May 7, 1968 J. F. ORLOFF 3,381,515

COLD FORMING DIE CONSTRUCTION

Filed Nov. 1, 1965 2 Sheets-Sheet 1

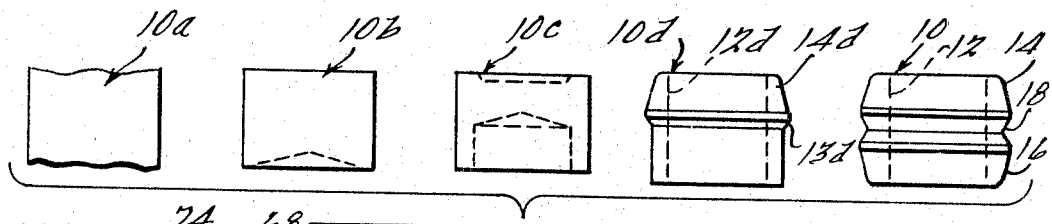


FIG. 1.

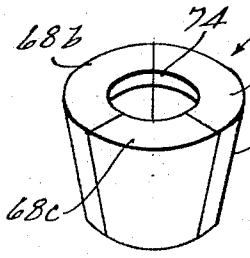
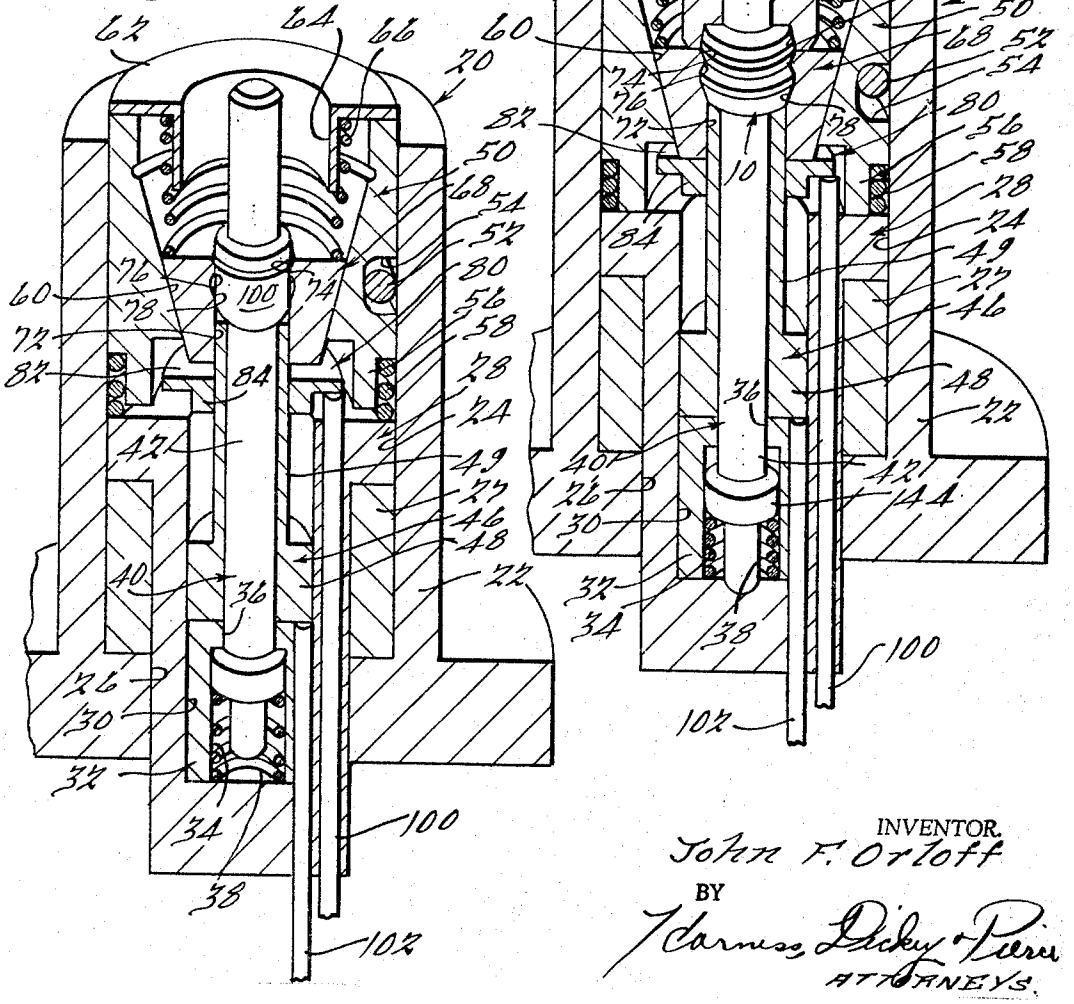


FIG. 3.

