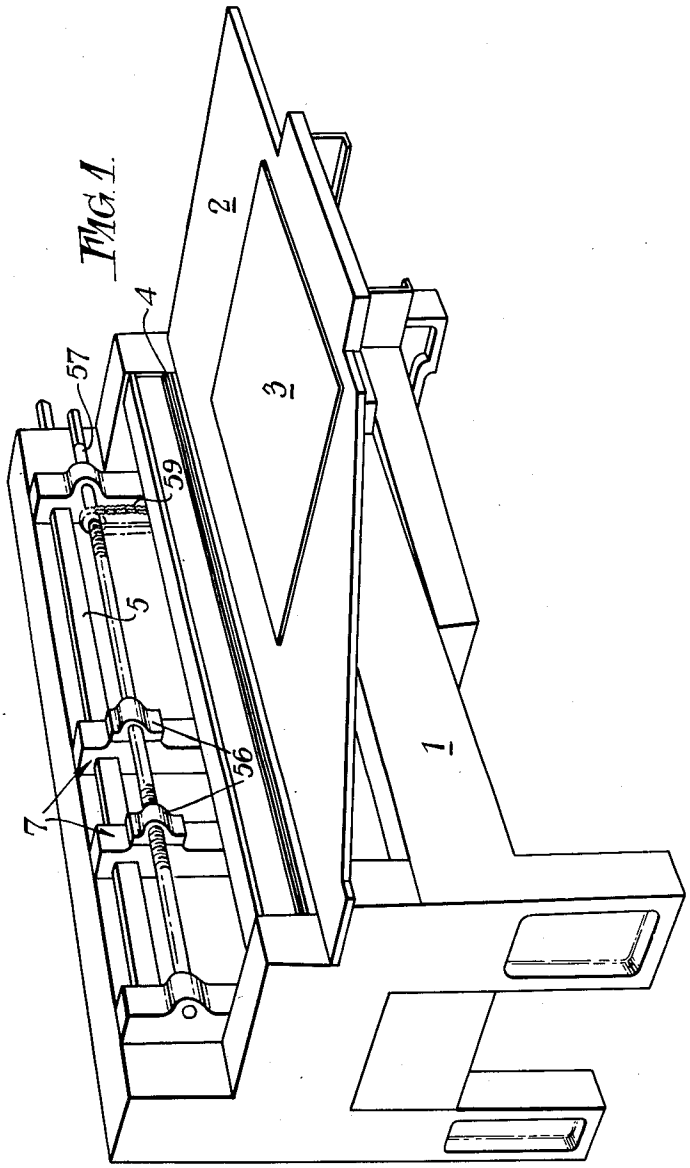
April 3, 1962 W. KIRBY ET AL 3,027,816

MACHINES FOR FORMING FOLD LINES IN BOARDS OR SHEETS

Filed Sept. 15, 1959 4 Sheets-Sheet 1

FIG. 1.



