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Kannegiesser et al.

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[54] **APPARATUS FOR CUTTING OFF SHEET-METAL CONTAINERS**

[75] Inventors: **Reinhard Kannegiesser,** Birenbach; **Werner Tiefenbach,** Gingen, both of Germany

[73] Assignee: **L. Schuler GmbH**

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[58] **Field of Search** ..... 82/58, 82, 85, 101; 72/71; 113/120 N

[56] **References Cited**

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2,702,597	2/1955	Wickmire	82/82 X
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Primary Examiner—Harrison L. Hinson
Attorney, Agent, or Firm—Craig & Antonelli

[57] **ABSTRACT**

Apparatus for severing waste material from cylindrical sheet-metal containers, which apparatus includes an inside mandrel having a cutting edge formed along a predetermined parting line of a container inserted thereover. A counter tool in the form of a contact pressure piece is provided for pressing the container material radially inwardly to tear the same along the predetermined parting line by way of the tool edge of the mandrel. This contact pressure piece is spaced axially from the tool edge and between the tool edge and an abutment for the waste portion of the container material such that the counter tool acts only to exert pressure on the container material with the severing taking place at a position spaced therefrom. Since the tool edge of the mandrel and the contact pressure piece of the counter tool are spaced from one another, the counter tool experiences practically no wear and tear, while the arrangement advantageously provides a smooth, burr-free parting edge for the materials being severed.

14 Claims, 2 Drawing Figures

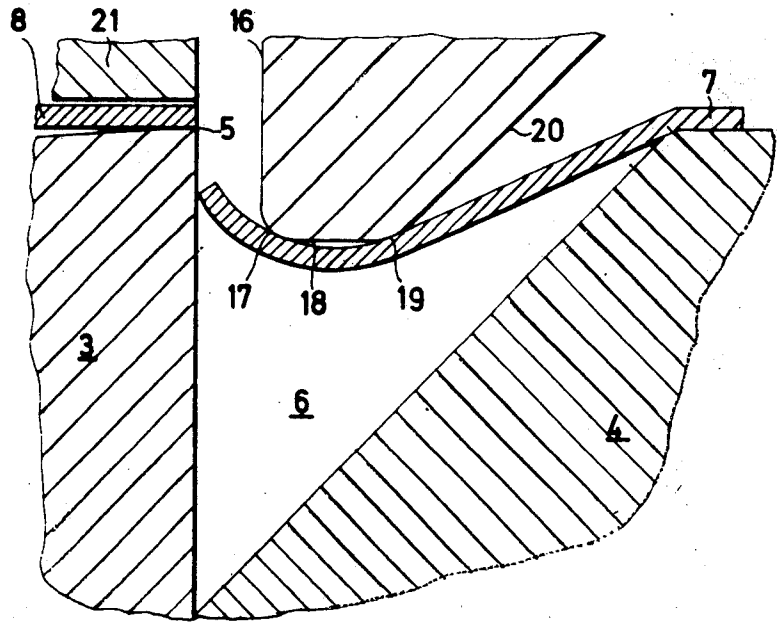
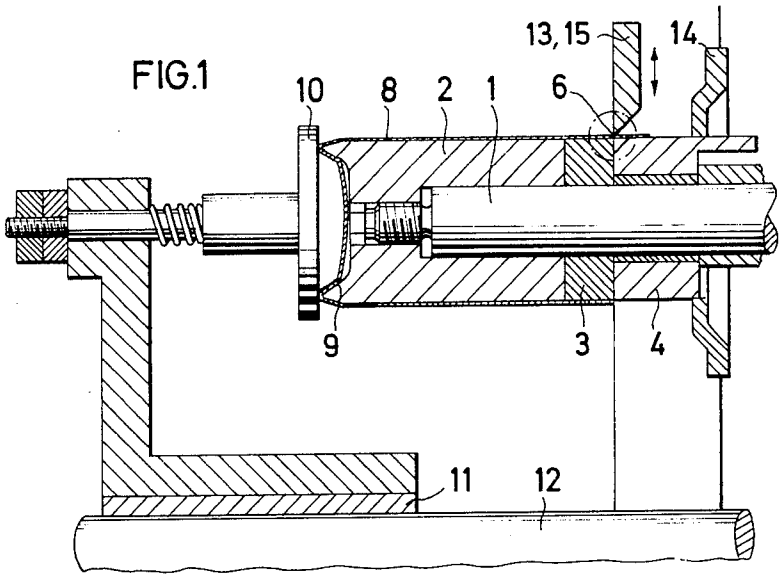


