United States Patent

[11] 3,581,542

[72] Inventors **Richard O. Wahler**
Rolling Meadows;
Albert J. Holk, Frankfort, both of, Ill.

[21] Appl. No. **796,013**
[22] Filed **Feb. 3, 1969**
[45] Patented **June 1, 1971**

[73] Assignee **Continental Can Company, Inc.**
New York, N.Y.

[54] APPARATUS FOR AND METHOD OF NECKING IN END PORTIONS OF TUBULAR MEMBERS

10 Claims, 12 Drawing Figs.

[52] U.S. Cl. 72/94, 72/370, 72/391
[51] Int. Cl. B21 41/04
[50] Field of Search 72/94, 193, 367, 370, 391, 411; 113/7

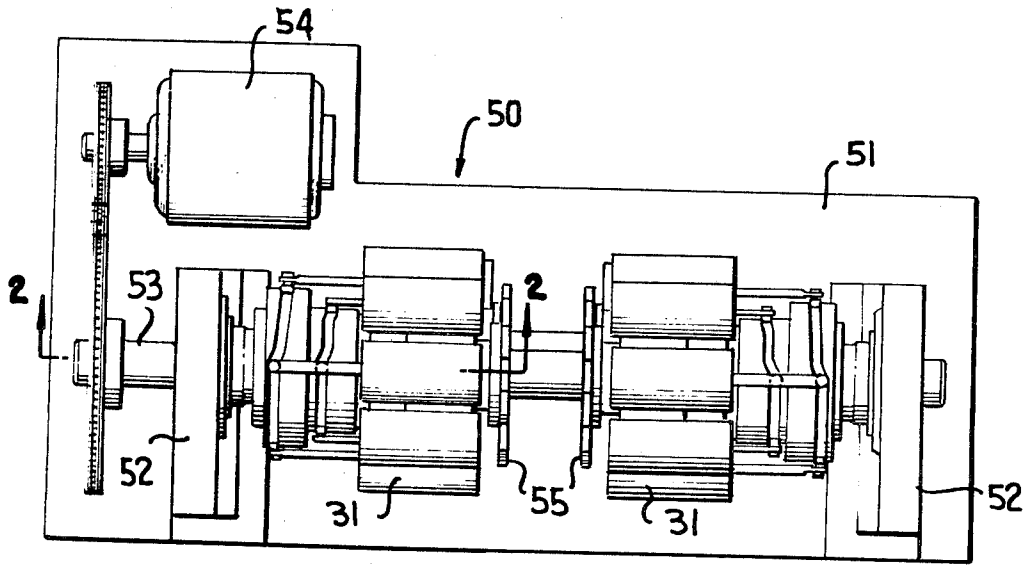
[56] **References Cited**

UNITED STATES PATENTS

996,122	6/1911	Osborn	72/94
1,698,999	1/1929	Hothersall	72/370

Primary Examiner—Lowell A. Larson
Attorneys—Mason, Porter, Diller & Brown and Diller, Brown, Ramik and Holt

ABSTRACT: This disclosure relates to apparatus for and method of necking in one or both end portions of tubular members. The disclosure particularly pertains to the necking in of tubular members which have internal surfaces which may be readily scratched by relative movement between the tubular member and the die center. Accordingly, a suitable die assembly is provided wherein it may be utilized in the necking in of a tubular member without there being relative movement between the die center thereof and the tubular member during the necking in of the tubular member.