FIG. 4.

FIG. 2.



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COLD FORMING DIE CONSTRUCTION

Filed Nov. 1, 1965 2 Sheets-Sheet 2

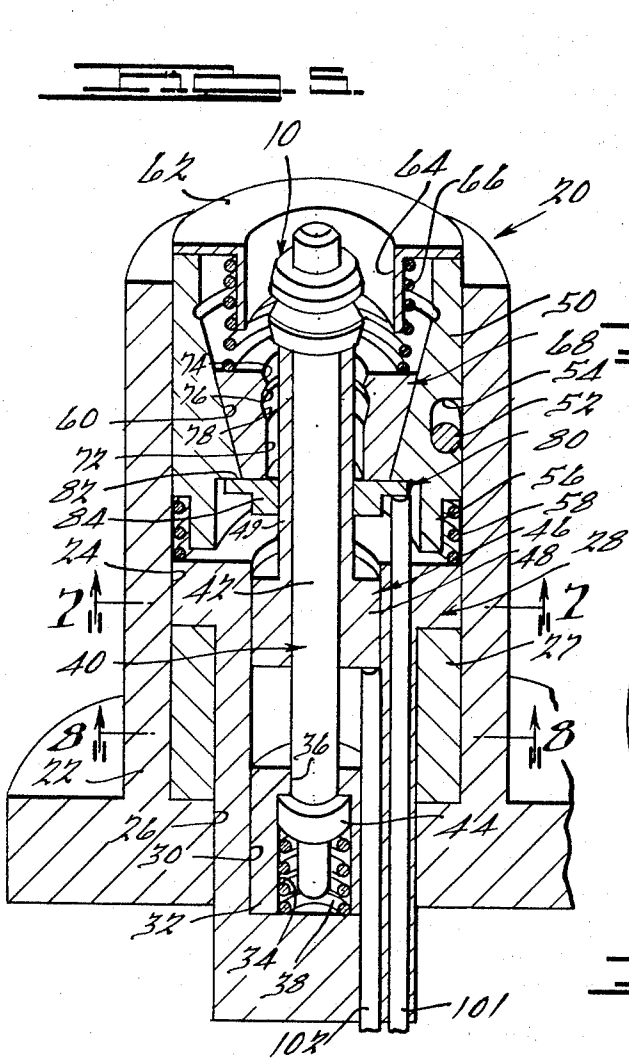


FIG. 1.

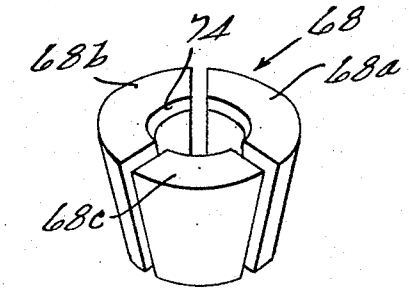


FIG. 3.

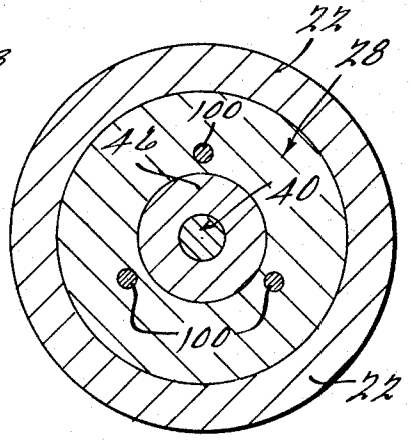


FIG. 2.

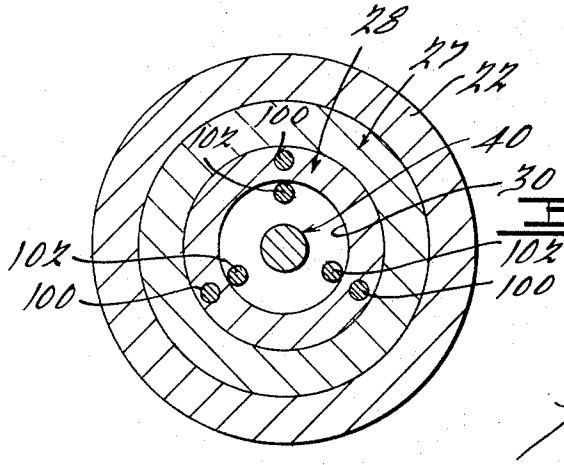


FIG. 4.