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MACHINES FOR FORMING FOLD LINES IN BOARDS OR SHEETS

Filed Sept. 15, 1959 4 Sheets-Sheet 2

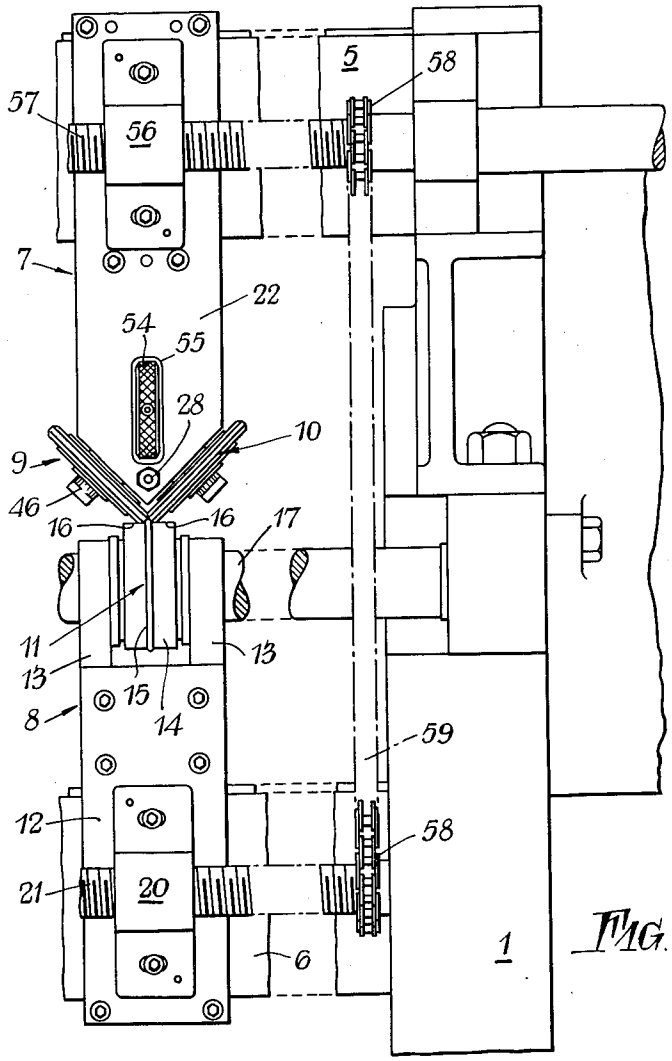


FIG. 2.

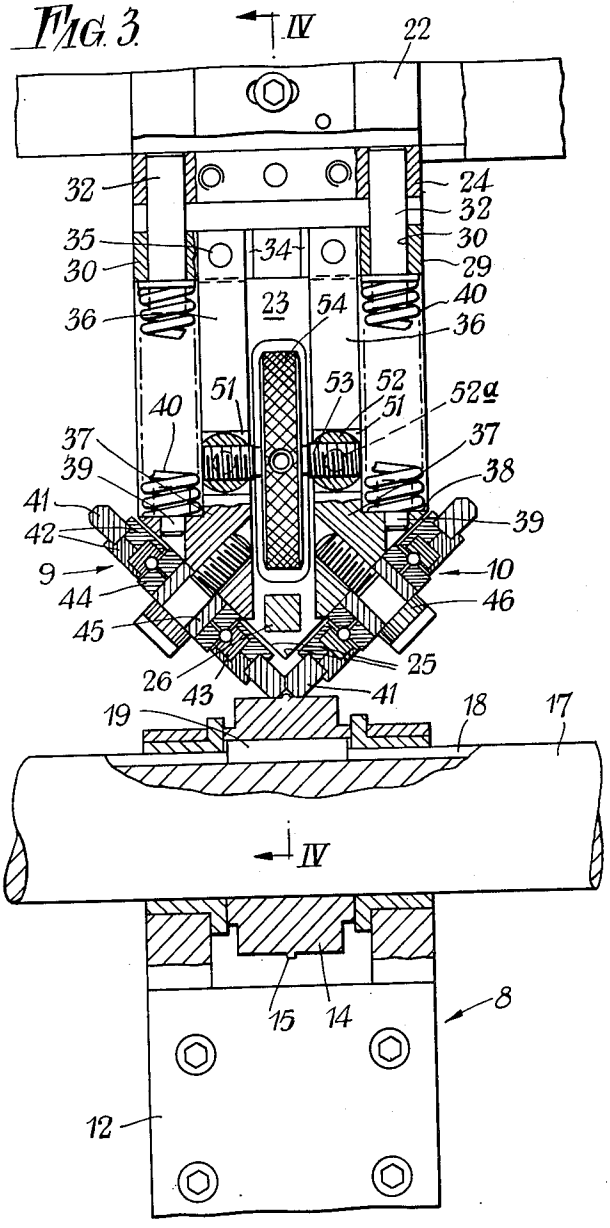
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MACHINES FOR FORMING FOLD LINES IN BOARDS OR SHEETS

Filed Sept. 15, 1959 4 Sheets-Sheet 3

FIG. 3.



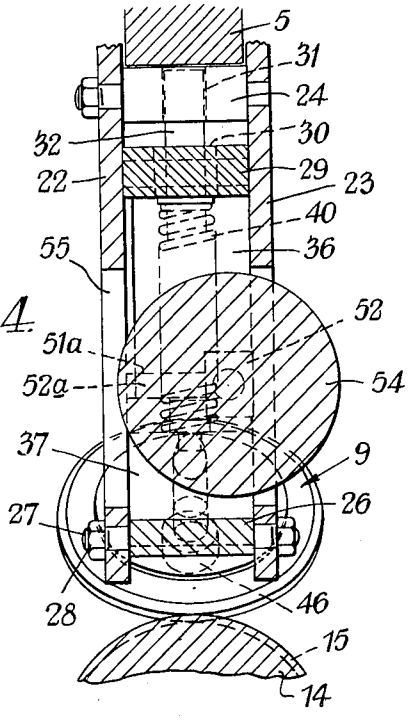
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MACHINES FOR FORMING FOLD LINES IN BOARDS OR SHEETS

Filed Sept. 15, 1959 4 Sheets-Sheet 4

FIG. 4.



