with portions shown in section, the plane of the section being a vertical, axial plane;

Figure 2 is an end elevation of the mandrel alone;

Figure 3 is a sectional view through the mandrel taken on the plane of line III—III of Figure 2;

Figures 4, 5 and 6 are transverse sectional views taken along the planes of lines IV—IV, V—V, and VI—VI, respectively, of Figure 3;

Figure 7 is a view similar to Figure 3 showing an embodiment particularly adapted for use in a coil holder;

Figure 8 is a transverse section taken along the plane of line VIII—VIII of Figure 7; and

Figure 9 is a transverse section taken along the plane of line IX—IX of Figure 7.

Referring now in detail to the drawings and, for the present, to Figures 1 through 6, a tension reel indicated generally at 10 in Figure 1 includes an expanding and contracting mandrel 11 supported in a bearing pedestal 12, and a driving motor M.

The mandrel 11 includes a main supporting shaft 13, one end of which is journaled in bearings 14 and 15 in the pedestal 12, the other end of the shaft projecting outwardly from the pedestal and being supported therefrom as a cantilever. The pedestal 12 includes a base 16 and a cover 17. A driving gear 18 is keyed to the portion of the shaft 13 between the bearings 14 and 15.

The motor M includes a built-in gear reducer 19 which is connected by a coupling 20 to a shaft 21 also journaled in suitable bearings in the pedestal 12. A pinion 22 on the shaft 21 meshes with the driving gear 18 whereby the shaft 13 and mandrel 11 may be rotated at the desired speed.

The shaft 13 has an axial bore 23 terminating adjacent the extremity of the overhanging end of the shaft and extending out through the opposite end which, as shown at 24, extends outwardly beyond the bearing 15. The projecting end 24 of the shaft is provided with a fluid-storage chamber 25 in the form of an annular body threaded on to the shaft at 26 and having a sealing ring 27 closing the joint between the shaft and the wall of the body spaced from the extreme end of the shaft.

A piston 28 is reciprocable in the end of the bore through the shaft 13 and is actuated by a

piston in a motor cylinder 29 secured to the chamber 25. The cylinder 29 is preferably a double-acting pneumatic cylinder having suitable supply and exhaust connections 30 and 31 and is adapted to advance or retract the piston 28 to apply pressure on fluid in the bore 23 of the shaft 13 or release the pressure thereon. The piston 28 is not shown in its fully retracted position in Figure 1. When it is fully retracted, it uncovers radial ports 32 through which make-up fluid flows from the chamber 25 into the bore 23 to compensate any slight loss of fluid by leakage.

The overhanging end of the shaft 13 is provided with spaced flanges 33 and 34. Segments 35 and 36 have projections 37 and 38 fitting into slots 39 spaced circumferentially of the flanges. The meeting edges of the segments are provided with alternate, interfitting slots and tongues 40 and 41. The segments are thus adapted to move radially from and to the shaft 13, being guided by the slots 39 in the flanges thereof.

Referring now more particularly to Figures 3 and 5, radial sockets 42 are spaced circumferentially of the shaft, being bored inwardly from flats 43 machined thereon. A plunger 44 is reciprocable in each of the sockets 42 and is normally urged inwardly by a compression spring 45. Bearing plates 46 secured to the flats 43 by screws 46a hold the springs 45 in the sockets 42. Screws 47 extending through counter-sunk bores in the segments 35, 36 are threaded into tapped holes in the plungers 44. By this construction, the segments are yieldingly held toward the shaft 13 and continuously urged inwardly.

Radial bores 48 spaced along the overhanging portion of the shaft 13 communicate with the central bore 23 therethrough. Pistons 49 reciprocable in the bores 48 bear on the inner faces of the segments 35 and 36. The application of pressure to the fluid in the bore 23 causes the pistons 49 to move outwardly and carry the segments 35 and 36 with them. Immediately the pressure is relieved from the fluid, the springs 45 are effective to restore the segments to their normal or contracted position as shown in Figures 3, 5 and 6. The outward movement of the segments is limited by the engagement of shoulders 50 on the plungers 44 with the inner surfaces of the bearing plates 46.

