Jan. 20, 1970 J. MARCOVITCH 3,490,265

DRAWING OF HOLLOWWARE FROM SHEET METAL

Filed Aug. 11, 1967

3 Sheets-Sheet 1

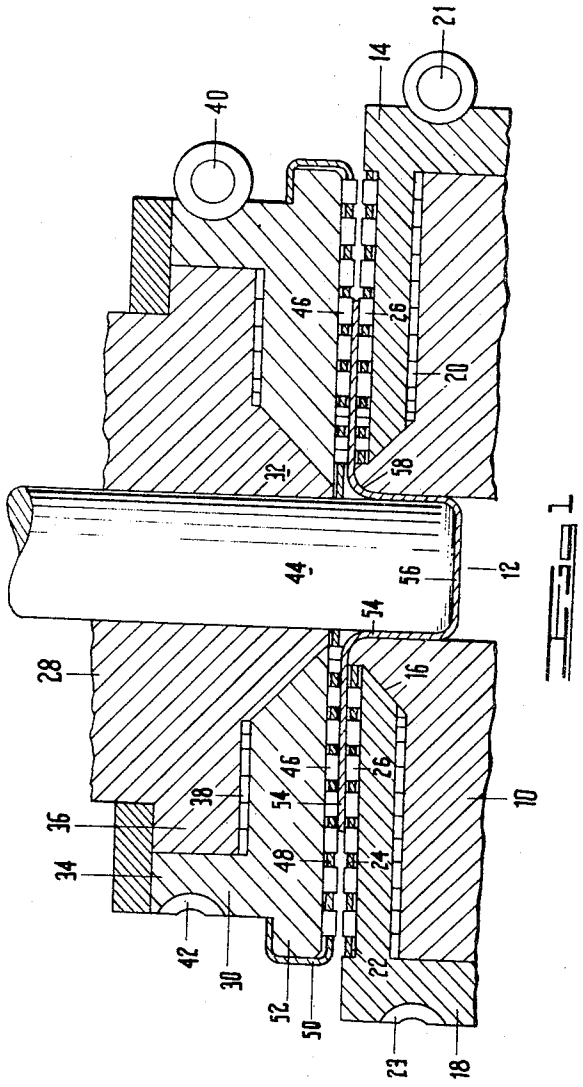


FIG. 1

INVENTOR
JACOB MARCOVITCH
BY Young & Thompson
ATTYS.

Jan. 20, 1970 J. MARCOVITCH 3,490,265

DRAWING OF HOLLOWWARE FROM SHEET METAL

Filed Aug. 11, 1967

3 Sheets-Sheet 2

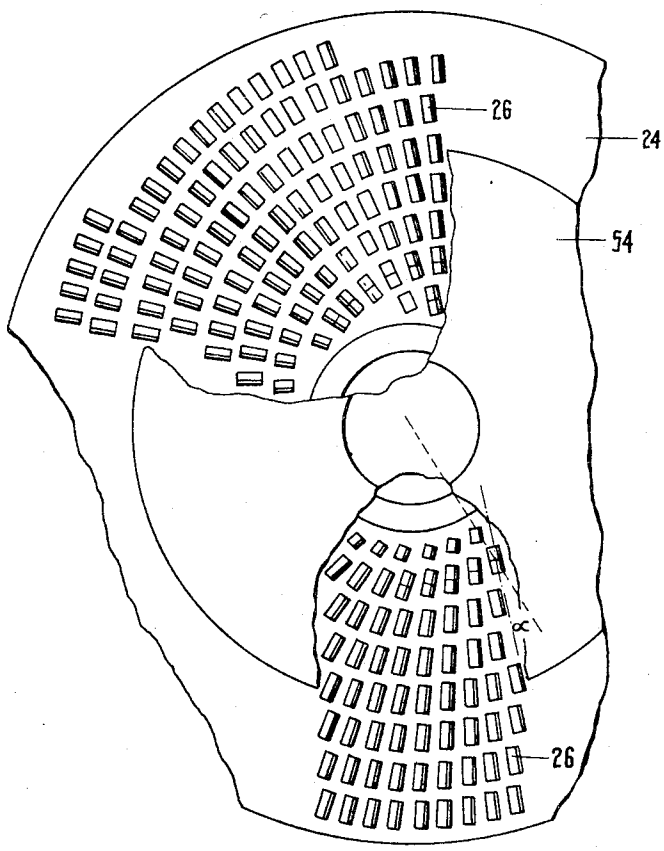


Fig 2

INVENTOR

JACOB MARCOVITCH

BY Young + Thompson

ATTYS.