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COLD FORMING DIE CONSTRUCTION

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Filed Nov. 1, 1965, Ser. No. 505,813
10 Claims. (Cl. 72—354)

The present invention relates to cold forming apparatus.

The manufacture of tubular collars of the type shown in the U.S. patent to Brilmyer, No. 3,057,246 issued Oct. 9, 1962, while being readily manufacturable by machining, because of its shape could not so readily be made by cold forming techniques. It is an object of the present invention to provide novel apparatus for cold forming collars of the above noted type.

It is a further object of the present invention to provide novel apparatus for cold forming a part to have a bulbed portion at one end.

It is a further object of the present invention to provide novel cold forming apparatus for forming a tubular member with a bulbed portion at least at one end.

It is a still further object of the present invention to provide novel apparatus for cold forming from a tubular member which is preformed with a bulb at one end a product having a bulb at the opposite end.

It is another object of the present invention to provide novel apparatus for cold forming a cylindrical part having an annular groove on its outer surface.

It is still another object of the present invention to provide novel apparatus for cold forming a tubular part having an annular groove on its outer surface.

It is a general object of the present invention to provide novel cold forming apparatus.

Other objects, features, and advantages of the present invention will become apparent from the subsequent description and the appended claims, taken in conjunction with the accompanying drawings, in which:

FIGURE 1 is a sequence diagram depicting the formation of a tubular collar of the type shown in the above noted patent to Brilmyer from cutoff to its final form;

FIGURE 2 is a perspective view with some parts shown in cross section of the lower section of a cold forming die for the final station for forming the collar as shown in FIGURE 1 with the cold forming die shown in one position at which it has received a partly formed collar from the preceding state;

FIGURE 3 is a view similar to FIGURE 2 and depicts the lower section of the cold forming die of FIGURE 2 along with the upper section and shows the die in a different position in which the collar has been final formed;

FIGURE 4 is a pictorial view of a multiple piece heading die member of the apparatus shown in FIGURES 2 and 3 with the die member shown in its condition during the steps depicted in FIGURES 2 and 3;

FIGURE 5 is a view similar to FIGURE 2 and depicts the condition of the lower die section with the final formed collar being ejected;

FIGURE 6 is a pictorial view of the multiple piece heading die member of FIGURE 4 shown in its condition in the lower die section upon ejection of the collar as shown in FIGURE 5;

FIGURE 7 is a cross-sectional view of the apparatus of FIGURE 5 taken substantially along the line 7—7; and

FIGURE 8 is a cross-sectional view of the apparatus of FIGURE 5 taken substantially along the line 8—8.

Looking now to FIGURE 1, the sequence of operations in the formation of a collar of the type shown in the Brilmyer patent noted above is shown with a solid cylindrical slug of material **10***a* being provided at a cutoff stage from a supply of wire stock. The slug **10***a* is then

transferred to a first station where it is sized and provided with an initial conical depression at its lower end to form a sized workpiece **10***b*. The sized workpiece **10***b* is then transferred to a second station at which further sizing takes place during which the depth of the depression at the lower end is increased substantially and a slight depression is formed at the upper end resulting in a formed workpiece **10***c*. The formed workpiece **10***c* is transferred to a third station at which further shaping occurs and the workpiece **10***c* is pierced to form a through bore **12***d*. The outer surface at the upper end of workpiece **10***d* is headed to form an annular bulbed portion **14***b*, resulting in a semi-formed collar **10***d*. The bulbed portion **14***b* terminates at its lower end in a tapered portion **13***d*. The semi-formed collar **10***d* is then transferred from the third station to the fourth station at which a second annular bulb portion **16** which is substantially identical to the bulb portion **14** is formed at its lower end and the result is a final formed collar **10** having a through bore **12** with annular bulbed portions **14** and **16** at opposite ends which taper radially inwardly away from each other and which are separated at their inner extremities by an annular groove **18**. The dies for the cutoff and the first, second and third stations can be conventional shearing, forming and heading dies and hence the formation of the semi-formed collar **10***b* can be done by apparatus well known to those skilled in the art. Thus, only the apparatus utilized in final forming of the collar **10** from a semi-formed collar **10***d* will be shown and described.