Segment 35 has a longitudinal slot 51 therein of generally triangular cross-section. The segment 35 is recessed at its mid-portion to receive a gripper 52 for radial movement in the slot. The gripper, as shown in Figure 4, has a generally triangular cross-section and has its sides grooved or ribbed to provide effective gripping engagement with the end of a strip 53 when the latter is introduced between the gripper and one end of the slot 51. The gripper 52 is provided with cross bars 54 secured to the base of the gripper by screws 55. The bars 54 are bored adjacent their ends to receive plungers 56 for reciprocation therein, compression springs 57 being disposed between heads formed on the plungers and the bottom of counter-bores through which the plungers extend. By this construction, the plungers are urged against seats 58 formed by recessing the inner surface of the segment 35 and, by the resulting reaction, tend to hold the gripper 52 inwardly away from the segment. The parts should be so designed, of course, that when the segment 35 is in its innermost position, the gripper and its cross bars will be spaced inwardly from the segment. The engagement of the segment 35 with the plate 46

limits inward movement of the segment 35 while inward movement of the gripper is limited by the engagement of the depending ends 59 of the cross bars 54 with the shaft 13.

A radial bore 60 similar to the bores 48 is provided with a piston 61 reciprocable therein similar to the pistons 49. The piston 61, however, as best shown in Figures 3 and 4, bears on the gripper 52 thus causing the latter to move outwardly on the application of pressure to fluid contained in the bore 23. On release of the pressure, furthermore, the springs 57 cause the gripper to move inwardly.

The entire operating cycle of the device described will doubtless be apparent. It is sufficient to state, however, that when there is no pressure on the fluid in the bore 23, the segments 35 and 36 and the gripper 52 occupy their innermost positions. When it is desired to start a coil on the mandrel 11, the leading end of the strip 53 is entered between the gripper 52 and one side of the slot in the segment 55. Air pressure is then admitted to the motor cylinder 29, driving the piston 28 forward in the bore 23 and thereby applying pressure to the fluid in the bore. This causes the pistons 49 and 61 to move outwardly. While the piston 61 moves simultaneously with the pistons 49, the former continues to move after the latter have reached the limit of their outward movement, thereby causing the gripper 52 to obtain a firm engagement upon the end of the strip. The motor M is then started and the strip is wound on the mandrel with the segments in their extreme outermost positions. When the coil has been completed, the motor cylinder 29 is operated to withdraw the piston 28 and relieve the pressure on the fluid in the bore 23. The segments 35 and 36 and the gripper 52 then move inwardly under the force of the springs 45 and 57, leaving the coil on the mandrel and the leading end thereof initially engaged by the gripper 52, free for endwise removal. It will be observed in Figures 3, 5 and 6 that the slot 52 extends the entire length of the segment 35.

Figures 7 through 9 illustrate an embodiment of the invention particularly suited for coil holders. In this embodiment, a mandrel 65 has a main supporting shaft 66 with an axial bore 67 therethrough. The shaft 66 may conveniently be supported in the same manner as the shaft 13 of the embodiment previously described. The outer end of the bore 67 is closed by a plug 68. Segments 69 are secured to pistons 70 reciprocable in radial bores 71 in the shaft 66, communicating with the bore 67. A conical centering guide 69a is positioned on the shaft 66 adjacent the outer end thereof.

Transverse bores 72 extend through the shaft 66 in pairs, each pair of adjacent bores being at right angles to each other. Plungers 73 reciprocable in the bores 72 are secured to the segments by screws 74. Compression springs 75 bear on shoulders 76 adjacent the inner ends of the plungers and are held in the bores 72 by bearing plates 77 secured to the shaft by screws 78.

It will be understood that the construction shown in Figures 7 through 9 operates on the same principles as that of Figures 1 through 6, the pistons 70 serving to force the segments outwardly upon the application of pressure to fluid in the bore 67, and the springs 75 serving to retract the segments on release of the pressure. The outermost positions of the segments and pistons are illustrated in Figures 7 through 9 in

chain lines. As indicated, the second embodiment is characterized by a large expansion whereby it is adapted to handle coils having eyes the diameter of which varies over a considerable range. This embodiment, therefore, is well suited for use in a coil holder. For that reason, it is not provided with a gripper, the latter being required only in mandrels forming part of coiling reels. It will be understood, however, that the embodiment of Figures 7 through 9 could be provided with a gripper like that shown at 52 if it were desired to employ the mandrel 65 in a coiling reel. Similarly, the embodiment of Figures 1 through 6 could be designed for a large expansion, if desired. In the case of a coiling-reel mandrel, however, only relatively small expansion is necessary since all that is required is that there be sufficient clearance between the mandrel when contracted and the interior of the coil to permit easy stripping of the latter.

