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APPARATUS FOR SPIN EXTRUDING METAL ARTICLES

Filed April 23, 1957

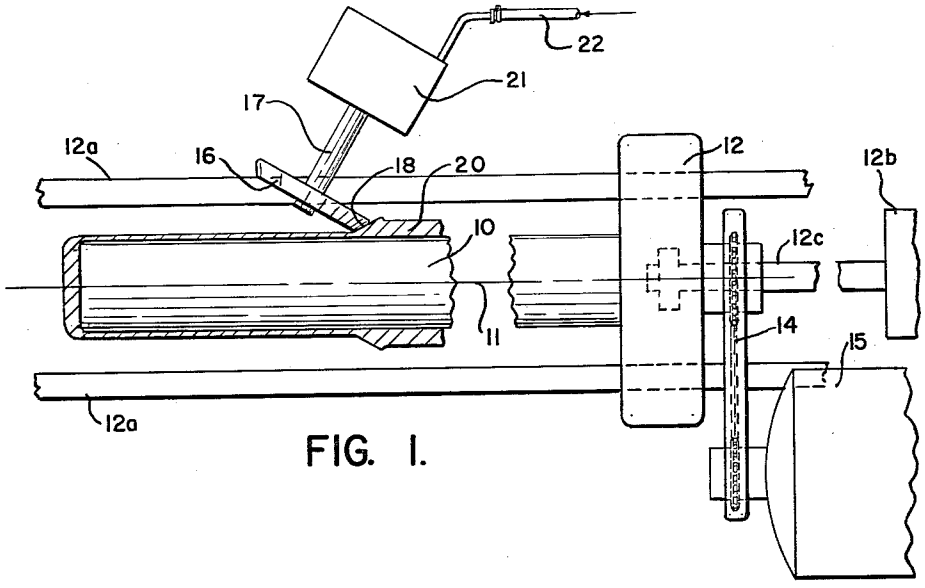


FIG. 1.

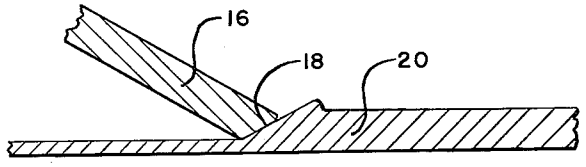


FIG. 2.

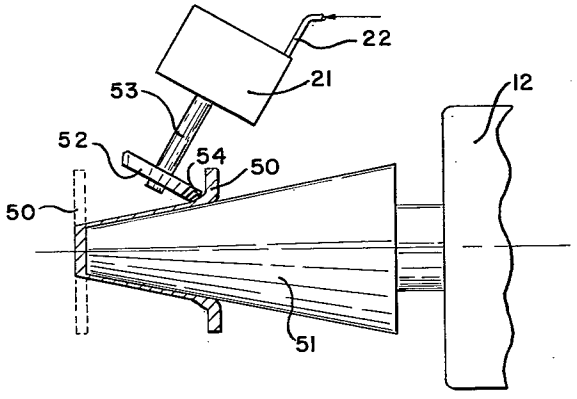


FIG. 3.

INVENTOR.
THOMAS C. KANE

BY Hopper, Leonard & Beall
his attorneys.

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APPARATUS FOR SPIN EXTRUDING METAL ARTICLES

Thomas C. Kane, Youngstown, Ohio, assignor to The Commercial Shearing and Stamping Company, a corporation of Ohio

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This invention relates to apparatus for metal forming and particularly to apparatus for forming metal blanks by cold-power spinning.

It has been the practice for many years to reduce the wall thickness of tubular metal blanks and the like by drawing operations using appropriate dies. Any substantial reduction in wall thickness requires a series of dies and an annealing operation between each die.

More recently, methods have been suggested for cold-forming cylindrical and other hollow parts from simple blanks by cold-flowing or spinning operations. Generally stated, the method consists of a mandrel conforming to the finished inside surface of the part being spun. The mandrel supports the blank to be spun and is rotated on its axis. A roll rotated on an axis generally parallel to the surface being rolled has a beveled outer edge. This beveled surface is applied to the rotating product and fed parallel to the work surface, thus spirally forming it to the mandrel surface while it thins the product and elongates it along the surface of the mandrel. The beveled surface of this roller, which is in contact with the work has different surface speeds and likewise the work being spun has different surface speeds while under contact with the roll.

The fastest diameter of the roller contacts the slowest portion of the spun surface while the slowest portion of the roller contacts the fastest portion of the work. This difference of speeds on the same surface produces a scuffing action under exceedingly high pressures and causes the surface of the softer metal of the product being spun to rupture. The greater the depth that the beveled roll is plunged into the surface of the work during this operation, the greater the difference in surface speeds of the roll and the product, and the higher the degree of scuffing and surface rupture. Small diameter parts cannot take as great a depth of roll plunge as a large diameter for the same reason. Consequently, to preserve a reasonably good outside surface on the spun parts, it is necessary to take multiple passes of the small plunge depth.

At times this surface rupturing becomes so severe that the rupture will extend entirely through the product and spoil the piece. And in any event, the multiple passes are quite expensive compared to a single pass.

I have discovered apparatus which eliminates these disadvantages and which permits high speed forming at greater working depths than has heretofore been possible.

