

[54] CYLINDER FORMING
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[56] **References Cited**
UNITED STATES PATENTS
2,179,194 11/1934 Passmore, Jr. 72/347
2,548,702 4/1951 Chamberlain 72/358

3,096,579 7/1963 Waller 72/358
3,139,670 7/1964 George 72/348
3,167,044 1/1965 Henrickson 72/349

FOREIGN PATENTS OR APPLICATIONS

14,046 10/1915 Great Britain 72/349

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[57] **ABSTRACT**

A punch for deep drawing of tubular components has at its leading end a rim of very hard material which projects radially just proud of the outer surface of the punch and is adapted to finish the interior side wall surface of the tubular component as the punch is withdrawn therefrom. The punch is used on apparatus in which it carries the material from which the component is to be formed through a forming die. At the limit of forward movement the tubular component is secured while the punch is withdrawn therefrom, thereby finishing the interior of the component.

8 Claims, 3 Drawing Figures

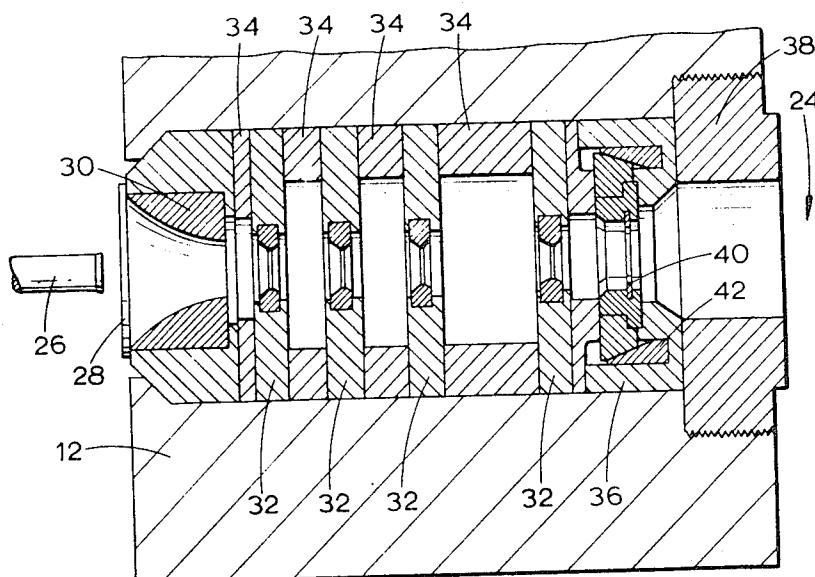


Fig. 1:

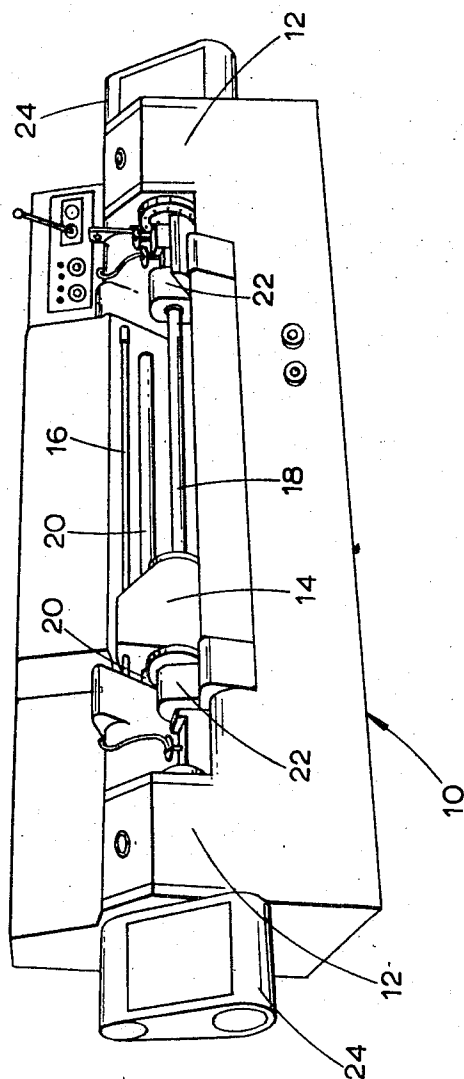


Fig. 2.