It will be apparent from the foregoing description and explanation that the invention is characterized by important advantages over expanding and contracting mandrels as constructed heretofore. In the first place, the invention permits the use of a large diameter shaft, even for a mandrel of a relatively small outside diameter. This is important because of the present trend toward heavy coils with smaller inside diameters. The considerable range of expansion obtainable by my construction has already been mentioned. The simplicity of construction, according to my invention, is readily apparent from even a brief consideration of the drawings. My mandrel may readily be assembled and taken apart and presents no difficulty from the standpoint of adjustment or maintenance.

The gripper incorporated in the mandrel for coiling reels is adapted to engage strip of any thickness which can be received in the triangular slot 51. No adjustment is necessary to accommodate materials of different thicknesses. The degree of expansion of the mandrel, furthermore, is not dependent on the thickness of the material engaged by the gripper. This means that the inside diameter of all coils formed on reels provided with the mandrel of my invention will be the same, regardless of the gauge of the material being coiled. This is a distinct advantage in subsequent processing or handling operations. The main supporting shaft, instead of being driven or mounted for rotation, may be fixed if desired and of any selected shape other than round. The mandrel may be used in this form, to shape the interior of an article. Similarly, it may be used to hold any object by its interior, whether fixed or rotating.

While I have illustrated and described only preferred embodiments of the invention for coiling reels and coil holders, it will be obvious that the invention may be otherwise applied and that changes in the construction and arrangement of the parts may be made without departing from the spirit of the invention or the scope of the appended claims.

I claim:

1. A mandrel comprising a shaft, a segment extending along and movable radially of said shaft, means yieldably holding the segment toward the shaft, a slot in said segment adapted to receive the end of a strip length, a strip-engaging gripper extending into said slot and radially movable on said segment, radial bores in said shaft, pistons in said bores adapted to force said gripper and seg-

ment outwardly, and means for supplying fluid under pressure to said bores.

2. A mandrel as defined by claim 1 characterized by means continuously urging said gripper inwardly relative to said segment.

3. A mandrel as defined by claim 1 characterized by said fluid-supply means including an axial bore through said shaft communicating with said pistons.

4. A mandrel comprising a shaft, a segment extending along and movable radially of said shaft, means yieldably holding the segment toward the shaft, a slot in said segment adapted to receive the end of a strip length, a strip-engaging gripper extending into said slot and radially movable on said segment, spring-urged plungers on said gripper engaging the segment and normally retracting the gripper from the segment, radial bores in said shaft, pistons in said bores adapted to force said gripper and segment outwardly, and means for supplying fluid under pressure to said bores.

5. A mandrel comprising a shaft, a segment extending along and movable radially of said shaft, means yieldably holding the segment toward the shaft, a slot in said segment adapted to receive the end of a strip length, a strip-engaging gripper extending into said slot and radially movable on said segment, means urging said gripper inwardly relative to said segment and means for forcing said gripper and segment outwardly.

6. A mandrel comprising a shaft, elongated segments extending along the shaft, a central bore through said shaft, radial bores spaced along the shaft and circumferentially thereof communicating with said central bore, pistons in said radial bores adapted to force the segments outwardly under the fluid pressure applied to said central bore, flat surfaces on said shaft normal to the axes of said radial bores, sockets extending into the shaft from said flat surfaces, plungers secured to said segments and reciprocable in said sockets, springs on said plungers urging them inwardly of said shaft and bearing plates secured to said flat surfaces adapted to hold said springs in said sockets.

7. A mandrel comprising a shaft, segments extending along said shaft, means urging the segments toward the shaft, an axial bore through the shaft, radial bores in the shaft communicating with said axial bore, and pistons in said radial bores for exerting an outward force on said segments on the application of pressure to fluid in said axial bore, one of said segments having a longitudinal slot to receive the end of a length of strip, a gripper movable radially on said one of said segments, a radial bore in said shaft communicating with said axial bore, and a piston in said last-mentioned radial bore adapted to actuate said gripper.

8. A mandrel comprising a shaft, elongated segments extending along the shaft, hydraulic means for forcing said segments outwardly, an axial bore through said shaft, a piston reciprocable in said bore for applying pressure to fluid therein, whereby to operate said hydraulic means, a pneumatic motor on said shaft and rotatable therewith for actuating said piston, and a fluid-storage chamber mounted on said shaft communicating with said bore.

9. The apparatus defined by claim 8 characterized by said chamber being of annular shape and disposed coaxially of the shaft.

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