Jan. 20, 1970 J. MARCOVITCH 3,490,265

DRAWING OF HOLLOWWARE FROM SHEET METAL

Filed Aug. 11, 1967 3 Sheets-Sheet 3

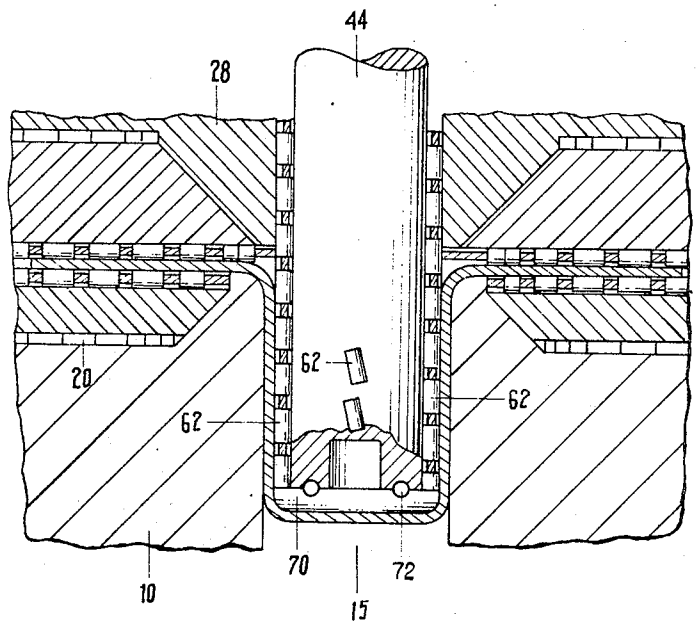


Fig 3

INVENTOR

JACOB MARCOVITCH

BY Young & Thompson

ATTYS.

United States Patent Office 3,490,265
Patented Jan. 20, 1970

3,490,265

DRAWING OF HOLLOWWARE FROM SHEET METAL

Jacob Marcovitch, Johannesburg, Republic of South Africa, assignor to Rotary Profile Anstalt, Vaduz, Liechtenstein

Filed Aug. 11, 1967, Ser. No. 659,998
Claims priority, application Republic of South Africa, Aug. 19, 1966, 66/4,959
Int. Cl. B21d 22/20, 22/22
U.S. Cl. 72—348 17 Claims

ABSTRACT OF THE DISCLOSURE

Hollowware is deep drawn from metal sheet by clamping the peripheral zone of the sheet, applying drawing pressure to the central zone by a punch within a die, and simultaneously rolling the clamped peripheral zone between two opposed series of small rollers, arranged obliquely to the central zone, for material to be urged from the peripheral zone towards the central zone. The punch may be rotatable and may have a series of small rollers round it to roll the drawn metal against the wall of the die.

This invention relates to the drawing of hollowware from sheet metal, in which the peripheral zone of the blank is clamped, while the unsupported central zone is displaced, for instance, by a punch to produce the component.

While this method of producing hollowware has obvious advantages over other techniques, such as metal spinning, it imports its own disadvantages. These are, principally, that the central zone has to be of sufficient diameter in relation to the outer diameter of the blank, and that the blank-holder pressure must be very critically regulated to produce the article without rupture; and that the metal work-hardens, which means that the drawing operation must be suspended from time to time for the metal to be annealed. There is the further trouble that the sinking of the punch into the central zone tends to wrinkle the clamped rim.

The object of the present invention is to provide a drawing technique which minimises the disadvantages and difficulties of the conventional drawing methods.

According to the invention, the peripheral zone of the blank is clamped between two juxtaposed wheels of small rollers that are mounted for rotation about a common axis, the individual rollers beink skewly mounted to urge the material of the peripheral zone towards the axis of rotation.

The concept upon which the invention proceeds is that the clamped rim is "ironed" towards the central zone, while remaining clamped between the two series of rollers, so that it is progressively forced to maintain a constant thickness, as the natural tendency for the rim is to thicken, or it may be thinned during the "ironing", if this is desired, and the surplus metal propelled inwardly into the central zone.