I preferably provide a blank holding mandrel rotating on a fixed axis. A working roll is provided on an axis intersecting the mandrel. The working face of this roll is a frustrum of a cone whose apex lies on the mandrel axis. The working face of the piece being formed forms a frustrum of a cone whose axis substantially coincides with the axis of the mandrel, and whose apex substantially coincides with the apex of the aforementioned cone. Under these conditions all mating parts of the surface of the roll and of the product move at identical speeds and the scuffing of the product surface is entirely eliminated. The rolling action may be compared to the action of a pair of beveled gears or of a conical roller bearing. The apex of the cone of the roller may be raised slightly above the center line of the mandrel to facilitate extrusion of the product surface under the roll.

While I have set out a generally preferred object and advantage of my invention, other objects, advantages and

purposes will be apparent from a consideration of the following description and the accompanying drawings in which

FIGURE 1 is a top plan view of a cold spinning apparatus according to my invention;

FIGURE 2 is an enlarged partial section of the apparatus of FIGURE 1 showing a work piece on the mandrel; and

FIGURE 3 is a top plan view of a second embodiment of my invention.

Referring to the drawings, I have illustrated a generally cylindrical mandrel **10** rotatable on a horizontal axis **11**. The mandrel is mounted in a support frame **12** and driven by conventional gear train **14** and electric motor **15**. The mandrel is movable axially by moving the support frame on rails **12***a* in known manner as for example by actuator **12***b* acting on frame **12** through rod **12***c*. A cold spinning roll **16** is mounted on a shaft **17** lying at an angle transverse to the axis **11** of the mandrel. The angle is adjusted so that the working face **18** of the roll **16** engages the work piece **20** being formed along a frusto-conical surface of a cone whose apex lies substantially on the mandrel axis **11**. The working roll **16** may be driven by frictional engagement with the work or by a hydraulic motor **21** receiving high pressure hydraulic fluid through an inlet lead **22**. Simultaneous rotation of the mandrel and the roll coupled with axial movement of the mandrel forces the material in the work piece to flow on the surface of the mandrel and to uniformly elongate along the mandrel, taking the shape of the mandrel.

It will be seen from the foregoing disclosure that the linear speed of the working or contact surface **18** of roll **16** can be substantially matched to the linear speed of the surface being worked over its entire area.

I have found that by the use of the apparatus and method described above I am able to elongate the work piece on the mandrel at a greater rate of speed than heretofore believed possible and to avoid the undesirable non-uniformity of surface characteristic of this process.

In FIGURE 3 I have illustrated another form of my invention in which a blank **50** is held on the end of a frusto-conical mandrel **51**. The mandrel **51** is rotatable on a horizontal axis in the same manner as mandrel **10**. A cold spinning roll **52** is mounted on a shaft **53** lying at an angle transverse to the axis of the mandrel **51** and so adjusted that the working face **54** of the roll engages the worked surface of blank **50** on a frusto-conical surface corresponding to a cone whose apex lies substantially on the mandrel axis. Simultaneous rotation of the mandrel **51** and roll **52** forces the material of the blank to flow on the surface of the mandrel and to uniformly elongate along the mandrel, taking the shape of the mandrel.

While I have described certain preferred embodiments of my invention it will be understood that this invention may be otherwise embodied and practiced within the scope of the following claims.

I claim:

1. An apparatus for cold spinning metal objects comprising a mandrel having the internal shape of the desired product and rotatable on an axis, means mounted on the apparatus for rotating said mandrel on its axis, means mounted on the apparatus for moving the mandrel axially, a frusto-conical work roll mounted for rotation on the end of a shaft transverse to the axis of the mandrel, said shaft being positioned so that the apex of the cone of the work roll lies within the mandrel and adjacent the axis of the mandrel and the working surface of the roll and the surface of the product being worked lie on the surface of a frustrum of a cone whose apex lies substantially on the axis of the mandrel, said surface lying at an acute angle to the mandrel surface.

2. An apparatus for cold spinning metal objects com-

prising a mandrel having the shape of the desired inside surface of the product, means mounted on the apparatus for rotating said mandrel on its axis, a frusto-conical work roll mounted on the apparatus for rotation on an axis transverse to the axis of the mandrel, said work roll axis being positioned so that the apex of the cone of the work roll lies within the mandrel and adjacent the axis of the mandrel and the working surface of the work roll and the surface of the product being worked lie on a surface of a frustrum of a cone whose apex lies substantially on the axis of the mandrel, said surface lying at an acute angle to the mandrel surface and means mounted on the apparatus for moving the mandrel and work roll relative to one another along the mandrel axis.

3. An apparatus for cold spinning metal objects comprising a mandrel having the internal shape of the desired product and rotatable on an axis, means mounted on the apparatus for rotating said mandrel, a frusto-conical work roll mounted on the apparatus for rotation on an axis transverse to the axis of the mandrel and positioned to lie on the surface of a cone whose apex lies substantially on the axis of the mandrel, said work roll being so positioned with respect to the mandrel that the apex of its cone lies within the body of the mandrel and adjacent to the axis of the mandrel, the working surface of said work roll lying at an acute angle to the surface of the mandrel and being in contact with the surface of the product being worked and means mounted on the apparatus

for moving the mandrel and work roll relative to one another along the mandrel axis.

4. An apparatus for cold spinning metal objects comprising a mandrel having the internal shape of the desired product and rotatable on an axis, work holding means on said mandrel, a frusto-conical work roll mounted for rotation on an axis transverse to the axis of the mandrel and positioned to lie on the surface of a cone whose apex lies substantially on the axis of the mandrel, the working surface of the work roll lying at an acute angle to the mandrel surface means mounted on the apparatus for driving one of the mandrel and work roll for rotation and means mounted on the apparatus for moving the mandrel and work roll relative to one another along the mandrel axis.

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