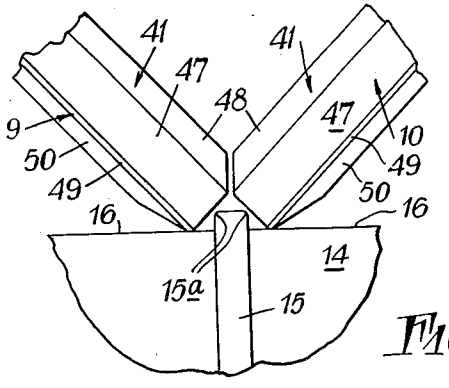


FIG. 5.

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MACHINES FOR FORMING FOLD LINES IN BOARDS OR SHEETS

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6 Claims. (Cl. 93—58.1)

This invention relates to machines for forming fold lines in boards or sheets composed of fibrous materials such as are used in the manufacture of boxes, containers, cartons and the like.

In our prior patent specification No. 745,171 now Patent No. 2,918,275, granted Dec. 22, 1959 there is described a machine for producing fold lines in boards or sheets, the machine including a pair of rotary forming members for contacting one side of a board or sheet, and a complementary rotary forming element having a peripheral edge for contacting the opposite side of the board or sheet, the complementary forming member including also a support on each side of the peripheral edge for supporting the board or sheet, the supports being displaceable so that the extent to which the peripheral edge projects from the supports is variable to take account of different thicknesses of blanks fed to the machine. Such machine is suitable for forming fold lines in blanks of a wide range of materials and can be used on relatively thick and also thinner materials.

According to the present invention there is provided a machine for forming fold lines in board or sheet blanks, the machine including at least one unit comprising a first rotary forming member having a peripheral edge for contacting one side of a board or sheet to define the centre of a fold line, and two other co-operating rotary forming members having peripheral edges for contacting the opposite side of the board or sheet at locations disposed at either side of the peripheral edge of said first forming member, the two other forming members being controlled by spring means for resilient displacement relatively to said first forming member to accommodate different thicknesses of blanks fed to the machine. The arrangement permits satisfactory results to be obtained, at least on the thinner materials and, due to its relatively simple construction, manufacture of the machine is facilitated and a substantial reduction in production costs can be achieved.

For a better understanding of the invention and to show how it may be carried into effect, an embodiment thereof will now be described, by way of example, with reference to the accompanying drawings, in which:

FIGURE 1 is a perspective elevation of a machine embodying the invention,

FIGURE 2 is a fragmentary front elevation to an enlarged scale illustrating part of the mechanism of the machine of FIGURE 1,

FIGURE 3 is a part sectional elevation to an enlarged scale of a detail of FIGURE 2,

FIGURE 4 is a cross-section taken along the line IV—IV of FIGURE 3, and

FIGURE 5 is an enlarged sectional view of a detail of FIGURE 3.

Referring to the drawings, the machine illustrated therein has a frame **1** including a table **2** for the reception of board or sheet blanks **3** that are to be fed forward over the table towards a horizontal opening **4** extending transversely with respect to the direction of feed of the blanks **3**, said opening being bordered above and below by horizontally extending upper and lower support beams **5** and **6** respectively, parallel to one another and disposed in the same vertical plane. The beams serve to support

slidably several fold lines forming units each comprising a pair of upper and lower carriages **7**, **8** so that a blank may be fed between the upper and lower carriages of each unit or pair. Each upper carriage **7** carries a pair of rotary forming members indicated generally at **9** and **10** respectively, and each co-operating lower carriage **8** carries a complementary rotary forming member indicated generally at **11**. Since the several pairs of carriages are similar in construction, the arrangement of one only of such pairs will be described.