FIG.1



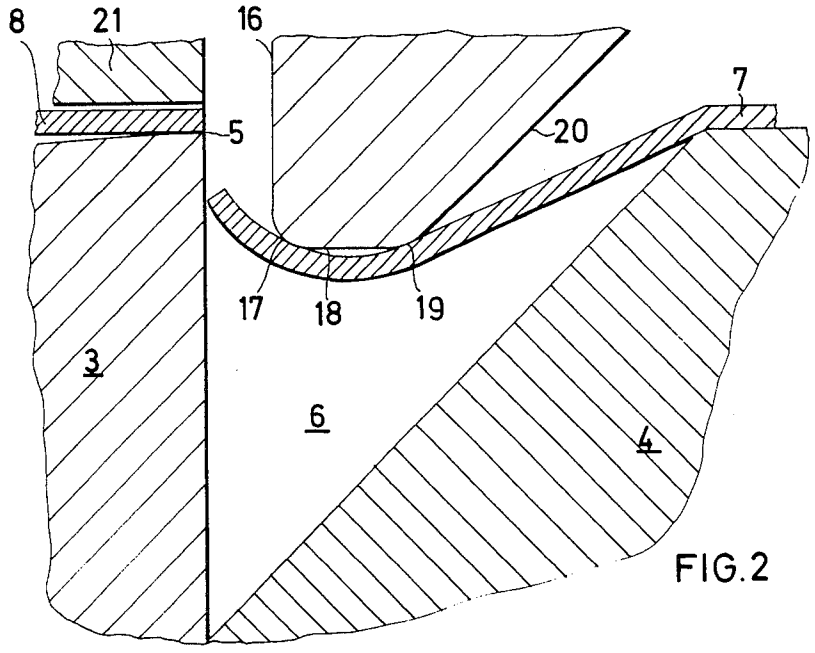


FIG.2

APPARATUS FOR CUTTING OFF SHEET-METAL CONTAINERS

BACKGROUND AND SUMMARY OF THE INVENTION

This invention relates to an apparatus for the severing of sheet-metal containers, especially an apparatus for cutting of the scrap edge of sheet-metal container blanks of the type wherein the blank is placed on a rotating mandrel having a sharp tool edge extending along a predetermined parting line. The blank is then severed by means of a fixedly disposed or likewise rotating counter tool cooperating with the tool edge of the mandrel.

The customary cutting of sheet metal by a severing operation has the disadvantage that the blades become rapidly blunt, due to their close mutual positioning, and a frequency change of the cutting tool is necessary to obtain clean, burr-free cutting edges.

The invention contemplates apparatus which avoids the above-mentioned disadvantages and which produces clean and smooth cutting edges.

More particularly, the present invention contemplates fashioning the counter tool as a contact pressure piece which is arranged at a spacing from the tool edge of the mandrel between this tooledge and an abutment for the blank spaced axially, longitudinally of the mandrel. The tool edge and the contact piece are movable relatively to each other, the contact piece extending preferably at an acute angle to the workpiece (blank) and being rounded at its tip.