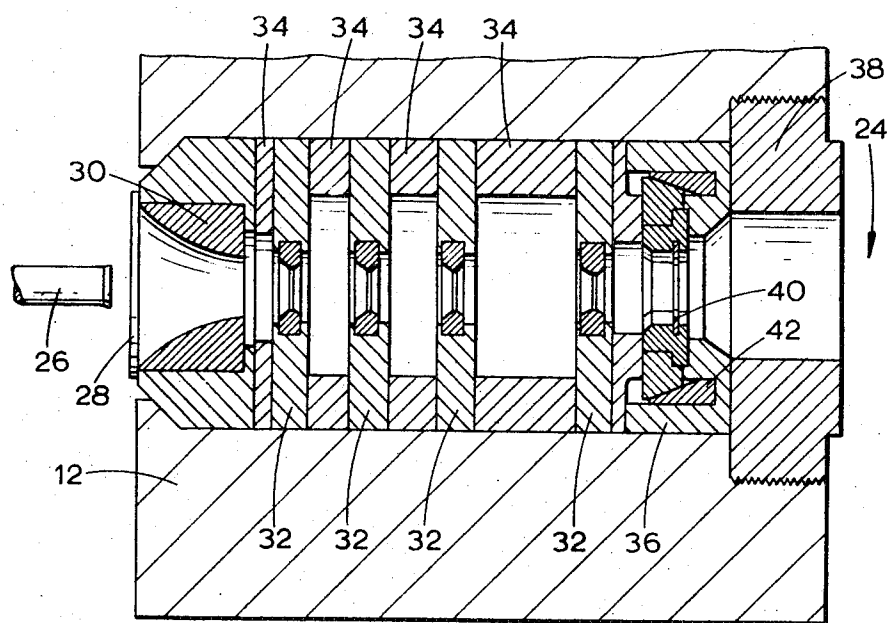
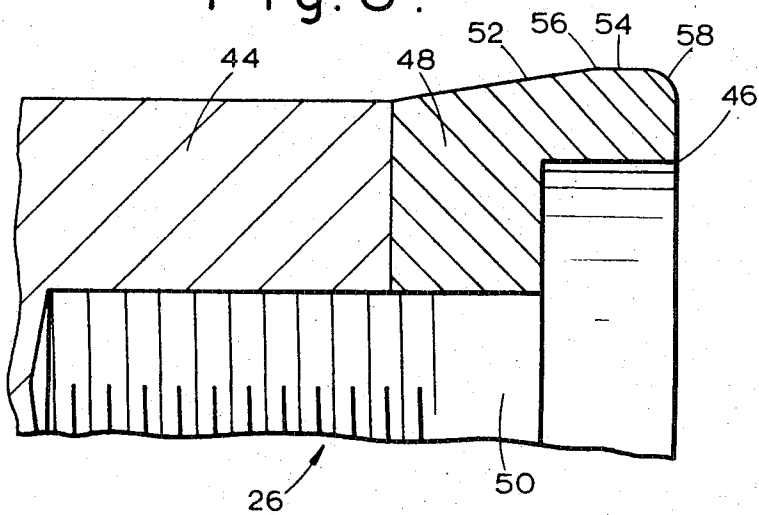


Fig. 3.



CYLINDER FORMING

This invention relates to forming tubular components.

Present methods of forming tubular components fall into two principal classes. In one, the tube is formed by rolling a flat strip of sheet material and then joining the edges along the seam, for example by welding. If necessary, the tube is then cut into smaller lengths as required. In any case, this results in an open ended tube, and if a closed end is required, an end closure piece has to be fitted on, for example by welding. Before doing this, however, the interior of the tube can be treated, for example by burnishing, polishing or sizing, (this is referred to herein generally as "finishing") by passing a hard plug of a suitable size through the tube, in at one end and out at the other. This produces a good finish throughout the tube length, but a separate step is then required to weld on the end closure.

An alternative method of forming a closed ended tube is by a deep drawing process. A punch is pushed against the centre of a flat metal blank or partially preformed cup element, and this is then advanced through a series of dies which progressively reduce the external diameter, while obviously at the same time increasing the length of the component. If necessary, the component can be drawn two or more times on different passes to achieve the final form. The component evidently has a closed end corresponding to the leading end of the punch, and it is ejected from the end of the punch after forming. To assist this, the punch is often stepped down towards its leading end, but where the interior of the component has to be of a uniform size, a parallel punch is required. If the interior of the tube then required finishing, a suitable plug could be pushed down the tube and then withdrawn. A plug such as is used with open-ended tubes is spherical, or else frusto-conical with the narrower end leading so that it can be introduced into the initially undersized tube. The problem here is that such plugs would not finish a closed ended component to the end of the tube. There would always be a substantial dead length of unfinished tube adjacent the closed end. This would be a serious disadvantage in some applications, for example vehicle shock absorbers, where the dead length means an increase in shock absorber length. Shock absorbers should be kept as short as possible so that the vehicle body can be kept as low as possible, with consequent better stability. For this reason, shock absorber bodies are usually made from seamed tube with the end closure fitted as a separate operation.