The lower carriage **8** of each pair or unit has a body **12** which embraces and is slidable along the lower beam **6**, the body extending upwardly and being formed with two upwardly directed arms **13** spaced apart longitudinally of the support beam **6**. Between the two arms **13** there is located the lower rotary forming member **11** comprising a roll **14** formed midway along its circumferential surface with a peripheral rib **15**. As shown in FIGURES 3 and 5, the rib is substantially rectangular in cross-section, the rib having at opposite sides, circumferentially extending rounded or bevelled edges **15***a* providing around the rib a peripheral edge engageable with the underside of a blank **3** and adapted to define the centre of a fold line. The cylindrical surfaces **16** of the forming roll **14** at each side of the peripheral rib **15**, constitute integral shoulders for supporting the blank. The forming roll **14** is mounted on and has a sliding fit along a main driving shaft **17** which passes through the arms **13** of the lower carriage **8** and which is formed with a longitudinal keyway **18**, the forming roll being provided with a key **19** which engages slidably in the longitudinal keyway. The main driving shaft **17** extends above and parallel to the lower support beam **6**, the latter serving not only to guide the sliding movement of the lower carriage **8** but also to support, through the lower carriages of the several pairs, the main driving shaft **17**. The body **12** of the lower carriage **8** has secured to it an internally screw-threaded bracket **20** which is engaged by a horizontal screw-threaded rod **21** so that by rotation of the rod **21**, the carriage **8** can be adjusted in position laterally of the blank **3**.

The co-operating upper carriage **7** comprises a pair of upright side plates **22** and **23** (FIGURE 3) arranged respectively at the front and rear of the upper support beam **5**. The upper portions of the side plates are spaced apart by top and bottom horizontal spacing plates located respectively above and below the support beam **5**, the bottom spacing plate being shown at **24**. The upper portions of the side plates and the spacing plates embrace the support beam **5** for sliding movement therealong. The bottom spacing plate **24** is located approximately mid-way between the upper and lower ends of the side plates **22**, **23** and the depending portions of the side plates are triangular in shape at their lower ends, the side plates having opposite lower edges **25** inwardly inclined at approximately 45° to the horizontal and meeting at an apex disposed above the peripheral edge **15** of the lower forming member **11**. The lower portions of the front and rear side plates **22**, **23** are spaced apart by a distance piece **26** having at its front and rear ends, a screw-threaded portion **27** which passes through a hole in the adjacent side plate and which is engaged by a nut **28** to hold the side plates in spaced apart relation. Between the depending portions of the side plates **22**, **23** and spaced downwardly from the lower spacing plate **24**, there is mounted for vertical sliding movement, a horizontal pivot plate **29** through which a vertical hole **30** is drilled at each end, the two holes registering with corresponding vertical holes **31** drilled in the lower spacing plate **24** for the reception of upright guide pins **32** having, near their lower ends, abutment collars engaged by the underside of the pivot plate **29**. Between the guide pins **32**, the

pivot plate is formed with two transverse reduced portions 34 through which extend horizontal pivot pins 35 engaged by the upper bifurcated ends of a pair of dependent carrier members 36 arranged substantially symmetrically at opposite sides of the axis of the carriage 7 and having at their lower ends laterally extending toe portions 37 providing outwardly directed ledges 38 disposed below the guide pins 32, the outer side faces of the toe portions 37, below the ledges, being mutually inclined inwardly and downwardly, approximately at 45° to the horizontal. The toe portions of the two carrier members are each provided with a locating pin 39 extending upwardly from the ledge for holding in position the lower end of a helical compression spring 40 confined between the ledge and the pivot plate 29, the upper end of the spring being engaged over the lower portion of the associated guide pin 32. The two upper forming members 9, 10 are rotatably secured to the lower inclined lateral faces of the toe portions 37 of the carrier members, said forming members thus being mutually inclined for rotation in planes at approximately 45° to the horizontal.

Each of the two forming members 9, 10 comprises a forming disc or ring 41 projecting radially around a pair of circular clamping plates 42 which serve to clamp the forming disc to the outer race 43 of a ball-bearing, the inner race 44 of the bearing being fitted over a central bush 45 through which extends a cap screw 46 for securing the assembly to the inclined side face of the associated toe portion 37, so that the outer race 43 together with the two clamping plates 42 and the forming disc 41 can rotate freely.