The advantages attained by the present invention reside particularly in the essentially smaller wear and tear on the tool system, since the two tools are no longer close, almost touching contact with each other, as in prior arrangements, but rather are arranged at a mutual spacing. Therefore, essentially only the sharp tool edge on the mandrel is worn off, while the contact tool experiences no wear and tear. Moreover, another important advantage attained is the feature of substantially better, smooth, and burr-free parting edges at the severed sheet-metal pieces, which is of special importance when cutting off the scrap edge from sheet-metal container blanks.

A preferred embodiment of apparatus constructed according to the present invention is illustrated in the drawings and will be described in greater detail below. This preferred embodiment utilizes a relatively fixed counter tool with the contact pressure piece formed therewith, and a mandrel for supporting the cylindrical container blanks which is mounted for rotation about the axis of the mandrel as well as for planetary-like rotation of the complete mandrel assembly about an axis spaced from the mandrel axis. During operation of this preferred embodiment, the mandrel is rotated about its own axis as well as about the axis spaced therefrom so as to bring the container into engagement with the contact pressure piece of the counter tool.

Other preferred non-illustrated embodiments utilize a similar cross-sectional configuration of cutting edge at a support for the container and counter tool contact pressure piece as in the illustrated embodiment, but with different means for relatively moving the material being cut, the cutting edge, and the contact pressure piece with repect to one another. In one of these other preferred embodiments, the counter tool and the cutting edge are formed on respective counter rotating members which also have means for moving the respective axes of these members toward one another to effect the severing operation. This last-mentioned preferred embodiment may utilize workpiece supports and cutter wheel constructions as in U.S. Pat. No. 2,702,597, however with the cutting edges and counter tool constructed in accordance with FIG. 2 of the present invention. A third preferred embodiment of the present invention utilizes a system such as disclosed in U.S. Pat. No. 3,425,251 for supporting and moving the respective containers, cutting edges and counter tools, however the cutting edges and counter tools are modified in accordance with FIG. 2 of the drawings of the present invention, as described below.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a part-sectional side view which shows parts of an apparatus constructed in accordance with a preferred embodiment of the present invention for severing the scrap edge from a container blank; and

FIG. 2 is an enlarged sectional view which shows the cutting zone illustrated in a circle in FIG. 1 on a larger scale.

DETAILED DESCRIPTIONS OF THE DRAWINGS

The apparatus has a mandrel **2** which rotates about an axle **1**. Mandrel **2** and axle **1** are reciprocable in the axial direction for purposes discussed further below. The right-hand end of this mandrel **2** is conventionally fashioned as an annular cutter **3**. A ring **4**, which is rotatably fixed with respect to axle **1** spaced to the right of annular cutter **3**. This ring **4** has a notch **6** at the end thereof facing the sharp cutting edge **5** of the annular cutter **3**. As best shown in FIG. **2**, this ring **4** serves as an abutment for supporting and receiving the scrap edge **7** of the container blank **8**.

When the mandrel **2** is advanced to the left-hand position illustrated in FIG. **1**, it enters a container blank **8** of sheet-metal which has previously been placed in front of the end face of the mandrel. A pressure member **10** resiliently contacts the bottom **9** of this blank **8** so that the container blank **8** is held firmly against the mandrel **2**. Mandrel **2** is one of a plurality of similar mandrels supported on an axle **12** which extends parallel to axle **1** of the individual mandrels. Mandrels **2** are movable by way of bearing **11** around the axis of axle **12** during operation of the apparatus, as described in more detail below. As best seen in FIG. **2**, a notch **6** is provided at the ring **4**, which notch **6** extends over an arc of approximately 30° with respect to the axis of axle **1**. This notch **6** faces the counter tool **13**. It will be understood that a complete device contains several, for example three, units consisting of parts indicated by reference numerals **1** to **6**, **9**, **10** and **14**. Each of these units are situated around axis **12** and rotatable together around this axle **12** and are rotatable together around this axle **12** by means of bearing **11**. During one rotation of the units around axle **12**, the following steps are performed consecutively:

- blank **8** is positioned adjacent mandrel **2**;
- mandrel **2** is then advanced (along with cutting tool edge **3**, ring **4**, etc.) in the direction of axle **1** into blank **8**;
- scrap material portions **7** is severed by means of engagement with fixed tool **13**;

mandrel **2** is retracted out of blank **8** along the direction of axis **1**;

blank **8** is then removed from mandrel **2** by means of stripper **14**; and

mandrel **2** is then moved into position adjacent another blank **8** for initiating another sequence of operations.