PATENTED JUN 1 1971

3,581,542

SHEET 1 OF 3

FIG.1

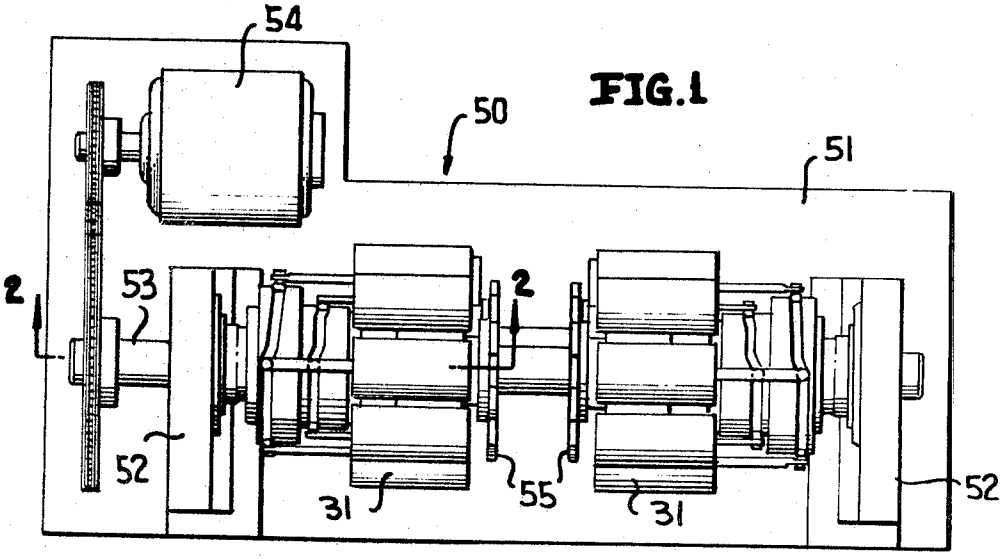
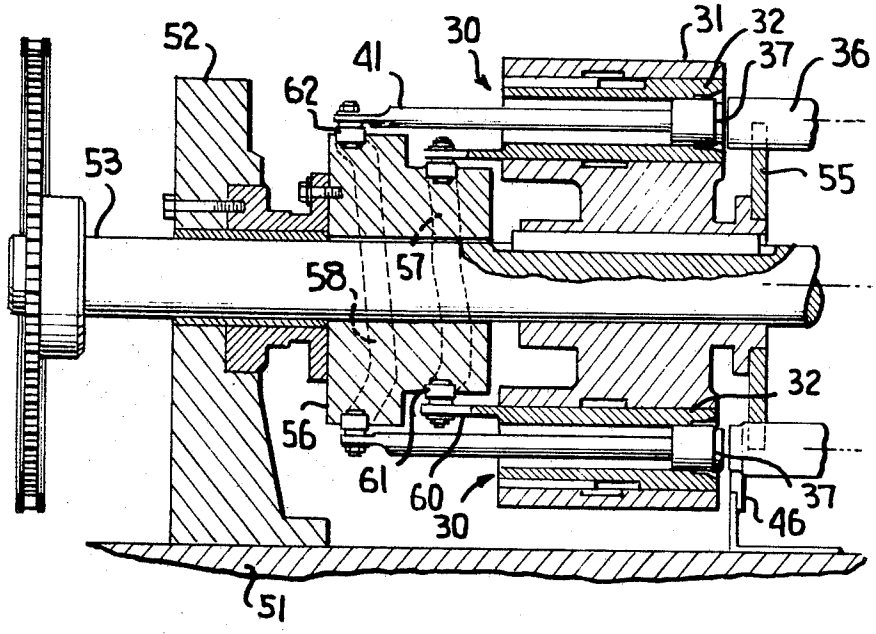