The central zone may be drawn in the conventional way by means of a punch, and, if it is, the flow of metal radially inwardly from the peripheral zone will facilitate the drawing operation, and lessen the number of annealing operations required. However, according to a development of the invention, the drawing operation is associated with a rolling operation, in which a series of rollers is presented to the inner wall of the drawn central area and rotates about the axis of rotation of the punch. The rollers press against the inner wall and assist in the drawing operation, rolling out irregularities and wrinkles and assisting to maintain the wall thickness uniform, if that is the desire, or to make the wall of different thicknesses. The inner rollers may be skewed to promote flow of metal downwardly into the drawing cavity and thus reduce the number of annealing stages, while reducing frictional drag.

The technique of the invention is illustrated in the accompanying drawings, in which:

FIGURE 1 is a vertical section through one embodiment, the two wheels of rollers are shown in section, clamping the rim of the blank between them.

FIGURE 2 is a partial plan, and shows a fragmentary plan view of one of the wheels of rollers, the individual rollers being mounted with their axes of rotation at an acute angle to the radius of the wheel that passes through the centre of the roller. Each wheel is backed by solid structure. The backing structures are rotated by means of suitable worm gearing and in opposite direction to neutralise torque on the component.

FIGURE 3 is a partial vertical section of a second embodiment.

The machine illustrated consists of a massive cylindrical base **10** centrally apertured at **12** to form a drawing cavity of appropriate diameter. The base is recessed to accommodate a turret **14** that has a conical hole to mate with a conical spigot **16** on the base. The opposed conical faces, together with a cylindrical skirt **18** on the turret that surrounds the base, ensures that the turret rotate around the base without play. Rotation is assisted by providing a series of rollers **20** between the opposed lateral faces of the base and the turret. The turret is driven around the base by a worm gear **21** that engages a circular rack **23** formed in the outer surface of the turret.

The upper face of the turret is recessed at **22** to accommodate a wheel that rotates freely around the spigot of the base. The wheel consists of a flat cage **24** which is extensively apertured, with a small roller **26** mounted within each aperture. The rollers are skewed, as seen in FIGURE 2, at an angle to the radii. The rollers need not be pinned to the cage, as they are supported on the floor provided by the turret.

A head **28** is mounted above the turret. It consists of a body **28** around which is arranged a cylindrical foot **30** that is formed centrally with a conical hole which receives a complemental spigot **32** on the body. The foot has an upstanding flange **34** that fits around a cylindrical part **36** of the body. The two parts have a series of rollers **38** between them, and the foot is rotated about the body by means of a worm gear **40** that engages a circular rack **42** formed in the body. The two wheels of the rollers are arranged for rotation in opposite directions.

The body is axially apertured slidably to receive a punch **44**.

There is a second wheel mounted below the head. It, too, consists of a series of rollers **46** mounted each in a skewed aperture in a cage **48**. The cage is trough-shaped, and its rim **50** is curved to engage a shoulder **52** on the foot **30**. The rollers are held within the cage by means such as pins (not shown). The cage **48** is centrally apertured to pass the punch **44**.

The blank **54** to be worked on is a disc and is placed upon the wheel of rollers **26**, and the head is lowered for the wheel of rollers **46** to rest on the blank. The punch **44** is then lowered and pressed downwardly to draw the central zone **56** of the blank. At the same time, the wheels of rollers are caused to rotate by turning the worm gears **21** and **40**. The rotation is in opposite directions, as stated above, in order to neutralise torque on the workpiece.

The alignment of the rollers is such that, as they rotate over and under the peripheral zone of the workpiece,

they "iron" it out, and prevents the buckling which tends to occur as the drawing proceeds. At the same time, the rollers, being skewed, cause metal to flow inwardly from the periphery inwardly towards the centre, thereby promoting uniformity in the thickness of the lands of the article, facilitating the drawing operation, and minimising the number of annealings that will be required. The flow of metal radially inwardly also has the great advantage that it thickens the metal at the junction **58** between the lands and the drawn part of the workpiece and permits a deeper draw than would otherwise be practicable.

The finished article is characterised by lands without buckles and of fair uniformity of thickness. The rolling of the lands produces a high finish, so that no after-treatment is necessary.

In a further development of the invention, either the inner or outer surface of the component (or both) in the die is or are urged downwardly during the drawing operation by orbiting rollers lining the mouth of the die for the walls of the punch. The punch is arranged for rotation.