During all of the aboved-described steps, all of the units rotate around axle **12** while simultaneously all mandrels **12**, together with cutting tools **3** are rotated around their axes (planetary movement). Since means for producing such a planetary movement in a container body forming machine are described and shown in U.S. Pat. No. 996,122, details thereof are not included herein in order not to obscure the present invention. It is noted that the direction of rotation around axle **12** is to be opposite the direction of rotation around the individual axles **1**. It is further noted that rings **4** and strippers **14** do not take part in the planetary movement but are rotatable around the axle **12** only along with the units associated therewith. In the particular illustrated embodiment, the tool **13** does not make any movement at all, with the individual blanks **8** being movable into engagement with the pressing edge of tool **13** by means of the planetary movement of the individual mandrels. It will also be understood that, with a complete device, several blanks will be processed in the device simultaneously, with different operations being performed at different positions about the axle **12**. U.S. Pat. No. 3,611,853 discloses indexing and transfer apparatus of the type which could be used in conjunction with the present invention.

As can best be seen in FIG. **2** of the drawings, according to the invention, the separation of the sheet-metal article into two parts does not take place by shearing in a single cut, but rather by forcing one part away from the other, namely in the illustrated example by forcing the scrap edge **7** off the container blank **8**. Scrap edge **7** rests during this forcing-off step with one end on the ring **4** acting as an abutment, and is pressed, with the other end, into the notch or gap **6** of the ring **4**. The following advantages are achieved by the arrangement of the counter tool **13, 15** as a non-cutting pressure tool. Since the pressure tool acting as the counter tool need not operate in firm close contact with the edge **5** of the annular cutter **3**, said tool **15, 13** can be arranged at a relatively large distance from the cutter edge **5** in the order of 0.3 to 0.6 mm. In other words, the pressure tool **15, 13** does not touch the annular cutter **3**, so that the pressure tool **15, 13** is subjected to an essentially lower wear and tear than conventional cutters used as counter tools. Due to the larger spacing of the pressure tool **15, 13** from the cutting edge **5** of annular cutter **3**, the cutter **3** is likewise exposed to less wear and tear.

The wear on the pressure tool **15, 13** is even more reduced by providing that the zone of the pressure tool pressing against the container blank **8** adjoins a vertical (vertical or radial with respect to axle **1** and parallel to the end face of cutter **3**) area **16** with a portion of small radius **17** of, for example, 0.2 mm., in accordance with a further feature of the present invention. This radius **17** passes over, preferably but not necessarily with a linear section **18**, into a further portion of small radius **19**, which radius **19** is in the range between the radius **17** and twice the radius **17**. This radius portion **19** is joined by an area **20** tangentially therewith, which area **20** is inclined at an acute angle with respect to the area **16**. Since the pressure zone, as compared to a pointed knife blade, is relatively wide, essentially only the zone **17, 18, 19** is worn at this pressure tool **15, 13**, due to its width and its relatively large spacing from the annular cutter **3**, to a substantially lesser extent than a knife edge would be. By this configuration of the pressure zone of the pressure tool **15, 13**, the wear of same is reduced by a further extent.

In a particularly preferred practical embodiment of the present invention, the axial dimension of the section **18** is maximally 1 mm and the axial dimension of the gap **6** is 3 to 5 mm with the radial dimension of the gap **6** being 2 to 3 mm.

Due to the wide pressure zone of the pressure tool **15, 13**, the scrap edge **7** is severed from container blank **8** in a burr-free manner by the sharp edge **5** of the annular cutter **3**, rather than being cut off by the pressure tool **15, 13**.