FIG.2



INVENTORS
RICHARD O. WAHLER
& ALBERT J. HOLK

BY Mason, Porter, Dillon & Brown

ATTORNEYS

FIG.5

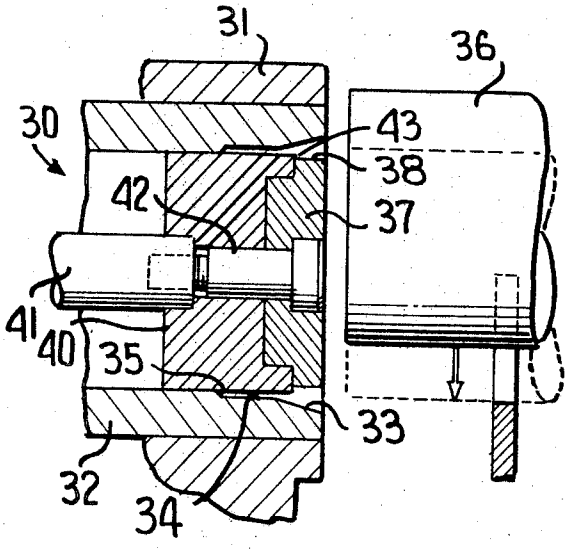


FIG.6

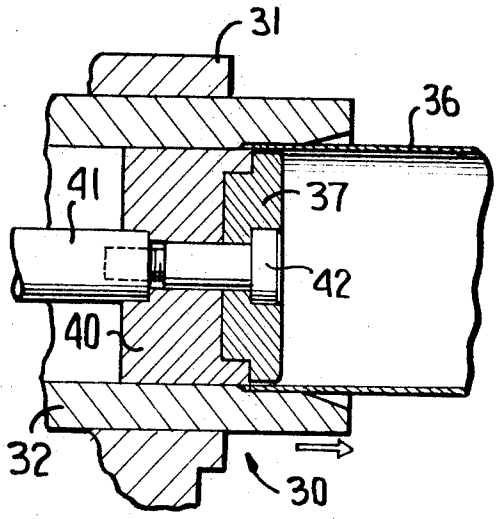


FIG.3

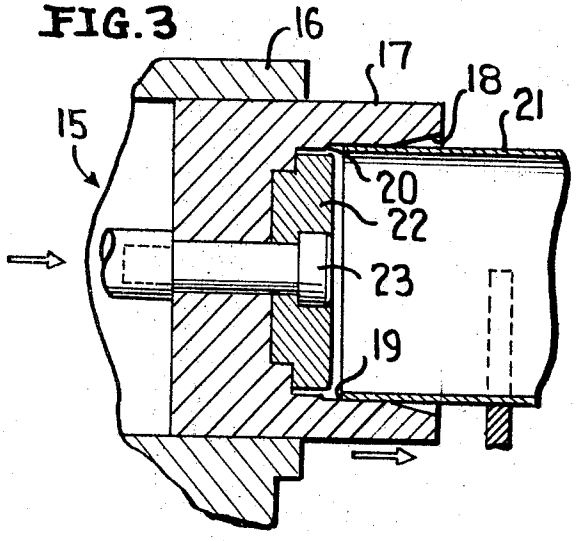
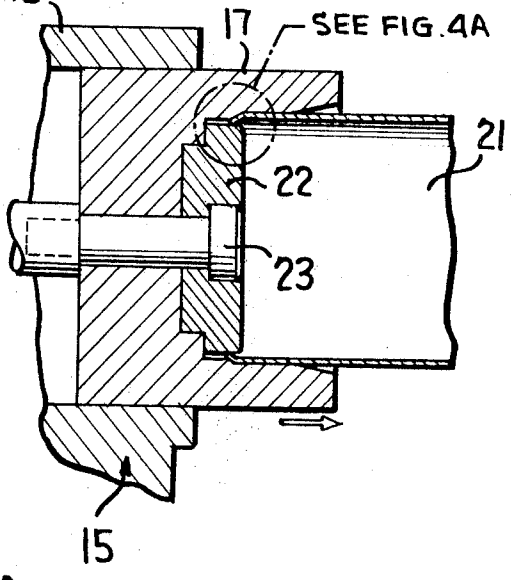