As shown in FIGURE 5, each disc 41 has a radially outer circumferentially extending peripheral face 47, an axially inner bevelled circumferentially extending side face 48 which is inclined at approximately 45° to the medial plane of the disc, and an axially outer bevelled side face 49 also inclined at approximately 45° to the medial plane of the disc. The arrangement is such that when the two mutually inclined discs 9, 10 are so positioned that the portions of the inner bevelled faces 48 adjacent the rib 15 are close to each other or in contact with each other substantially in the medial plane of the rib 15, the contiguous mutually inclined portions of the peripheral faces 47 will be disposed symmetrically at opposite sides of the rib and spaced from the edges 15*a* thereof. Moreover, the outer bevelled faces 49 of the discs 41 will engage the supporting shoulders 16 at the sides of the rib 15, these axially outer bevelled faces being adapted to define, during operation of the machine, the outer limits of the fold line to be formed in a blank 3. The axially outer bevelled face 49 of each disc is narrower than the similar bevelled face 48 at the axially inner side of the disc. Conveniently, each disc can be chamfered around its axially outer edge at approximately 30° to the medial plane of the disc as shown at 50, to provide clearance at the outer side of the disc.

The two carrier members 36 are recessed at 51 immediately above the lower toe portions 37, for the reception of nut elements 52 (FIGURES 3 and 4), one of the nut elements being formed with a left-handed internal screw-thread and the other with a right-handed internal screw-thread. The nut elements are each formed with an integral pin portion 52*a* perpendicular to the screw-threaded body of the element and rotatable in a hole 51*a* drilled in the associated carrier member 36, thereby rotatably to support the body of the nut element in its recess 51. The nut elements are engaged by corresponding screw-threaded portions of an adjustment screw 53 at the middle of which there is fixed a knurled adjustment wheel 54. The knurled wheel 54 is accessible through a vertical slot 55 formed centrally in the front plate 22 of the upper carriage so that, by turning the wheel 54, the two carrier members 36 can be moved about their pivots 35 away from, or towards, each other thereby to vary the spacing between the lower adjacent peripheral portions of the two forming discs 41, in accordance with the required width or lateral extent of the fold line to be formed in the blank 3.

The arrangement is such that when no material is passing between the upper and lower carriages, the upper forming discs 41 will rest on the lower forming member 11 and will rotate with it. In this condition, there will be a small gap of the order of .01 inch between the upper ends of the guide pins 32 and the underside of the upper support beam 5. When a blank passes between the upper and lower carriages, the two upper forming discs and the associated carrier members 36, together with the compression springs 40, the pivot plate 29 and the guide pins 32, will move upwardly as a unit until the guide pins abut against the support beam 5 whereafter further upward displacement of the forming discs 41 will result in compression of the springs and the pivot plate will be moved upwardly and guided over the guide pins, according to the thickness of the blank.

The upper carriage 7 is provided with means, similar to that associated with the lower carriage 8, for adjustment along the upper support beam 5, the upper carriage carrying an internally screw-threaded bracket 56 engaged by a screw-threaded rod 57 extending across the machine parallel to, and in front of, the upper support beam. To permit the upper and lower carriages to be moved simultaneously, the adjustment rods 21 and 57 have secured thereto vertically aligned chain sprockets 58 engaged by a roller chain 59 which is appropriately tensioned to eliminate backlash.

As a blank 3 moves between the lower forming member 11 and the upper pair of spring controlled forming discs 41, pressure is applied to the material to form the fold line but the arrangement is such that great moulding pressures are not required, nor is the blank diminished significantly in the dimension perpendicular to the fold line. Moreover, the upper pair of forming discs 41 cooperate with the central rib 15 of the lower member to produce, in forming the fold line, shear slip planes in a zone along the fold line, in a manner substantially as described in our aforementioned patent specification.

As previously explained, the machine may have several pairs of the described upper and lower carriages arranged side-by-side so that several fold lines can be made simultaneously in a single blank. The upper and lower screw-threaded adjustment rods 21, 57 may be formed therealong with corresponding right-handed and left-handed screw-threaded portions, the right-handed threaded portions being arranged to move one pair of carriages and the left-handed threaded portions being arranged to move a second pair of carriages laterally of the machine. In this manner, two pairs of upper and lower carriages, disposed symmetrically at opposite sides of the centre line of a blank, can be moved towards or away from one another.