The heretofore conventional cutters as a counter tool for the annular cutter **3** are disadvantageous, in addition to producing a cutting edge at the sheet metal which is not free of burrs and being subject to great tool wear, also because of another phenomenon: Since a radial play of, for example, 1–2 mm. is necessary between the container blank **8** and the mandrel **2** so that the blank can be placed on the mandrel, the container blank **8** will tumble to a minor degree on the mandrel during its approximately 1½ revolutions together with the mandrel while the scrap edge **7** is severed. As a consequence, in addition to the scrap edge **7**, thin sheet-metal strips and splinters are severed from the container blank **8** and furthermore the burred container edge is flanged inwardly. This is undesirable, because especially the container edge must be absolutely burr-free, as well as exactly cylindrical at the end for purposes of further processing of the container blank, which is, for example, drawn, stretch-formed, or extruded, e.g., for the production of drinking containers. Both characteristics (burr-free edge, cylindrical shape) are attained by the process of this invention for cutting off blanks. In preferred embodiments an output of 150 container blanks per minute with a diameter of 66 mm. and a length of 200 mm., or of 200 container blanks of the same diameter and a length of 125 mm., with a sheet-metal thickness of respectively 0.1 – 0.5 mm. can be obtained.

Although this type of severing contemplated by the present invention comes closer to a tearing off or breaking off of the scrap edge **7** from the container blank **8** than a cutting operation, an edge of such smoothness is produced at the container blank **8** that no burr can be detected with the naked eye or with a small microscopic enlargement. Furthermore, the container edge passes over into the cylindrical container wall without any seams or flanges, and a clean, ring-shaped waste piece is obtained without any additional troublesome sheet-metal strips or splinters. Thus, it is possible to create at the container blank **8** a container edge which also satisfies very high demands with respect to freedom of burrs at the cutting edge and a continuously smooth cylindrical shape of the container wall, in a simpler manner and with a more rugged counter tool, as well as with lesser wear and tear than heretofore possible.

If the tumbling motion is partially or completely suppressed by holddown tool **21** which presses against the mandrel **2** during the severing step, this further im-

proves the quality of the cutting edge at the container rim. Holddown tools of conventional configuration per se can be used in conjunction with the present invention as the tool **21**.

Other preferred embodiments of the present invention utilize a pressure tool and cutting tool configuration as illustrated in FIG. **2** and described above, however different mechanisms for moving the pressure tool and cutting tool with respepct to one another are provided. In one other preferred embodiment, the basic work support and cutting arrangement of U.S. Pat. No. 2,702,597 is modified by replacing anvil face **41** by a rotary tool formed with a cross-section similar to tool **13** of the present application and with cutting edge **5** and gap **6** as shown in FIG. **2** of the present application provided on parts **40, 17** of this U.S. Pat. No. 2,702,597.

In another preferred embodiment, the basic arrangement of U.S. Pat. No. 3,425,251 is utilized with knife sector **36** of said patent being replaced by a rotary tool formed-like tool **13** of present application and with an edge and gap such as **5** and **6** of FIG. **2** of the present application included in place of cutter member **28** of the patent.

It is further noted that the present invention can be applied in cutting devices of various types, such as shears or punching tools. The cutting operation can take place, as in the present illustrated embodiment, progressively along the parting line or simultaneously at once across the entire parting line.

While we have shown and described several embodiments in accordance with the present invention, it is understood that the same is not limited thereto but is susceptible of numerous changes and modifications as shown to hose skilled in the art and we therefore do not wish to be limited to the details shown and described herein but intend to cover all such changes and modifications as are encompassed by the scope of the appended claims.