FIG.4



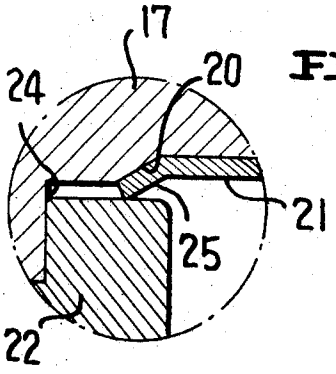


FIG.4A

INVENTORS
RICHARD O. WAHLER
& ALBERT J. HOLK

BY Mason, Porter, Dillon & Brown

ATTORNEYS

FIG.7

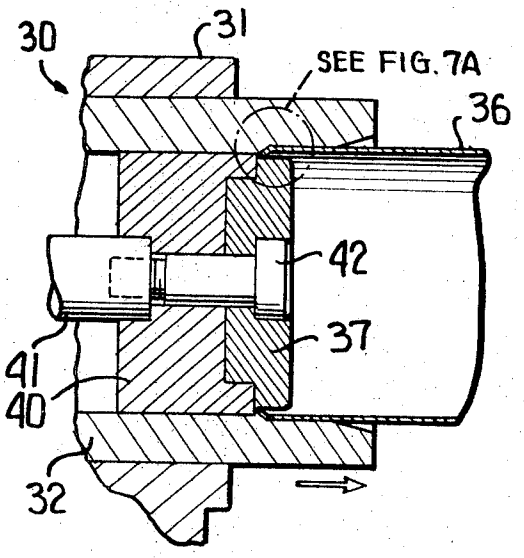


FIG.8

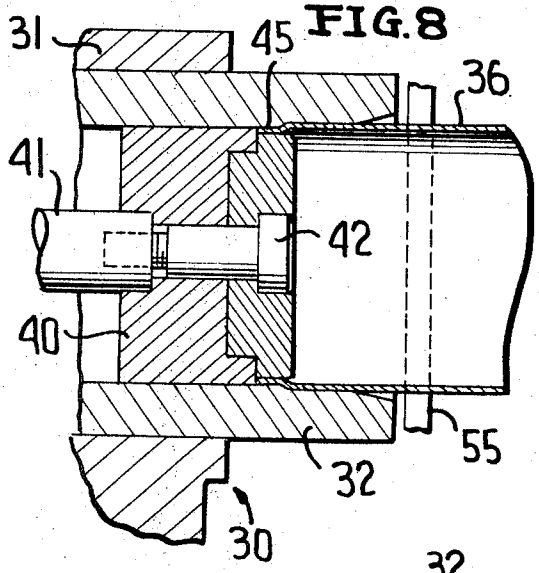
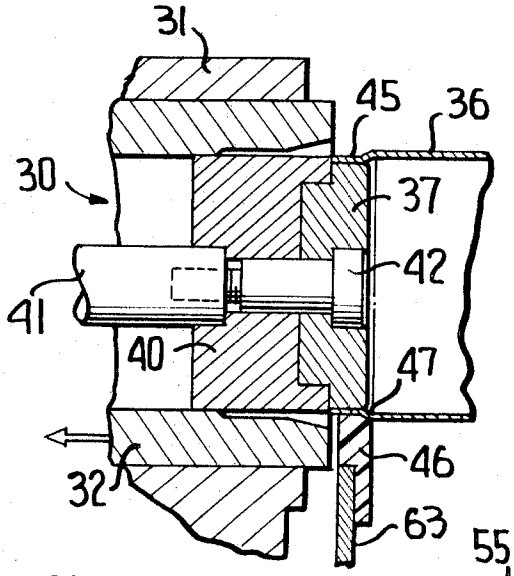


FIG.9



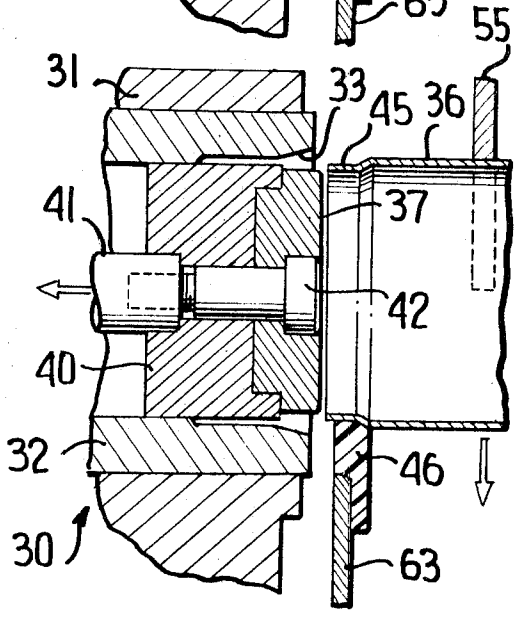


FIG.10

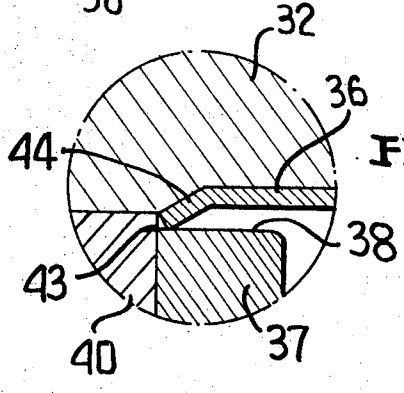


FIG.7A

INVENTORS
RICHARD O. WAHLER
& ALBERT J. HOLK

BY Mason, Porter, Diller & Brown

ATTORNEYS

APPARATUS FOR AND METHOD OF NECKING IN END PORTIONS OF TUBULAR MEMBERS

This invention relates to the necking in of tubular members at the ends thereof. The invention particularly relates to the necking in of tubular members wherein the tubular members have internal surfaces or surface coatings which are readily scratched or scored during a necking in operation and care must be taken to prevent such scratching or scoring of the surfaces.