Moreover, each upper and lower support beam may have associated with it not only a screw-threaded adjustment rod at the front, but also a similar adjustment rod at the rear thereof, the several pairs of upper and lower carriages being so arranged that two, for example, of such pairs can be moved laterally by the adjustment rods at the front of the support beams and two others can be adjusted in position by the adjustment rods at the rear of the beams.

It will be understood that the several pairs of carriages need not all be mounted side-by-side in a line transverse to the direction of movement of the blanks, but certain pairs of the carriages could be mounted one behind the other. For example, the machine may comprise a second pair of upper and lower support beams arranged behind the first pair in the direction of intended movement of the blanks, the second pair of beams carrying additional pairs of upper and lower carriages and associated screw-threaded adjustment rods. In such an arrangement, the carriages supported by the front and rear beams may be

appropriately position laterally to enable the distance between adjacent fold lines to be made as small as desired. In this manner, the several carriages can be positioned to permit any practical disposition of fold lines to be formed in a blank.

In the production of a box, container, carton or the like, the board or sheet blank from which the box or the like is to be formed is passed through the machine so that fold lines are formed in the material of the blank at the desired positions. Thereafter, the blank is bent along the fold lines to assemble the box or the like.

We claim:

1. A machine for forming fold lines in board and the like sheet blanks, said machine including a unit comprising a first rotary forming member having a peripheral edge for contacting one side of a blank to define the centre of a fold line, two other co-operating mutually inclined rotary forming members having peripheral edges for contacting the opposite side of the blank at locations disposed at either side of the peripheral edge of said first forming member, and a separate pivoted spring-loaded functionally displaceable mounting for each inclined rotary forming member to support the inclined rotary forming member for individual resilient displacement relatively to said first forming member during a fold-line forming operation.

2. A machine as claimed in claim 1, including screw means operatively engaging the separate pivoted spring-loaded mountings of the two inclined forming members, for adjustably swinging said two inclined forming members towards and away from each other.

3. A machine as claimed in claim 1, wherein said first rotary forming member comprises a roll and said peripheral edge thereof comprises a circumferential rib extending around said roll, and wherein said two other co-operating inclined rotary forming members comprise two discs each having around its outer periphery a circumferential surface parallel to the axis of said disc, an axially inner bevelled face located in a plane substantially parallel to the medial plane of the circumferential rib of said first rotary forming member, an axially outer bevelled face for rolling engagement with a blank at a location disposed at one side of the circumferential rib of said first rotary forming member, said axially outer bevelled face being narrower than said axially inner bevelled face, and a chamfered clearance edge extending around the axially outer side of the disc adjacent said axially outer beveled face.

4. A machine for forming fold lines in board and the like sheet blanks, said machine including a fold forming

unit comprising a driven rotary forming roll, a circumferential rib extending around said driven forming roll for contacting one side of a blank to define the centre of a fold line, two co-operating and mutually inclined forming discs having peripheral edges for contacting the opposite side of the blank at locations disposed at either side of the circumferential rib of said driven forming roll, a separate pivoted spring-loaded mounting for each inclined forming disc, each of such mountings comprising a dependent carrier member, means pivotally connecting the upper end of said carrier member to a vertically displaceable support, laterally outwardly and downwardly inclined axle bearing means at the lower end of said dependent carrier member for rotatably securing the associated inclined forming disc to said member for rotation in a plane inclined with respect to the medial plane of the circumferential rib of said driven forming roll, and a compression spring confined between said support plate and a laterally outwardly extending ledge at the lower end of said dependent carrier member for resiliently urging the associated inclined forming disc into engagement with the blank.

5. A machine as claimed in claim 4, including screw means disposed between and operatively engaging the two dependent carrier members, for adjustably swinging said dependent carrier members and the associated inclined forming discs, towards and away from each other.

6. A machine as claimed in claim 4, wherein each of said inclined forming discs has around its outer periphery a circumferential surface parallel to the axis of said disc, an axially inner bevelled face located in a plane substantially parallel to the medial plane of the circumferential rib of said driven forming roll, an axially outer bevelled face for rolling engagement with a blank at a location disposed at one side of the circumferential rib of said driven forming roll, said axially outer bevelled face being narrower than said axially inner bevelled face, and a chamfered clearance edge extending around the axially outer side of the disc adjacent said axially outer bevelled face.

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