We claim:

1. Apparatus for severing sheet-material blanks comprising:

a blank holder for holding a blank, said blank holder having a sharp tool edge extending along a predetermined parting line,

an abutment spaced from said sharp tool edge for abuttingly engaging a portion of said blank at the side of the material of said blank facing toward said blank holder,

a countertool which is engageable with the side of said material facing away from said blank holder for cooperating with said sharp tool edge to sever said blank along said parting line,

and moving means for moving said blank holder and countertool toward one another in the direction of the thickness of said sheet material to effect a severing operation with severing of said sheet material along said parting line,

wherein the countertool is constructed as a non-cutting contact pressure piece which is disposed at a spacing from the tool edge between the tool edge and said abutment during said severing operations.

2. Apparatus according to claim **1**, wherein said blank holder is of cylindrical shape for engaging one of the inside and outside walls of a blank of cylindrical shape, and wherein said predetermined parting line extends in a circle about the longitudinal axis of said blank holder.

3. Apparatus according to claim **2**, wherein said blank holder is constructed as a mandrel insertable inside of a cylindrically shaped container blank, wherein said abutment is a cylindrical member of approximately the same diameter extending about the same axis as said mandrel, and wherein an annular gap is formed between said tool edge and said abutment for accommodating relative movement of said counter tool and tool edge, as well as cut portions of blank, during said severing operations.

4. Apparatus according to claim **3**, wherein said countertool is fixed in position, and wherein said moving means includes means for moving said mandrel about an axis positioned outside of said mandrel and parallel to the axis of the mandrel, as well as means for rotating said mandrel about the axis of the mandrel.

5. Apparatus according to claim **1**, wherein said contact pressure piece extends at an acute angle with respect to the sheet material of a blank being held by said blank holder and abutment.

6. Apparatus according to claim **3**, wherein said contact pressure piece extends at an acute angle with respect to the sheet material of a blank being held by said mandrel and abutment.

7. Apparatus according to claim **1**, wherein said contact pressure piece exhibits two rounded portions engageable directly with said sheet material and spaced from one another in the direction from said tool edge toward said abutment, the rounded portion closest to the tool edge having a radius of curvature no greater than the radius of curvature of the other rounded portion.

8. Apparatus according to claim **3**, wherein said contact pressure piece exhibits two rounded portions engageable directly with said sheet material and spaced from one another in the direction from said tool edge toward said abutment, the rounded portion closest to the tool edge having a radius of curvature no greater than the radius of curvature of the other rounded portions.

9. Apparatus according to claim **8**, wherein said contact pressure piece exhibits a straight portion connecting said rounded portions which is parallel to the axis of said mandrel.

10. Apparatus according to claim **8**, wherein the rounded portion closest to the tool edge merges at the side thereof closest to the tool edge with a side of said contact pressure piece which is perpendicular to the axis of said mandrel, and wherein the other rounded portion closest to the abutment merges with a side of said contact pressure piece which is inclined with respect to the axis of the mandrel.

11. Apparatus according to claim **10**, wherein said annular gap exhibits a half V-shaped cross-section with the edge closest to the cutting edge extending radially of the axis of the mandrel and the edge closest to the abutment inclined similarly as the inclined side of the contact pressure piece.

12. Apparatus according to claim **11**, wherein said countertool is fixed in position, and wherein said moving means includes means for moving said mandrel about an axis positioned outside of said mandrel and parallel to the axis of the mandrel, as well as means for rotating said mandrel about the axis of the mandrel.

13. Apparatus according to claim 3, wherein said countertool is a rotatable approximately cylindrically shaped member having an axis of rotation parallel to the axis of the mandrel, and wherein said moving means includes means for moving the axes of said countertool and mandrel toward one another, as well as means for rotating said mandrel and said countertool in respective opposite directions.

14. Apparatus according to claim 11, wherein said countertool is rotatable approximately cylindrically shaped member having an axis of rotation parallel to the axis of the mandrel, and wherein said moving means includes means for moving the axes of said countertool and mandrel toward one another, as well as means for rotating said mandrel and said countertool in respective opposite directions.

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