In the past, the die assemblies for necking in end portions of tubular members have been so operated whereby the necking in of an end portion has commenced while the die center is only partially telescoped within the end portion of the tubular member whereby as the tubular member is necked in around the die center, there is relative movement between the die center and the tubular member. This relative movement in the past has, in many instances, resulted in the undue scratching or scoring on the internal surface of the tubular member. This is particularly true when the tubular member is provided with an internal coating such as an enamel coating utilized in coating internal surfaces of can bodies.

In view of the foregoing, it is a primary object of this invention to provide a novel method of necking in end portions of tubular members wherein there is no relative movement between the die center and the tubular member during the necking in operation, thereby avoiding any possibility of scratching or scoring the internal surface of the tubular member.

A primary feature of this invention is the provision of a die assembly which includes a positive stop associated with the die center, and wherein the die center is initially telescoped within the tubular member until the stop shoulder thereof is in transverse alignment with the extreme end of the tubular member whereby when the tubular member is initially inwardly deformed, it will come into engagement with the stop shoulder and relative movement between the die center and the tubular member will be prevented during the continuation of the necking in operation.

Another object of this invention is to provide a novel die assembly which may be incorporated in a rotary machine for simultaneously and progressively necking in opposite ends of a plurality of tubular members.

A further feature of this invention is the provision of a stripper which is engageable with the necked in portion of a tubular member after the outer ring die has been moved out of telescoped relation with respect to the tubular member and prior to the withdrawal of the die center whereby the tubular member may be firmly held in place during the withdrawal of the die center.

With the above and other objects in view that will hereinafter appear, the nature of the invention will be more clearly understood by reference to the following detailed description, the appended claims and the several views illustrated in the accompanying drawings:

IN THE DRAWINGS:

FIG. 1 is a plan view of a machine for simultaneously necking in opposite ends of tubular members in accordance with this invention.

FIG. 2 is an enlarged fragmentary longitudinal sectional view taken along the line 2–2 of FIG. 1 and shows more specifically the details of one-half of the machine including the mounting of die assemblies therein.

FIG. 3 is a fragmentary sectional view taken through a prior die assembly and shows the same during the initial stage of engagement with an end of a tubular member.

FIG. 4 is a sectional view similar to FIG. 3 and shows the relationship of the die members of the die assembly at the time an extreme end of a tubular member is initially inwardly deformed.

FIG. 4A is an enlarged sectional view showing a portion of the die assembly of FIG. 4 and the details of the initially deformed part of the tubular member.

FIG. 5 is a sectional view showing the withdrawn position of a die assembly in accordance with this invention, the tubular member being positioned in alignment with the die assembly.

FIG. 6 is a sectional view of the die assembly of FIG. 5 and shows the same during an initial telescoping movement relative to a tubular member.

FIG. 7 is a sectional view showing a further movement of the die assembly with the die assembly being in position to initially inwardly deform an end of the tubular member.

FIG. 7A is an enlarged sectional view showing a portion of the die assembly of FIG. 7 and the relationship of the deformed extreme end of the tubular member with respect to the die members.

FIG. 8 is another sectional view showing the fully operative position of the die assembly.

FIG. 9 is a sectional view showing the outer ring die fully retracted and the tubular member brought into engagement with a stripper.

FIG. 10 is a sectional view showing the die assembly as the die center moves out of telescoped relation with the necked in tubular member.

Referring now to the drawings in detail, reference is first made to the prior art showings of FIGS. 3, 4 and 4A wherein there is illustrated a die assembly, which die assembly is generally referred to by the numeral 15. The die assembly 15 is mounted for axial movement within a housing 16.

Basically, the die assembly 15 includes an outer ring die 17 which has a tapered entrance portion 18, an intermediate tubular member supporting portion 19, and a forming shoulder 20. The outer ring die 17 is configurated to snugly receive therein an end portion of a tubular member to be necked in, the tubular member being identified by the numeral 21.