According to one aspect of the present invention there is provided a punch for the deep drawing of tubular components, the leading end of the punch being provided with a rim of very hard material which projects radially just proud of the outer surface of the punch and is adapted to finish the interior side wall surface of the tubular component as the punch is withdrawn therefrom. The rim may be provided by a disc or annulus of hard material secured to the punch, or else the entire punch can be formed from the hard material. The peripheral surface of the rim preferably has a first annular surface portion remote from the leading end which tapers to a reduced diameter in the direction away from the leading end. An annular surface portion is preferably provided of uniformly cylindrical form at the region of maximum diameter of the rim. An annular

surface portion may also be provided at the leading end of the punch to suitably shape the interior corner region between the end wall and side wall of the component.

According to another aspect of the present invention, there is provided a method of deep drawing a tubular component, which comprises contacting the leading end of a punch, having a hard upstanding rim as described above, with the material from which the component is to be formed, advancing the punch and material through apparatus adapted to form the material into a tubular shape around the punch, and then securing the component while withdrawing the punch from within the component, whereby the interior side wall surface of the component is finished by the sliding contact of the hard rim of the punch.

According to a third aspect of the invention, there is provided apparatus for deep drawing tubular components, comprising a punch having a hard upstanding rim as described above, die means adapted to form material carried therethrough by the punch into a tubular shape around the punch, drive means adapted to advance and retract the punch through the die means, and securing means adapted to hold the component at the limit of the forming stroke while the punch is withdrawn therefrom.

The invention further includes tubular components made using such a punch, method or apparatus.

In order that the invention may be more clearly understood, one embodiment will now be described with reference to the accompanying drawings wherein:

FIG. 1 is a perspective view of a deep drawing press,

FIG. 2 is a diagrammatic longitudinal sectional side view through the forming part of the press, and

FIG. 3 is a greatly enlarged cross-sectional side view through part of the leading end of the punch.

Referring firstly to FIG. 1, the press comprises a supporting structure 10, having a tool chamber 12 at each end, a cross-head 14 travelling horizontally between the tool chambers on a guide 16, and a punch extension 18 extending from each side of the cross-head towards the tool chambers. The cross-head is reciprocated horizontally by hydraulic rams housed within the structure 10 at each end and connected to the cross-head through piston rods 20. The punch extension is supported on each side in bearings 22. Beyond each tool chamber 12 is a work discharge zone 24 to receive the finished components. The punch extension at each end carries a punch which, on reciprocation of the cross-head moves into and out of the respective tool chamber 12. Thus, each stroke of the cross-head provides a working stroke at one end or the other of the press.

FIG. 2 shows the working region in more detail, where a punch 26 is shown about to bear upon a metal blank 28 at the mouth of the tool chamber 12. The tool chamber houses an intake ring 30 and a series of ironing rings 32, all axially aligned with the punch and separated by spacing rings 34 which get longer towards the end of the working stroke to allow for the increasing length of the component. Beyond the ironing rings is a stripper assembly 36, and the whole set of parts is held in the chamber 12 by a locking ring 38. The stripper assembly comprises a segmented annulus 40, the segments being separately mounted so as to be moved radially by axial movement of a wedge element 42. The intake ring is trumpet-shaped to perform the initial

cupping of the blank 28, while the ironing rings 32 are of steadily decreasing diameter so as to progressively iron the blank to a tubular component of the required external diameter. When the punch has pushed the component past the last ironing ring and into the stripper assembly, the segments 40 are moved inwardly to engage behind the trailing edge of the component and hold it as the punch is withdrawn. Thereafter the component falls from the opening in the locking ring into the discharge zone 24.

FIG. 3 shows in more detail the leading end of the punch 26. The punch 26 is generally of conventional design, comprising for the most part a steel bar 44 of uniformly cylindrical cross-section. At its leading end 46, however, the bar is provided with a rim component 48 which is made of very hard material such as tungsten carbide and is held to the end of the bar by a screw 50. The peripheral surface of the rim has a first annular surface portion 52 which tapers to a reduced cross-section in the direction away from the leading end of the punch, and a second uniformly cylindrical annular surface portion 54 which meets the surface portion 52 at a clean edge 56. The surface 54 and therefore the edge 56 represent the region of maximum diameter of the rim, and stand just proud of the surface of the bar 44. For example, the radius of the edge 56 might be five thousandths of an inch (about 0.13 mm.) greater than the radius of the bar 44. There is also a short radiused corner 58 at the leading end.

In use, the initial cylinder forming steps are carried out as described above. When the cylindrical component has been secured against axial movement by the segments 40, the plug is then slowly withdrawn. The edge 56 of the rim of the punch scrapes the inside surface of the component as the punch is withdrawn and imparts a very smooth finish of accurately known bore.