Looking now to FIGURE 2, the lower die section is generally indicated by the numeral **20** and includes a tubular body member **22** having a cavity **24** open at its upper end and in communication with a reduced diameter through bore **26** at its lower end. A bushing **27** is located at the lower end of the cavity **24** and a die casing **28** is located in the cavity **24** and extends through the bushing **27** and the through bore **26** and is supported upon the bushing **27** by means of an enlarged flange at its upper end. The casing **28** is provided with a cavity **30** which is open at its upper end and which has located at its lower extremity a spring housing member **32**. The housing member **32** has a cavity **34** open at its lower extremity and is in communication with a reduced through diameter bore **36** at its upper end. A return coil spring **38** is located within the cavity **34** for a purpose to be seen. A die pin **40** has an upper pin portion **42** which extends upwardly through the reduced diameter bore **36** and generally up through the open cavity **24** in the body member **22**, and is generally slidable within the bore **36** and has an enlarged flange portion **44** proximate its lower extremity, which is located within the cavity **34** and hence restricts the upward movement of the die pin **40**. The spring **38** is biased against the flange portion **44** under a precompressive load to normally maintain the pin **40** in its uppermost position as shown in FIGURE 2.

A tubular knockout sleeve **46** is also located in the cavity **30** and is movably piloted therein by an enlarged diameter portion **48** which matably fits within the cavity **30** and terminates at its upper end in a reduced diameter elongated knockout portion **49** which normally extends upwardly beyond the confines of the cavity **30**. The knockout sleeve **46** is normally seated upon the upper end of the spring housing member **32**.

A sliding die holder **50** has an outside diameter to matably fit the cavity **24** and is supported for slidable movement in the upper end thereof, with movement being restricted by a locking pin **52**, which extends through an elongated groove **54** in the radially outer surface of die holder **50** and is fixed to the body member **22**. The sliding die holder **50** has a reduced diameter projecting portion **56** at its lower extremity about which is located a return

spring member 58. The spring member 58 is precompressed and is located between the upper end of the flange portion of the die casing 28 and the shoulder defined by the projecting portion 56. The upper movement of the sliding die holder 50 is restricted by the locking pin 52, and as a result of spring member 58 is normally located in its uppermost position, as shown in FIGURE 2.

The sliding die holder 50 is provided with a frusto conically shaped central bore 60 which diverges radially outwardly in a direction toward its upper end. A die holder cap 62 is fixedly located at the upper end of the bore 60 and partially overlaps the opening of the bore 60 and has a downwardly extending tubular portion 64 about which is located a spring member 66 which is maintained under a compressive preload. The upper end of the spring member 66 contacts the bottom of the die holder cap 62 while its lower end is in engagement with a multiple piece die 68.

The multiple piece die 68 is provided with an outer surface 70, which is of a frusto conical shape to mate the frusto conical shape of the bore 60. The taper on the outer surface of the die 68 is provided such that the die 68, as urged downwardly by the spring 66, will be located at the lower extremity of the bore 60 with the lower extremity of the die 68 extending beyond the lower extremity of the bore 60.

The multiple piece die 68 defines a frusto conical shape in its lowermost extreme position at which its various segments are in engagement with each other. In the preferred form, the multiple piece die 68 is constructed of three identical segments 68*a*, 68*b* and 68*c*. The composite multiple piece die 68 defines a central bore 72, which is straight at its lower extremity but is provided at its upper extremity with an outwardly chamfered or beveled portion 74 which connects to a radially inwardly projecting annular portion 76 which in turn connects to a radially inwardly downwardly tapering portion 78.

Looking now to the partly formed collar 10*d* and the final formed collar 10 of FIGURE 1, the chamfered portion 74 would correspond to and be similar in shape to the tapered portion 13*d* and hence in locating the partially formed collar 10*d* within the bore 72, the collar 10*d* would rest with the tapered portion 13*d* located upon the chamfer 74. The radially inwardly projecting portion 76 of the multiple piece die 68 corresponds to the contour of the groove 18 of collar 10 while the tapering portion 78 corresponds to the bulbed portion 16 of the collar 10.

The knockout portion 49 of the knockout sleeve 46 normally extends above and beyond the open cavity 30 in the casing 28 and normally extends into the lower extremity or straight portion of the bore 72 of the multiple piece die 68 with its upper end portion being proximate to the lower end of the partially formed collar 10*d*.

The collar 10*d*, as noted, is located at the upper end of the pin portion 42 of the die pin 40. The spring member 66 will normally maintain the multiple piece die 68 in its lowermost position within the cavity 60 as shown in FIGURE 2. A die aligning washer 80 is slidably located over the knockout portion 49 of the knockout bushing 46 and has an enlarged flange portion 82 which is engageable with the lower extremity of the multiple die 68. The washer 80 terminates at its lower extremity in a reduced diameter portion 84 which is slidably located within the upper end of the open cavity 30 in the die case 28. The aligning washer 80 serves a purpose to be readily understood. With the apparatus described and with the partially formed collar 10*d* located within the cavity of the multiple piece die 68, the final heading operation is ready to be performed.

An upper die section 86 includes a punch holder 90 having a through bore 92 in which is slidably located a tubular punch member 94. The punch member 94 has a central bore 96 which receives the upper end of the pin portion 42 of the die pin 40. The lower end of the punch holder 90 is engageable with the upper end of the die holder cap 62 and can exert pressure thereupon to cause a downward movement of the movable die holder 50. The punch 94 is provided at its lower end with a cavity 98 which is of a contour to match the upper or beaded end 14*d* of the partly formed collar 10*d*. Thus note that the cavity 98 and the pin portion 42 along with the upper end of the multiple piece die 68 totally enclose the upper end portion 14*d* of the partly formed collar 10*d*. As the punch holder 90, along with the punch 94 is moved downwardly, the sliding die holder 50 is moved downwardly and the multiple piece die 68 is also moved downwardly. This downward movement continues until the movable die holder 50 bottoms out at the upper surface of the die casing 28. In moving the movable die holder 50 and the multiple die piece 68 downwardly, the partly formed collar 10*d* is moved downwardly into engagement with the upper end of the knockout portion 49 of the knockout sleeve 46 thereby causing the metal at the lower end of the partly formed collar 10*d* to be moved to fill the cavity defined by the tapering portion 78 of the multiple piece die 68, the knockout portion 49, and the pin portion 42 to eventually provide for the finished collar having the shape as indicated by the collar 10. Note that this downward movement continued until the multiple piece die 68 engaged the upper surface of the die aligning washer 80. The die pin 40 is free to move against the compression of the spring 38 and is moved downwardly as it is gripped by the metal of the partly formed collar 10*d* as it is swaged or moved into the tapering portion 78 of the multiple piece die 68. Thus, as shown in FIGURE 3, the collar is made into its final form being collar 10.

After completion of the downward stroke of the upper die section 86, it is moved upwardly and away from the lower die section 20; at the same time a first set of ejecting rods 100 is caused to move upwardly against the lower surface of the enlarged flange 32 of the guide washer 80 moving upwardly against the bottom surface of the multiple piece die 68 and a second set of knockout pins 102 is caused to move upwardly against the bottom surface of the enlarged head portion 48 of the knockout sleeve 46. As the knockout pins 100 and 102 are moved upwardly, the multiple piece die 68 is moved upwardly and hence the segments 68*a*, 68*b*, and 68*c* are separated as shown in FIGURE 6, thereby providing for clearance for the final formed collar 10 whereby the knockout pin 46 can then eject the collar 10 from the lower die section 20. Note that a plurality of knockout pins 100, 102 are shown and extend through aligned bores in the lower die section 20 to contact the die aligning washer 80 and the knockout bushing 46, respectively. Thus note that the knockout pins 100 will open up the multiple piece die 68 to provide clearance about the final formed collar 10 while the knockout bushing 46, as it is moved upwardly by pins 102, will strip the final formed collar 10 from the die pin 40. Note that the spring 58 will have moved the sliding die holder 52 to its uppermost position as shown in FIGURE 2, and the spring 38 will have moved the die pin 40 to its uppermost position as shown in FIGURE 2, and upon retraction of the knockout pins 100 and 102, the knockout sleeve 46 will be free to move downwardly to its lowermost position within the open cavity 30, to the position as shown in FIGURE 2, while the spring 66 which has been precompressed will now move the multiple piece die 68 downwardly to its lowermost position in which the die assumes the position shown in FIGURES 2 and 4. With the various parts then returned to their original position as shown in FIGURE 2, the lower die section 20 is now in condition to receive another partly formed collar member 10*d* and the sequence will be repeated.

While it will be apparent that the preferred embodiments of the invention disclosed are well calculated to fulfill the objects above stated, it will be appreciated that the invention is susceptible to modification, variation and change without departing from the proper scope or fair meaning of the subjoined claims.

What is claimed is:

1. A die for cold forming a tubular collar from a partly formed collar having a straight through bore, a straight cylindrical portion at its lower end and a radially outwardly bulbed portion at its upper end comprising: an upper die section and a lower die section, said lower die section including a lower die housing having a cavity open at its upper end, means including a spring and a spring holder located at the lower end of said cavity with said spring holder having an opening for holding said spring, a die pin having a pin portion extending upwardly through a bore communicating said opening with said cavity and having an enlarged head portion movably located within said opening and engageable with said spring with said spring normally biasing said die pin to its uppermost position, said pin portion generally extending through said cavity, a knockout sleeve slidably located upon said pin portion, a die holder slidably located in the upper end of said cavity and movable between upper and lower positions, a first spring member engageable with said die holder for normally urging said die holder to its upper position, said movable die holder having a frusto conically shaped bore, a multiple piece die member formed by a plurality of radially divided die segments located in said frusto conically shaped bore and having a composite outer surface which is frusto conically shaped to match said frusto conically shaped bore, the lower end of said die member extending beyond the lower extremity of said frusto conical bore, and a second spring member mounted to apply a preload between said die segments and said die holder to normally urge said die segments downwardly into said frusto conical bore and into engagement with each other, said die member with said segments engaged defining a through die cavity having a straight bore portion at its lower end for receiving the upper end of said knockout sleeve which is normally located therein, said die cavity at its upper end having a tapered portion for matably receiving the lower end of the bulbed portion of the partly formed collar, said die cavity having a radially outwardly extending depression connecting said tapered portion and said straight bore portion, a first knockout pin engageable with said knockout sleeve for moving said knockout sleeve upwardly to eject the tubular collar, means including a second knockout pin engageable with said lower end of said die member for moving said die member upwardly to separate said die segments whereby the tubular collar can be ejected from said die member, said upper die section including a punch member having a different cavity for receiving said pin portion and being movable over said pin portion and into the confines of said frusto conical bore, the lower extremity of said different cavity having a contour matching the shape of the partly formed collar at its upper end, said lower extremity of said different cavity of said punch member, said depression and said tapered portion in said die member, said upper portion of said knockout sleeve and said pin portion defining a confined volume whereby as said upper die section moves said movable die holder and said die member downwardly the straight cylindrical portion of the partly formed collar is moved against said knockout sleeve and is deformed to fill said confined volume resulting in the formation of a tubular collar having similarly radially outwardly bulbed portions at both ends separated by a reducer diameter groove.

2. A die for cold forming a tubular collar from a tubular blank comprising: an upper die section and a lower die section, said lower die section including a lower die housing having a cavity open at its upper end, means including a spring and a spring holder located at the lower end of said cavity with said spring holder having an opening for holding said spring, a die pin having a pin portion extending upwardly through a bore communciating said opening with said cavity and having an enlarged head portion movably located within said opening and engageable with said spring with said spring normally biasing said die pin to its uppermost position, said pin portion generally extending through said cavity, a knockout sleeve slidably located upon said pin portion, a die holder slidably located in the upper end of said cavity and movable between upper and lower positions, a first spring member engageable with said die holder for normally urging said die holder to its upper position, said movable die holder having a frusto conically shaped bore, a multiple piece die member formed by a plurality of radially divided die segments located in said frusto conically shaped bore and having a composite outer surface which is frusto conically shaped to match said frusto conically shaped bore, the lower end of said die member extending beyond the lower extremity of said frusto conical bore, and a second spring member mounted to apply a preload between said die segments and said die holder to normally urge said die segments downwardly into said frusto conical bore and into engagement with each other, said die member with said segments engaged defining a through die cavity having a straight bore portion at its lower end for receiving the upper end of said knockout sleeve which is normally located therein, said die cavity at its upper end having a tapered portion, said die cavity having a radially outwardly extending depression connecting said tapered portion and said straight bore portion, a first knockout pin engageable with said knockout sleeve for moving said knockout sleeve upwardly to eject the tubular collar, means including a second knockout pin engageable with said lower end of said die member for moving said die member upwardly to separate said die segments whereby the tubular collar can be ejected from said die member, said upper die section including a punch member having a different cavity for receiving said pin portion and being movable over said pin portion and into the confines of said frusto conical bore, the lower extremity of said different cavity having a preselected contour, said lower extremity of said different cavity of said punch member, said depression and said tapered portion in said die member, said upper portion of said knockout sleeve and said pin portion defining a preselected volume having a shape defined by a tubular collar having a straight through bore and radially outwardly extending beaded portions at opposite ends separated by an annular groove.