This is shown in FIGURE 3, where the punch **44** carries a series of skewed rollers **62** held in a cylindrical cage **64** that is fast with it. The punch is rotated to orbit the rollers **62**. The punch is propelled downwardly for the rollers **62** to draw the workpiece by rolling the central zone against the inner wall of the drawing cavity **12**. The skewing of the rollers **62** promotes flow of the material of the workpiece downwardly into the cavity **12**, thus assisting the drawing. The rollers roll out all irregularities and wrinkles and assist to produce a wall of uniform thickness, or, if that be desired, a wall of different thicknesses. A pad **70** is carried on the end of the punch and is separated from the punch by a thrust bearing **72**.

The provision of drawing rollers much reduces frictional drag, and minimises or avoids the need for annealing of the drawn zone.

I claim:

1. Apparatus for drawing an article of hollowware from a sheet of metal, comprising a punch adapted to draw a central zone of the sheet, means to support the peripheral zone of the sheet surrounding the central zone, said means comprising, on at least one side of the sheet, a plurality of rollers adapted to roll on the surface of the sheet, and means for forcing said rollers against said surface of the sheet in a direction to urge material from the peripheral zone of the sheet toward the central zone, each roller being skewed by having its axis inclined obliquely to a line radial to the punch axis and intersecting the axis of the roller at the geometric center of the roller, whereby roller rotation imparts spirally inward forces to the sheet.

2. The apparatus of claim **1**, and means mounting the rollers for movement relative to the sheet in a path around the punch.

3. The apparatus of claim **1**, in which the rollers are arranged with their axes parallel to the plane of the peripheral zone of the sheet.

4. The apparatus of claim **3**, in which the rollers have substantially cylindrical working surfaces.

5. A method of drawing an article of hollowware from a sheet of metal, comprising supporting a peripheral zone of the sheet against movement normal to the plane of the sheet, applying pressure to a central zone of the sheet surrounded by the peripheral zone to draw the article, and forcing rollers against at least one surface of the sheet in the peripheral zone in a direction to urge the material of the peripheral zone toward the central zone with the roller axes inclined obliquely to a line radial to the punch axis and intersecting the axis of the roller at the geometric center of the roller.

6. A method as claimed in claim **5**, in which said forcing is effected by moving the rollers relative to the sheet in a path about said central zone.

7. The method of claim **6**, in which the rollers move in a circular path around the cenral zone.

8. The method of claim **5**, in which both surfaces of the sheet are rolled by rollers.

9. The method of claim **8**, in which the direction of movement of the rollers is different on opposite sides of the sheet.

10. The method of claim **9**, in which the rollers on each side of the sheet move in a circular path around the central zone.

11. The method of claim **5**, in which at least one surface of the central zone is traversed by rollers while pressure is applied to the central zone.

12. The apparatus of claim **3**, in which the rollers are supported in a cage and backed in line contact by a wheel, the wheel being adapted to be driven around the punch to cause the rollers to roll relatively on the sheet.

13. The apparatus of claim **1**, in which rollers and roller-mounting means are provided on both sides of the sheet.

14. The apparatus of claim **13**, in which the rollers on each side of the sheet have substantially cylindrical working surfaces and are arranged with their axes parallel to the plane of the peripheral zone of the sheet.

15. The apparatus of claim **13**, in which the rollers on each side of the sheet are supported in a cage and backed in rolling contact by a wheel, and including means to drive the wheels in opposite directions.

16. The apparatus of claim **1**, in which the punch is provided with rollers mounted at its surface for rotation and adapted to roll upon the inner surface of the drawn central zone of the sheet as drawing proceeds.

17. The apparatus of claim **16**, in which the rollers are supported in rolling contact on the surface of the punch, the punch surface being circular in cross section, and including means to rotate the punch relative to the central zone of the sheet as drawing proceeds.

References Cited

UNITED STATES PATENTS

531,337	12/1894	Saltzkorn et al.	72—350
2,988,208	6/1961	Loew	72—350
3,314,275	4/1967	Mullen	72—350

FOREIGN PATENTS

87,874	8/1896	Germany.
98,092	2/1940	Sweden.

RICHARD J. HERBST, Primary Examiner

U.S. Cl. X.R.

72—350