Various modifications to this specific embodiment can be made. For example, the hard rim can be secured to the remainder of the punch by other means, such as brazing, or else the whole of the punch could be made from the hard material. The design of the rim could be varied. For example, the radiused corner 58 could be omitted or modified, for example to a bevelled corner, but generally some slight shaping will be necessary here to avoid too sharp a corner between the side and end walls of the component. The length of this section is kept as short as is practicable. The uniformly cylindrical surface portion 54 could be omitted, but the resultant wear on the edge 56 would then reduce the overall diameter, and require replacement of the rim 48. By using a short length of uniform section, the tapering section 52 can be recut to provide a new edge 56 of the same diameter. The tapering section 52 could be omitted in favour of a radially planar surface, but this would be likely to tear the material of the component on withdrawal and provide an unsatisfactory finish. It may be necessary in some cases to arrange for the component to be secured against axial expansion while the punch is withdrawn. With very thick walled components, the wall thickness will provide sufficient resistance to the ironing action of the punch. In some thin walled components axial expansion may be tolerated.

It will be apparent that the present invention allows closed ended tubular components to be formed in a press with internal finishing in the same operation, and

that the internal finish can extend virtually right up to the end closure.

I claim:

1. A method for deep drawing and ironing the interior surface of a tubular component, using a punch having a leading end provided with a rim of very hard material which projects radially proud of the outer surface of the punch, and die means comprising an intake ring and a series of ironing rings of progressively reducing diameter, which method comprises the steps of

- i. locating a sheet metal blank at the mouth of the intake ring,
- ii. advancing the leading end of the punch against the blank and carrying it through the intake ring and ironing rings so as to draw the blank into an elongate tubular component, and
- iii. securing the component while withdrawing the punch, whereby the raised leading end thereof effects ironing of the interior surface of the component.

2. A method according to claim 1 wherein the raised rim of the punch is provided by a disc or annulus of relatively harder material secured to the punch.

3. In a method for deep drawing a tubular component, wherein a metal blank is carried by a punch through a series of ironing rings of progressively reducing diameter to draw it into a tubular component, the improvement wherein the leading end of the punch is provided with a rim of very hard material which projects radially proud of the outer surface of the punch, and at the end of the deep drawing stroke of the punch the tubular component is secured while the punch is withdrawn, whereby the raised leading end of the punch effects ironing of the interior surface of the component during withdrawal.

4. For apparatus for deep drawing tubular components, comprising a frame carrying a punch provided at its leading end with a rim of very hard material which projects radially proud of the outer surface of the punch and is adapted to iron the interior side wall surface of the tubular component as the punch is withdrawn therefrom, die means comprising a series of ironing rings of progressively reducing diameter adapted to form a sheet metal blank carried there-through by the punch around said projecting leading end of the punch into a tubular shape of internal diameter substantially the diameter of the punch, drive means adapted to advance and retract the punch through the die means, and securing means adapted to hold the component at the limit of the forming stroke while the punch is withdrawn therefrom, whereby the raised leading end of the punch irons the interior surface of the tubular component from substantially the closed end thereof.

5. Apparatus according to claim 4 wherein the rim of the punch is provided by a disc or annulus of relatively hard material secured to the punch.

6. A punch for the deep drawing of tubular components having its leading end provided with a rim of very hard material which projects radially proud of the outer surface of the punch, said rim having an annular portion adjacent the leading end and of uniformly cylindrical form at the region of maximum diameter of the rim and an annular portion adjacent the uniformly cylindrical portion, which tapers to a reduced diameter in the direction away from the leading end, the uniformly cylindrical portion forming with the tapered portion a

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sharp edge whereupon on wearing of said edge a new edge may be formed by cutting a new tapered portion which forms with the uniformly cylindrical portion the new edge.

7. Apparatus for deep drawing tubular components, comprising a frame carrying a punch provided at its leading end with a rim of very hard material which projects radially proud of the outer surface of the punch and is adapted to iron the interior side wall surface of the tubular component as the punch is withdrawn therefrom, die means comprising a series of ironing rings of progressively reducing diameter adapted to form a component carried therethrough by the punch around said projecting leading end of the

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punch into a drawn out tubular shape of internal diameter substantially the diameter of the punch, drive means adapted to advance and retract the punch through the die means, and securing means adapted to hold the component at the limit of the forming stroke while the punch is withdrawn therefrom, said raised leading end of the punch on withdrawal ironing the interior surface of the tubular component from substantially the closed end thereof.

8. Apparatus according to claim 7 wherein the rim of the punch is provided by a disc or annulus of relatively hard material secured to the punch.

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