The die assembly 15 also includes a die center 22 which has an outer diameter substantially equal to the intended inner diameter of the necked in end portion of the tubular member 21. The die center 22 is telescoped within and is carried by the outer ring die 17. It is to be noted that the outer ring die 17 is provided with a recess in which the die center 22 is seated. The die center 22 is secured to the ring die 17 by means of a suitable support member, preferably in the form of a screw 23, which screw also secures the outer ring die 17 to a suitable support member for axial movement. It is to be noted that the outer die ring 17 is shaped so as to define a stop shoulder 24 surrounding the die center 22.

It will be seen that the outer ring die 17 is brought into telescoped relation with respect to the tubular member 21 before the die center 22 enters into the tubular member 21. This is clearly shown in FIG. 3.

Referring next to FIG. 4, it will be seen that at the time the outer ring die 17 has telescoped over the tubular member 21 sufficient for the forming shoulder 20 thereof to engage the extreme part of the tubular member 21, the die center 22 is only partially telescoped within the end of the tubular member 21. As a result, when the extreme end of the tubular member is inwardly deformed, as is best shown in FIG. 4A, the deformed end portion, which is identified by the numeral 25 is brought into pressure contact with the die center 22 at the time the die center 22 is still moving into telescoped relation with respect to the tubular member 21. As the end portion of the tubular member 21 is continued to be deformed due to the continued telescoping of the outer ring die 17 and the die center 22 with respect to the tubular member 21, the necked in or deformed end portion of the tubular member 21 is in relative moving pressure contact with the die center 22. This, undesirably, oftentimes results in the undue scratching or scoring of the internal surface of the tubular member 21. This is particularly true when the internal surface of the tubular member 21 is coated with a suitable coating material, such as an enamel. Such an enamel is customarily utilized in protectively coating the interior of can bodies and like tubular members.

Reference is now made to FIG. 5 wherein there is illustrated a die assembly which is of a configuration somewhat similar to

the die assembly **15**, but wherein the outer ring die and the die center are mounted for separate operation. The die assembly of FIG. **5** is generally identified by the numeral **30** and is mounted within a housing **31** for axial advancing and retracting movement.

The die assembly **30** includes an outer ring die **32** which is suitably journaled within the housing **31** for relative axial movement. The outer ring die **32** has an internal surface which includes a tapered end portion **33**, an intermediate tubular member supporting portion **34**, and a forming shoulder **35**. The outer ring die **32** is of an internal cross section to have slightly received therein an end portion of a tubular member **36** which is to have an end thereof necked in.

The die assembly **30** also includes a die center **37** which has a peripheral surface **38** of a configuration to be snugly received within a necked in end portion of the tubular member **36** following the reforming or reshaping thereof. The axial length of the surface **38** of the die center is at least equal to the intended length of the necked in end portion of the tubular member **36**.

The die center **37** is carried by a support member **40** which is suitably mounted within the hollow outer ring die **32** for relative axial movement. The support member **40** is carried by a plunger or rod **41** which is reciprocated in a manner to be described hereinafter. A suitable fastener **42** is utilized for the purpose of securing the die center **37** and the support member **40** to the rod **41**.

It is to be noted that the support member **40** is of a diameter greater than the diameter of the die center **37**. As a result, there is formed at the inner end of the surface **38** a stop shoulder **43**, the support member **40** defining the stop shoulder **43**. The stop shoulder **43** functions to limit the relative movement between the die center **37** and the tubular member **36** during the necking in operation.

Referring next to FIG. **6**, it will be seen that during the initial movement of the die assembly **30**, the outer ring die **32** and the die center **37** are simultaneously advanced into telescoped relation with respect to the tubular member **36**. The die center **37** is moved into fully telescoped engagement within the tubular member **36** and the stop shoulder **43** is in transverse alignment with the extreme end of the tubular member **36**. The movement of the die center **37** has stopped, and the outer ring die **32** continues to advance into telescoped relation with respect to the tubular member **36**. It is to be noted that the forming shoulder **35** of the outer ring die **32** has not as yet engaged the tubular member **36**.

Referring now to FIGS. **7** and **7A**, it will be seen that there is illustrated the initial forming operation performed on the tubular member **36**. At this time, the forming shoulder **35** has engaged an extreme end of the tubular member **36** and an end portion of the tubular member **36**, the end portion being identified by the numeral **44**, has been inwardly deformed into engagement with the peripheral surface **38** of the die center **37**. Inasmuch as the extreme end of the tubular member **36** prior to the initial deforming thereof was in transverse alignment with the stop shoulder **43**, it will be readily apparent that the deformed end portion **44** is brought into engagement with the stop shoulder **43** so that as the end portion of the tubular member **36** is further deformed or necked in, there can be no relative axial movement between the tubular member **36** and the die center **37**.