3. A die for cold forming a cylindrical tubular member from a cylindrical to blank comprising: an upper die section and a lower die section, said lower die section including a lower die housing having a cavity open at its upper end, a die pin having a pin portion extending upwardly through said cavity, said pin portion generally extending through said cavity, a knockout sleeve slidably located upon said pin portion, a die holder slidably located in the upper end of said cavity and movable between upper and lower positions and having a frusto conically shaped bore, a multiple piece die member formed by a plurality of radially divided die segments located in said frusto conically shaped bore and having a composite outer surface which is frusto conically shaped to match said frusto conically shaped bore, the lower end of said die member extending beyond the lower extremity of said frusto conical bore, said die member with said segments engaged defining a through die cavity for receiving the upper end of said knockout sleeve which is normally located therein, a first knockout pin engageable with said knockout sleeve for moving said knockout sleeve upwardly to eject the cylindrical member, means including a second knockout pin engageable with said lower end of said die member for moving said die member upwardly to separate said die segments whereby the cylindrical member is ejected from said die member, said upper die section including a punch member having a different cavity for receiving said pin portion and being movable over said pin portion and into the confines of said frusto conical bore, the lower extremity of said different cavity having a preselected contour, said lower extremity of said different cavity of said

punch member, said die cavity in said die member, said knockout sleeve and said pin portion defining a confined volume having a preselected shape.

4. A die for cold forming a cylindrical member having a pair of beaded portions at its opposite ends separated by an annular groove comprising: an upper die section and a lower die section, said lower die section including a lower die housing having a cavity open at its upper end, a knockout member reciprocably supported within said cavity, a die holder reciprocably supported in the upper end of said cavity and movable between upper and lower positions and having a frusto conically shaped bore, a multiple piece die member formed by a plurality of radially divided die segments located in said frusto conically shaped bore and having a composite outer surface which is frusto conically shaped to match said frusto conically shaped bore, said die member with said segments engaged defining a through die cavity for receiving the upper end of said knockout sleeve, said upper die section including a punch member having a different die cavity being movable into the confines of said frusto conical bore, said different die cavity of said punch member defining the upper portion of the beaded portion at one end of the cylindrical member, said die cavity in said die member and said knockout member defining a confined volume having a contour defining the lower portion of that beaded portion at that one end of the cylindrical member, the beaded portion at the other end and the annular groove.

5. A die for cold forming a cylindrical member having an annular groove in its outer surface comprising: a die housing having a cavity open at its upper end, die holder means located at the upper end of said cavity and defining a frusto conically shaped bore, a multiple piece die member formed by a plurality of radially divided die segments located in said frusto conically shaped bore and having a composite outer surface which is frusto conically shaped to match said frusto conically shaped bore, means including said die cavity of said die member defining a confined volume having a contour defining a cylindrical member having an annular groove in its outer surface.

6. A die for cold forming a cylindrical member having an annular groove in its outer surface comprising: a die housing having a cavity open at its upper end, a knockout member reciprocably supported within said cavity, die holder means located at the upper end of said cavity and defining a frusto conically shaped bore, a multiple piece die member formed by a plurality of radially divided die segments located in said frusto conically shaped bore and having a composite outer surface which is frusto conically shaped to match said frusto conically shaped bore, said die member with said segments engaged defining a cavity, a first knockout means engageable with said knockout member for moving said knockout member upwardly to eject the cylindrical member, second knockout means engageable with the lower end of said die member for moving said die member upwardly to separate said die segments whereby the cylindrical member can be ejected from said die member, means including said die cavity of said die member defining a confined volume having a contour defining a cylindrical member having an annular groove in its outer surface.

7. A die for cold forming a tubular collar with an annular groove in its outer surface from a tubular blank, comprising: a die housing having a cavity open at its upper end, a die pin having a pin portion extending upwardly through a knockout sleeve located upon said pin portion, die holder means located at the upper end of said cavity and defining a frusto conically shaped bore, a multiple piece die member formed by a plurality of radially divided die segments located in said frusto conically shaped bore and having a composite outer surface which is frusto conically shaped to match said frusto conically shaped bore, said die member with said segments engaged defining a cavity, means including said die cavity of said die member, said knockout sleeve and said pin portion defining a confined volume having a contour defining a tubular member having an annular groove on its outer surface.

8. A die for cold forming a tubular collar having an annular groove on its outer surface from a tubular blank comprising: a die housing having a cavity open at its upper end, a die pin having a pin portion extending upwardly through said cavity, a knockout sleeve reciprocably supported within said cavity and located upon said pin portion, die holder means located at the upper end of said cavity and defining a frusto conically shaped bore, a multiple piece die member formed by a plurality of radially divided die segments located in said frusto conically shaped bore and having a composite outer surface which is frusto conically shaped to match said frusto conically shaped bore, said die member with said segments engaged defining a die cavity, a first knockout means engageable with said knockout sleeve for moving said knockout sleeve upwardly to eject the tubular collar, a second knockout means engageable with the lower end of said die member for moving said die member upwardly to separate said die segments whereby the tubular collar can be ejected from said die member, means including said die cavity of said die member, said knockout sleeve and said pin portion defining a confined volume having a contour defining a tubular member having an annular groove on its outer surface.

9. A die for cold forming a tubular collar with an annular groove on its outer surface from a tubular blank comprising: an upper die section and a lower die section, said lower die section including a lower die housing having a cavity open at its upper end, means including a spring and a spring holder located at the lower end of said cavity with said spring holder having an opening for holding said spring, a die pin having a pin portion extending upwardly through a bore communicating said opening with said cavity and having an enlarged head portion movably located within said opening and engageable with said spring with said spring normally biasing said die pin to its uppermost position, said pin portion generally extending through said cavity, a knockout sleeve slidably located upon said pin portion, a die holder slidably located in the upper end of said cavity and movable between upper and lower positions, a first spring member engageable with said die holder for normally urging said die holder to its upper position, said movable die holder having a frusto conically shaped bore, a multiple piece die member formed by a plurality of radially divided die segments located in said frusto conically shaped bore and having a composite outer surface which is frusto conically shaped to match said frusto conically shaped bore, the lower end of said die member extending beyond the lower extremity of said frusto conical bore, and a second spring member mounted to apply a preload between said die segments and said die holder to normally urge said die segments downwardly into said frusto conical bore and into engagement with each other, said die member with said segments engaged defining a through die cavity having a straight bore portion at its lower end for receiving the upper end of said knockout sleeve which is normally located therein, a first knockout pin engageable with said knockout sleeve for moving said knockout sleeve upwardly to eject the tubular collar, means including a second knockout pin engageable with said lower end of said die member for moving said die member upwardly to separate said die segments whereby the tubular collar can be ejected from said die member, said upper die section including a punch member having a different cavity for receiving said pin portion and being movable over said pin portion and into the confines of said frusto conical bore, the lower extremity of said different cavity of said punch member, said die cavity of said die member, said upper end of said knockout sleeve and said pin portion defining

a confined volume whereby as said upper die section moves said movable die holder and said die member downwardly the tubular blank is moved against said knockout sleeve and is deformed to fill said confined volume resulting in the formation of a tubular collar having an annular groove on its outer surface.

10. A die for cold forming a cylindrical member having an annular groove on its outer surface comprising: a lower die housing having a cavity open at its upper end, die holder means located at the upper end of said cavity and defining a frusto conically shaped bore, a multiple piece die member formed by a plurality of radially divided die segments located in said frusto conically shaped bore and having a composite outer surface which is frusto conically shaped to match said frusto conically shaped bore, means for moving said die member into said frusto conical bore until said die segments are in engagement

with each other and at which time said die member defines a die cavity and for moving said die member out of said frusto conical bore with said die segments separating from each other to release the formed cylindrical member, means including said die cavity of said die member defining a confined volume having a contour defining a cylindrical member having an annular groove on its outer surface.

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