Reference is now made to FIG. **8** wherein the die assembly **30** is in full telescoped engagement with the tubular member **36** and wherein the forming of a necked in end portion **45** thereof has been completed. It will be readily apparent that inasmuch as the extreme end of the tubular member **36** has been in constant engagement with the stop shoulder **43**, the could have been no relative axial movement between the tubular member **36** and the die center **37**. Accordingly, there can be no scratching or scoring of the internal surface of the tubular member **36** up to this point in the necking in thereof.

In FIG. **9** there is illustrated the position of the die assembly **30** wherein the outer ring die **32** has fully retracted with respect to the tubular member **36**. At this point, the die center **37** remains fully telescoped within the necked in end portion **45** of the tubular member **36**. However, since the pressure on the neck in end portion **45** by the outer ring die **32** has been removed, there has been a slight bounce back of the necked in end portion **45** with the result that it is no longer tightly gripping the peripheral surface **38** of the die center **37**.

At this time the necked in end portion **45** of the tubular member **36** is brought into engagement with a stripper **46** which engages a shoulder **47** between the necked in end portion **45** and the remainder of the tubular member **36** so as to restrain the tubular member **36** against axial movement.

Referring now to FIG. **10**, it will be seen that with the stripper **46** holding the tubular member **36** against axial movement together with the die center **37**, the die center **37** may be retracted from within the tubular member **36**. Inasmuch as the necked in end portion **45** is not tightly gripping the die center **37** at the time the die center **37** is withdrawn, there is no scratching or scoring of the internal surface of the tubular member **36** even if the interior of the tubular member **36** is coated with a suitable enamel or other readily scratchable material.

It is to be understood that the die assembly **30** will return to its starting position of FIG. **5** and while in that position, the necked in tubular member **36** will be removed and another tubular member **36** positioned relative thereto.

Reference is now made to FIGS. **1** and **2** wherein there is illustrated a machine incorporating a plurality of the die assemblies **30** for simultaneously and progressively necking in opposite ends of tubular members. The machine, which is generally identified by the numeral **50**, includes a suitable base **51**. The base **51** has mounted thereon adjacent opposite ends thereof aligned supports **52** in which there is journaled for rotation a shaft **53**. The shaft **53** is suitably driven by means of a power unit **54**.

Intermediate portions of the shaft **53** have mounted thereon in fixed relation for rotation therewith a pair of the housings **31**. In the illustrated machine, each of the housings **31** is provided with six of the die assemblies **30**. The die assemblies **30** of the two housings **31** are disposed in axial alignment.

It is to be noted that the machine **50** also includes a suitable carrier **55** which is disposed between the housings **31** for positioning tubular members **36** in alignment with the die assemblies **30**. The details of the carrier **55** are immaterial as far as this invention is concerned and will not be described further hereinafter.

It is to be noted that there is associated with each of the supports **52** a fixed cam assembly **56**. Each cam assembly **56** is provided with a pair of cam elements **57** and **58** for effecting the timed reciprocation of the outer ring die **32** and the die center **37**. The outer ring die **32** has an extension **60** which is provided with a cam follower **61** which engages the cam element **57**. On the other hand, the rod **41**, which is secured to the die center **37**, extends sufficiently rearwardly whereby a cam follower **62** carried thereby is engaged with the cam element **58**.

It will be readily apparent that as the housings **31** rotate with the shaft **53**, the stationary cam assembly will be effective, through the cam followers **61** and **62**, to reciprocate the outer ring die **32** and the die center **37** in the desired timed relation, as is shown in FIGS. **5** through **10**. Thus, each die assembly **30** will be sequentially operated to effect a necking in of an end portion of an associated tubular member **36**. Since there will be a die assembly **30** engaging each of the opposite ends of the tubular member **36**, it will be seen that the tubular member **36** will be simultaneously necked in at the opposite ends thereof.

At this time it is pointed out that the stripper **46** may be conveniently in the form of a rail, as is shown in FIG. **2**. The stripper rail **46** may be suitably supported relative to the base **57** by suitable support means **63**.

At this time it is pointed out that although the stripper **46** has been specifically described and illustrated as being in the form of a rail, it is also to be understood that it is feasible for

the stripper **46** to be mounted on the associated housing **31**. In which event, there would be a stripper for each of the die assemblies and each stripper **46** would have to be projected into engagement with the necked in end portion **45** of a tubular member in timed relation to the withdrawal of the outer ring die **32** and the die center **37**.

It will be readily apparent from the foregoing that the die assemblies **30**, when operated in the sequence specifically illustrated in the drawing and described herein, will automatically neck in the opposite ends of tubular members without in any way scoring or scratching the internal surface or internal surface coatings of the tubular members. On the other hand, it will be readily apparent that the die assemblies **30** are readily adaptable to an automatic machine type operation.

It is to be understood that a single die assembly **30** may be utilized for the purpose of necking in one end only of a tubular body. When the tubular body is provided with a bottom, which is either integrally formed or which is applied prior to the necking in of one end thereof, the body can be removed from the die center **37** by means of air pressure. To this end, the rod **41** and the fastener **42** may be provided with aligned bores **65** and **66**, respectively, through which air under pressure may be introduced into the tubular body at the end of the necking in operation.

Although only a preferred embodiment of the invention has been specifically illustrated and described herein, it is to be understood that minor variations may be made in the construction and operation of the die assembly without departing from the spirit of the invention.

We claim:

1. A method of necking in an end portion of a tubular member comprising the steps of fully positioning a die center within an end portion of a tubular member, engaging the extreme end portion of the tubular member with a forming portion of an outer ring die, progressively necking in the desired end portion of said tubular member around said die center, and during the initial necking in of said tubular member extreme end portion bringing said extreme end portion into positive engagement with a stop associated with said die center to prevent relative movement between said die center and said tubular member during the remainder of said necking in operation.

2. A method of necking in an end portion of a tubular member comprising the steps of fully positioning a die center within an end portion of a tubular member, engaging the extreme end portion of the tubular member with a forming portion of an outer ring die, progressively necking in the desired end portion of said tubular member around said die center, and said outer ring die being fully withdrawn from said tubular member prior to the withdrawal of said die center, and said tubular member being held stationary by a stripper engaged with the necked in portion of said tubular member as said die center is withdrawn.

3. A method of necking in an end portion of a tubular member comprising the steps of fully positioning a die center within an end portion of a tubular member, engaging the extreme end portion of the tubular member with a forming portion of an outer ring die, progressively necking in the desired end portion of said tubular member around said die center, and said outer ring die and said die center being initially simultaneously positioned in telescoped relation relative to said tubular member.

4. A die assembly for necking in an end portion of a tubular member comprising an outer ring die having a recessed forming shoulder, and a die center having a stop shoulder at one end thereof, and means for independently advancing and retracing said outer ring die and said die center being operable to fully position said die center within a tubular member prior to the engagement of said forming shoulder within the tubular member.

5. The die assembly of claim **4** wherein said means are operable to position said stop shoulder in transverse alignment with an extreme end of a tubular member prior to engagement of said forming shoulder with the tubular member to prevent relative axial movement between said die center and the tubular member during the necking in thereof.

6. The die assembly of claim **5** wherein said means are operable to fully withdraw said outer die ring prior to the initial withdrawal movement of said die center.

7. The die assembly of claim **4** wherein said means are operable to fully withdraw said outer die ring prior to the initial withdrawal movement of said die center.

8. The die assembly of claim **8** wherein said means are operable to fully withdraw said outer die ring prior to the initial withdrawal movement of said die center, and a stripper for engaging a necked in portion of a tubular member for holding the tubular member stationary during the withdrawal of said die center.

9. The die assembly of claim **4** wherein there are two of said die assemblies mounted in opposed relation for simultaneously necking in opposite ends of a tubular member.

10. The die assembly of claim **4** wherein said die center and said outer ring die are mounted for rotation about an axis and said means includes fixed cams.

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 3,581,542
DATED : June 1, 1971
INVENTOR(S) : Richard O. Wahler and Albert J. Holk

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Claim 4, line 7, "within" has been changed to read --with--.

Signed and Sealed this

eighteenth Day of *May 1976*

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks