Sept. 25, 1962 F. M. SAYFORD, JR 3,055,567

BLANK FORMING APPARATUS AND METHOD

Filed Oct. 22, 1957 4 Sheets-Sheet 1

Fig. 1.

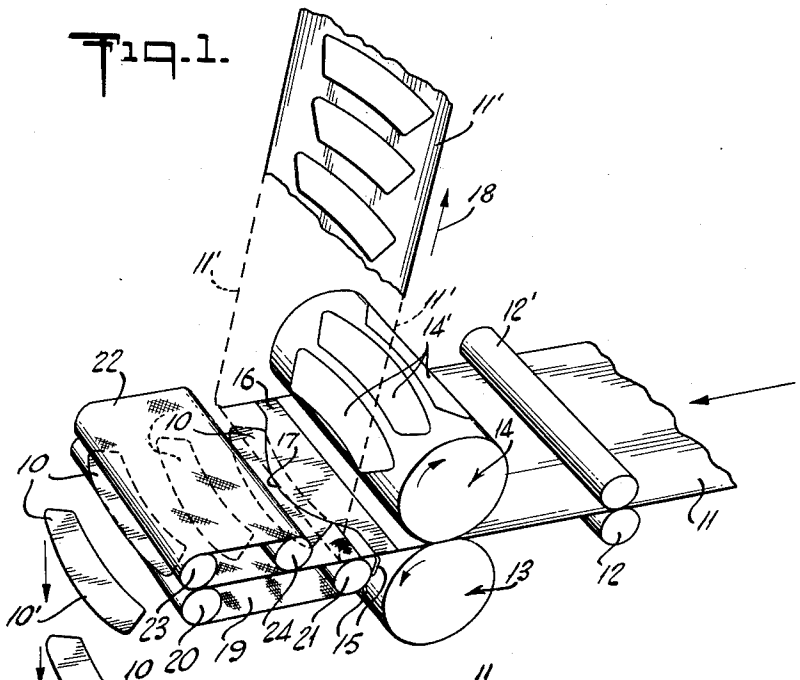
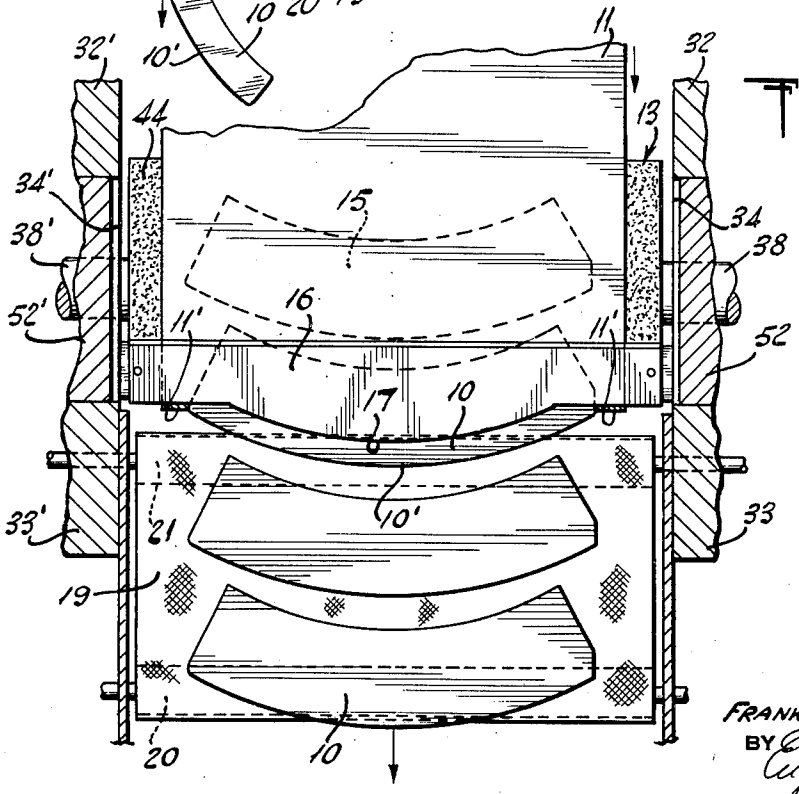


Fig. 4.



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Fig. 2.

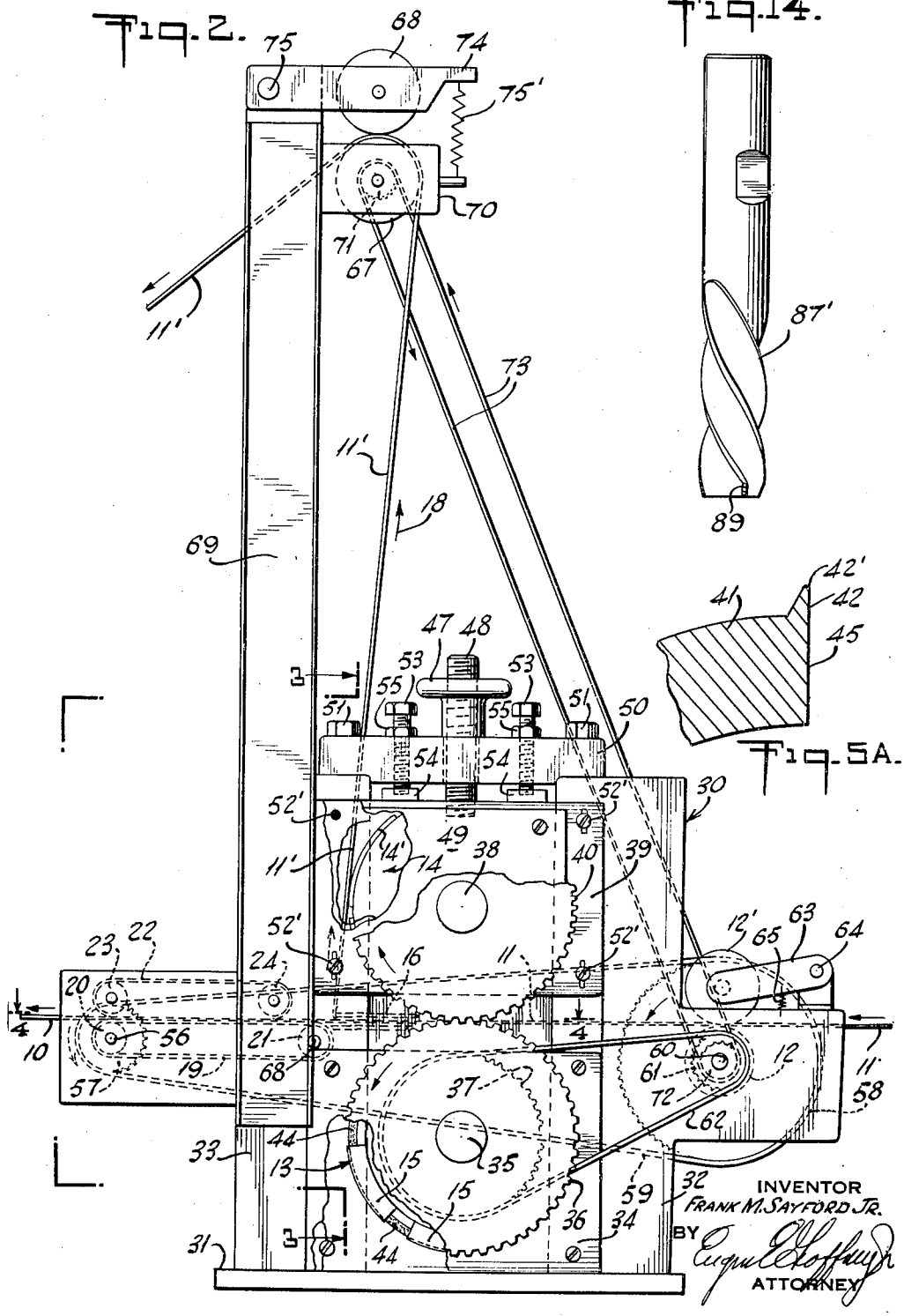


Fig. 4.

Fig. 5A.

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Fig. 3.

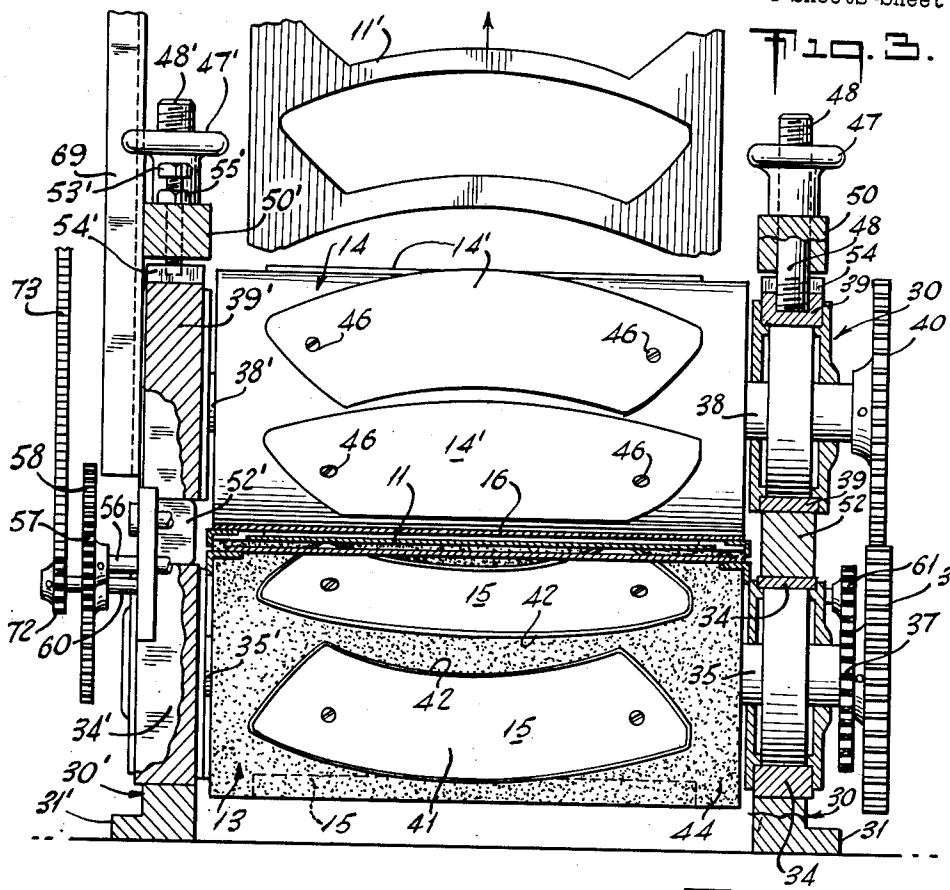


Fig. 5.

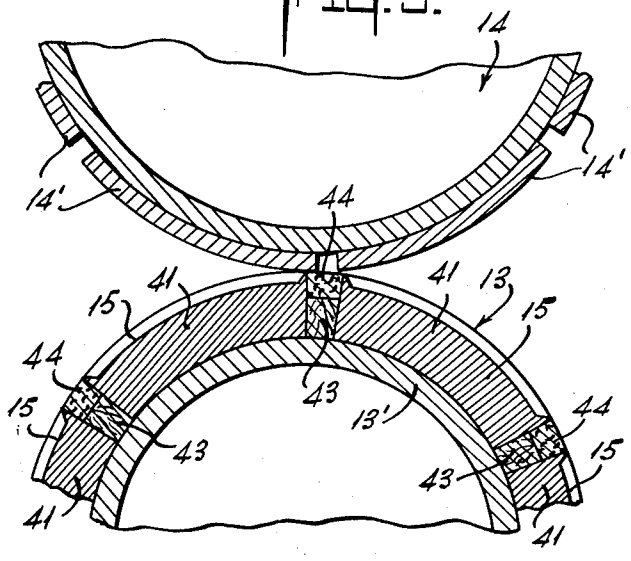


Fig. 6.

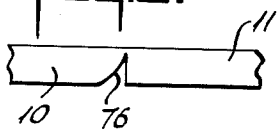
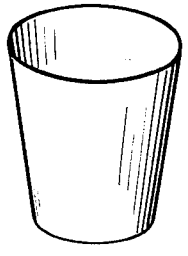


Fig. 7.



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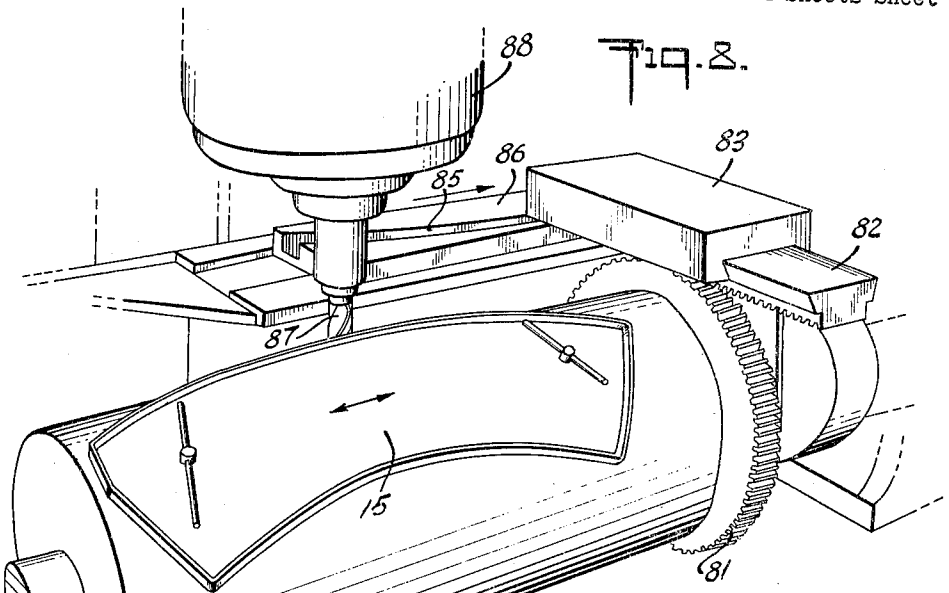


Fig. 8.

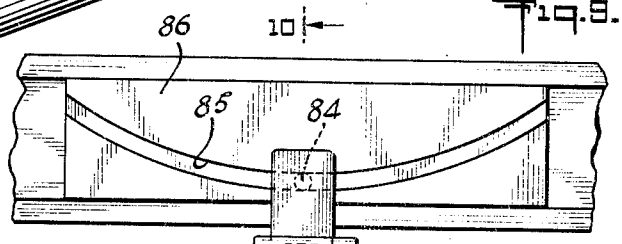


Fig. 9.

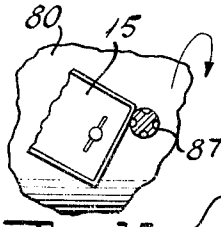


Fig. 13.

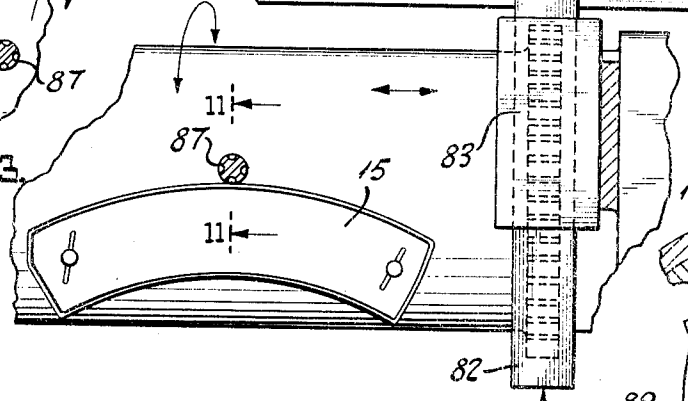
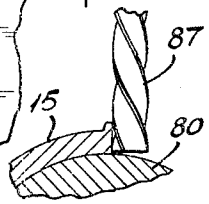


Fig. 11.



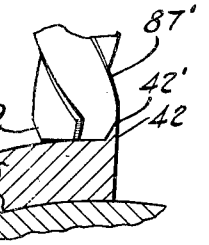


Fig. 10.

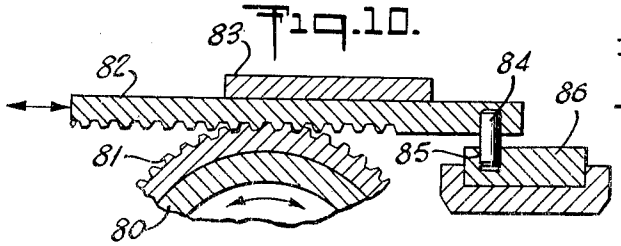


Fig. 12.

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United States Patent Office 3,055,567 Patented Sept. 25, 1962

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BLANK FORMING APPARATUS AND METHOD

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Filed Oct. 22, 1957, Ser. No. 691,706
5 Claims. (Cl. 225—2)

This invention relates to the forming of blanks from sheet materials and more specifically to a novel and improved method and apparatus for compressing paper and other compressible sheet materials to form blanks for use in the manufacture of cups and other products. The invention further relates to the method of making compressing and forming dies for paper and other sheet materials.

While the invention to be described herein is generally applicable to forming blanks of a wide variety of sizes and configurations from sheet material, for convenience it will be described as applied to the forming blanks of paper for use in the fabrication of cups and other similar articles. Heretofore blank forming apparatus has been in the form of relatively large reciprocating machines arranged to cut or sever a large number of blanks from single or multiple sheet, with the cut blanks being retained in place on a sheet by uncut sections or connections. After partial severance of the blank in this way further operations were required to sever the blanks from the sheet stock and arrange them in stacks for feeding to subsequent forming apparatus. This procedure was not only time consuming in that the partially cut sheets had to be removed from the cutting machine for the blank stripping operation, but was also expensive in that complicated, bulky cutting equipment was required and blank stripping was performed by hand. The use of connections or ties to hold the blanks in place in the stock materially complicated the process since the ties often remained on the blanks after stripping and had to be manually removed prior to subsequent operations.

This invention overcomes the foregoing and other disadvantages of prior blank cutting methods and apparatus and provides a continuously operating machine that is small, compact, avoids the need for complicated mechanisms and will produce and stack finished blanks at speeds far in excess of that heretofore obtainable.

Another object of the invention resides in a novel and improved method of forming blanks from paper and other compressible sheet materials wherein the blank is completely severed from the material and ready for stacking or delivery to subsequent article forming apparatus.

A further object of the invention resides in the provision of a novel and improved rotary blank forming machine that is characterized by its high speed, simplicity, dependability and need for little, if any, maintenance. Because of the inherent nature of this apparatus, once the machine is properly adjusted for operation, the adjustment will remain for extended periods of time and an operator's attendance is required only periodically to insure that stock is constantly fed to the machine.

A still further object of the invention resides in a novel and improved high speed rotary apparatus for forming blanks from paper and other sheet material stock.

A still further object of the invention resides in a novel and improved method for making rotary dies for use in forming blanks from sheet material.

The above and other objects and advantages of the invention will become apparent from the following description and accompanying drawings forming part of this application.

In the drawings:

FIG. 1 is a perspective view in diagrammatical form

illustrating one embodiment of apparatus in accordance with the invention;

FIG. 2 is a side elevation of apparatus in accordance with the invention and embodying the principles illustrated in FIG. 1;

FIG. 3 is a cross sectional view of the apparatus of FIG. 2 taken along the line 3—3 thereof;

FIG. 4 is a cross sectional view of FIG. 2 taken along the line 4—4 thereof;

FIG. 5 is a fragmentary view in cross section showing the construction and cooperation of the blank forming elements of FIGS. 2 and 3;

FIG. 5A is an enlarged section of a forming die in accordance with the invention;

FIG. 6 is a fragmentary view in cross section of a portion of a formed blank and the adjoining stock to show the compression of the material in accordance with the invention;

FIG. 7 is a perspective view showing a partially formed cup utilizing a blank formed with the illustrated apparatus;

FIG. 8 is a perspective view of milling apparatus for making a forming element in accordance with the invention;

FIG. 9 is a top view of the apparatus shown in FIG. 8 with portions omitted;

FIG. 10 is a cross sectional view of FIG. 9 taken along the line 10—10 thereof;

FIG. 11 is a cross sectional view of FIG. 9 taken along the line 11—11 thereof;

FIG. 12 is a fragmentary section of a rotary milling tool and a portion of the blank forming element illustrating another step in the making of a blank forming element;

FIG. 13 is a fragmentary section of FIG. 8 showing another step in the procedure for forming the side edges of the blank forming element; and

FIG. 14 is a side elevation of the cutting tool as shown in fragmentary form in FIG. 12.

Referring now to the drawings, the illustrated embodiment of the invention is for the purpose of forming blanks of paper and other similar compressible materials for the manufacture of cups. For convenience in understanding the invention, a diagrammatic view is illustrated in FIG. 1. In this figure the blanks are denoted by the numeral 10 and are formed from continuous paper stock generally denoted by the numeral 11. The paper stock is preferably fed to the apparatus through a pair of feed rollers 12 and then through the forming or compressing rollers 13 and 14. The roller 13 includes a plurality of forming or compressing elements 15 disposed about the periphery thereof and which will be described in connection with the other figures showing the construction thereof.

The roller 14 includes a plurality of make-ready plates 14' each of which cooperates with one of the blank forming elements 15 for the purpose of forming blanks from the stock 11. The elements 15 are generally referred to as forming or compressing elements as they do not actually sever the blanks but rather compress the stock along lines defining the blanks so that the latter may be readily removed merely by breaking the stock along the compressed portions. With this procedure finished blanks are provided having a completely smooth, uninterrupted edge, free from connections, ties or other discontinuities. Forming of the blanks is accomplished by spacing the elements 15 from the make-up plates 14' or surface of the roller 14, as the case may be, so that the distance between the forming edges of the elements 15 and the surfaces of the roller 14 is less than the thickness of the paper stock. In this way a sufficient depression of the paper stock is obtained so that slight pressure on the formed blank will break or fracture the com-

pressed portions to separate the blank from the stock. With this procedure extremely high cutting speeds can be obtained that are far in excess of cutting speeds obtainable with known apparatus. Moreover, the blanks produced are completely severed from the stock with smooth, uninterrupted edges and the blanks may be stacked or delivered directly to subsequent material forming apparatus.

After the paper stock **11** has passed between the forming rollers **13** and **14**, the stock, with the blank still attached passes beneath a blank removing or stripping plate **16**. This plate has a curved forward edge **17** which in the present instance is formed with a radius somewhat smaller than the radius of the edge **10'** of the blank **10**. With this arrangement, as the stock moves beneath the plate **16** the foremost portion of the edge **10'** first appears from beneath the edge **17** of the plate **16**. The waste stock **11'** is pulled in an upward direction as shown by the arrow **18**, so that it forms a relatively sharp angle with the edge of plate **16**. Pulling of the waste stock **11'** upwardly as shown in FIG. 1 causes the blank **10** to separate from the waste **11'** at the leading edge **17** of the plate **16** and continue in the plane of movement of the stock **11**. Successive portions of the edges of the blanks **10** are separated and the severed blanks are fed to a moving belt **19** carried by rollers **20** and **21**. The blanks are then engaged by an upper moving belt **22** carried by rollers **23** and **24** with the belt **22** being substantially in contact with the belt **19**. These two belts actually grip the blanks before final separation from the waste **11'** and the finished blanks **10** are then fed either directly to subsequent forming apparatus or stacked, as may be desired.

FIGS. 2 through 5 illustrate in detail a machine embodying the principles of the apparatus shown and described in connection with FIG. 1. The machine includes a base generally denoted by the numeral **30** and having a base **31** and upright members **32** and **33** on one side of the base and corresponding members **32'** and **33'** on the other side of the base. The forming roller **13** is mounted in the lower part of the base **30** and is secured to the frame members **32**, **33** and **32'**, **33'** by suitable bearing assemblies generally denoted by the numerals **34** and **34'** in FIG. 2. The bearing assemblies **34** and **34'** may be of any desired form for rotatably supporting the forming roller **13** by means of the shaft portions **35** and **35'**. The roller shaft **35** extends beyond the bearing assembly **34** and carries an outer spur gear **36** and an inner sprocket **37**. The upper roller **14** carrying the make-up plates **14'** has a diameter substantially the same as the diameter of the roller **13** and is supported by a pair of outwardly extending shaft parts **38** and **38'** journalled in bearing assemblies **39** and **39'**, adjustably supported by the frame members **32**, **33** and **32'** and **33'**, respectively. The roller shaft **39** extends beyond the bearing assembly **39** and carries a spur gear **40** which meshes with the spur gear **36** for synchronising the rotation of the rollers **13** and **14**. The forming blades **15** carried by the roller **13** have a configuration corresponding to the blank to be cut from the stock **11**. It comprises essentially a curved structure having an arcuate base **41** and a peripheral ridge **42**. The outer edge of this ridge is rounded to effect a compressing action when contacting the stock, rather than producing a severing action such as that obtained with knives or shears. The forming blades **15** are bolted to the supporting roller structure **13'** and these portions of the roller **13'** surrounding the blades **15** carry a suitable material to bring these filled portions to a level approximately even with the ridges **42** of the cutting blades **15**. It is preferable to provide a filler material having a slightly resilient characteristic so that it will not interfere with the forming action of the blades **15** and at the same time will prevent buckling or distortion of the paper stock as it is fed between the rollers **13** and **14**. A suitable filler material for this purpose may include wood blocks **43** and a surface **44** of cork or other similar material. An enlarged fragmentary view of a forming in accordance with the invention is shown in FIG. 5A. It will be observed in this figure that the sides **45** of the blade are substantially in line with the radii of the roller **13'** and the outer end of the compressing ridge **42** is rounded as shown at **42'**.

The upper or make-up plate roller **14** carries on its surface a series of make-up plates **14'** that are secured to the roller by means of screws **46**. The make-up plates have a configuration substantially the same as that of the blades **15** but are somewhat larger in area. Make-up plates are used in order to permit the placement of shims beneath them so that the plates may be adjusted to provide a uniform spacing between the plate and the peripheral ridge of the cooperating blades **15** and thereby compensate for normal manufacturing tolerances in the fabrication of the parts.

With the make-up plates adjusted so that each plate **14'** is uniformly spaced from its cooperating blade **15**, the entire roller **14** can be shifted vertically to increase or decrease the gap between the rollers. For this purpose the bearing plates **39** and **39'** supporting the roller **14** can be moved vertically by operation of a hand wheel **47** threadably engaging a screw **48** secured to a member **49** forming part of the bearing assembly **39**. The threaded screw **48** extends through a bridging member **50** that is bolted to the upper end of the frame members **32** and **33** by a pair of bolts **51**. By loosening screws **52'** which hold the bearing assembly **39** to the frame **30**, rotation of the hand wheel **47** will raise and lower the bearing assembly **39** and the roller **14**. A similar hand wheel **47'** is provided for raising and lowering the other end of the roller. The relative positions of the rollers **13** and **14** is determined by a shim or spacing block **52** that is disposed between the bearing assemblies **34** and **39**. While these blocks are shown in one piece, they may include separate shims for the purpose of facilitating adjustment of the rollers. When the shim block **52** is adjusted to provide proper spacing the hand wheels **47** and **47'** are loosened to permit the upper bearing assemblies **39** and **39'** to move into their lowermost positions. Securing the assemblies in place is accomplished in the case of the bearing assembly by a pair of bolts **53** threaded in the bridging member **50** and bearing against blocks **54** carried by the bearing assembly **39**. The bolts **53** are locked in place by lock nuts **55**. The bearing member **39'** supporting the other end of the roller **14** is similarly constructed and locked in the adjusted position. When the roller **14** is properly adjusted relative to the roller **13**, the screws **52'** are tightened to prevent lateral displacement of the assemblies **39** and **39'**.

Power for driving the rollers **13** and **14** is applied to a shaft **56** which carries a roller **20** and a drive sprocket **57**. The sprocket **57** drives a second sprocket **58** by means of a chain **59** with the sprocket **58** being carried by a shaft **60** journalled in the frame members **32** and **32'**. The shaft **60** further carries a sprocket **61** that is coupled to the sprocket **37** on the roller **13** by means of a chain **62**. The shaft **60** is also provided with a driven feed roller **12** engaging the underside of the stock **11**. An upper drive roller **12'** is an idler and is carried by a pair of links **63** pivoted at **64** and urged downwardly against the drive roller **12** by means of springs **65**.

The drive roller **20** on the drive shaft **56** carries a flat belt **19** and the inner end of the belt is supported by the roller **21** as previously described. Roller **21** is carried by a shaft **66** journalled to the frame members **33** and **33'**. The upper belt structure comprises belt **22**, rollers **23** and **24** and is driven in synchronism with the belt **19** from the shaft **56** by suitable means not illustrated.

After the stock **11** has passed between the feed rollers **12** and **12'** and the forming rollers **13** and **14**, it then passes beneath the stripping plate **16** illustrated more clearly in FIG. 4. In this embodiment of the invention the stripper

plate **16** has a rounded trailing edge **17** and the plate is supported at its ends by attachment to the frame members **33** and **33'**. It will be observed in FIG. 4 that the trailing edge **17** of the stripper plate slightly overlaps the leading edge of the belt **19** so that as the blanks **15** are stripped from the waste **11'**, they will be supported and guided between the belts **22** and **19**. While the stripper plate has a curved forward edge **17** in this embodiment of the invention, it is apparent that its configuration may be modified when forming blanks having other configurations.

In order to maintain constant tension on the waste **11'** to perform the stripping operation, the waste is brought upwardly at an angle to the stripper **16** and passes between a pair of feed rollers **67** and **68**. These rollers are carried by an upwardly extending frame member **69** secured to the frame member **33**. The lower roller **67** is journalled in an outwardly extending arm **70** and carries a drive sprocket **71**. The roller is coupled to the sprocket **72** secured to the shaft **60** by a chain **73**. The upper roller **68** is carried by an arm **74** pivoted at **75** to the frame **69** and urged downwardly against the driven roller **67** by a spring **75'**.

With the apparatus as described above, all of the driven elements are synchronized one with the others so that the speed of the operation can be changed readily without affecting the operation of the machine. In addition, once the rollers **13** and **14** are properly set for a given thickness of material, no further adjustments need be made, and since there is no metal-to-metal contact between the blades **15** and the make-up plates **14'**, little if any wear will be encountered. As a result the machine will operate for extended periods of time without readjustment of the apparatus. While actual severance of the stock is avoided in the forming operation, slight deflection of the stock upon emergence from between rollers **13** and **14** may break portions of the compressed parts, but in no instance does the blank become separated from the stock until after the stripping operation.

FIG. 6 shows an enlarged view of the stock **11** to illustrate the manner in which material is compressed to form the blanks. The portion of the stock **11** to the left of the depression **76** constitutes part of the blank **10**, while the portion to the right constitutes part of the waste **11'**. The depression **76** is generally of a V-shaped configuration and does not penetrate the stock but rather compresses the stock so that the innermost portion of the V-shaped depression **76** is brittle and will break readily when the material on each side thereof is deflected. This deflection in the operation of the apparatus is produced by the stripper plate **16** which maintains the blanks in a horizontal plane while the waste **11'** is drawn upwardly at a sharp angle. After the blanks have been severed they are processed by suitable apparatus for producing cylindrical cups such as that shown in FIG. 7. It is to be understood, however, that this invention is not limited to the fabrication of cup blanks, but can be used for forming blanks for other purposes.

FIGS. 8 through 14 illustrate the process and apparatus for fabricating the forming blades **15**. The first step in this process is to cast the blade **15** in the general shape required with an upwardly extending edge portion **42**. The under side of the blade is then machined to provide a proper radius for securing it to the drum **13'**, as previously described. After forming the underside of the blade, the blade is then positioned on a drum or cylinder **80** rotatably supported on the horizontally movable bed of a milling machine or other suitable device. One end of the drum or cylinder **80** carries a spur gear **81** secured thereto. Above the spur gear and meshing therewith is a rack **82** slidably carried by a support **83** secured to and movable with the milling machine bed. The outer end of the rack **82** carries a pin **84** which rides in a groove **85** formed in a stationary cam member **86**. The curve of the groove **85** is arranged to coordinate with the curvature of the plate **15** so that as the plate is transported by longitudinal movement of the drum **80**, the rack **82** and spur gear **81** will automatically rotate the drum **80** about its longitudinal axis. A rotary cutting tool **87** is carried by a driving head **88** and mills the far edge of the cutter blade **15**, as shown in FIG. 8 to the proper curvature. To start this milling operation the drum **80** is moved to the right so that the cutter **87** is at the left hand edge of the cutter blade **15**. This brings the rack **82** and pin **84** to the right hand edge of the groove **85**, as shown in FIG. 9. The cutter **87** is then positioned relative to the edge to be cut so that proper depth of the cut will be obtained. The milling machine is then adjusted to move the cylindrical member **80** to the left and in so doing the cam groove **85** will cause the rack **82** to rotate the cylinder **80**, producing relative arcuate motion between the cutter **87** and the cylinder **80** to mill the desired curvature on the blade **15**. The position of the milling tool **87** relative to the outer edge of the blade **15** will be observed more clearly in FIG. 11.

The ends of the blade **15** are formed by utilizing conventional milling machine practice wherein gearing is used to rotate the drum **80** and at the same time transport it longitudinally. The inner edges of the blank forming ridges **42** of the blade **15** are machined in substantially the same manner except that the milling tool **87'** is provided with a bevelled edge **89** to provide a tapered inner surface on the ridge **42**. The milling process produces a keen edge **42'** and this edge is then broken by the use of emery cloth or other similar material so that the forming ridge will actually terminate in a slightly rounded radius to avoid actual cutting of the stock.

While only one embodiment of the invention has been illustrated and described, it is apparent that modifications, alterations and changes may be made without departing from the true scope and spirit thereof.

What is claimed is:

1. The method of continuously forming blanks from a strip of compressible sheet material comprising the steps of moving said sheet material in one path between a pair of cooperating material engaging rollers, compressing the material to form relatively narrow, highly compacted, brittle blank defining lines while moving between said rollers, preventing the sheet material from buckling and distorting while between said rollers, guiding said sheet material from said one path into another path at an angle to said one path to fracture said compressed material along the highly compacted brittle blank defining lines and separate the blanks from the sheet material.

2. Apparatus for forming blanks from compressible sheet material comprising a pair of cooperating rollers, at least one curved blank forming die carried by one of said rollers and having a narrow rounded material compressing ridge for forming said blank, means rotatably supporting said rollers in spaced relationship with the ridge of said die being spaced from said other roller a distance less than the thickness of said material, means for rotating said rollers, means for feeding said material between said rollers to form successive blanks defined by a line of highly compacted brittle material, a stripper plate having one surface adjacent said material upon leaving said rollers, and means for guiding said material past the trailing edge of said stripper plate to break the compacted portions of material and separate the formed blanks from the material.

3. Apparatus according to claim 2 wherein said one roller includes a plurality of blank forming dies spaced about the periphery thereof, and said other roller includes a make-ready plate for cooperation with each die to adjust the spacing between each die and the surface of its associated make-ready plate.

4. Apparatus for forming blanks from compressible sheet material such as paper and the like comprising a pair of cooperating rollers disposed one above the other,

at least one of said rollers carrying a plurality of spaced blank forming dies each of said dies having at least a peripheral ridge extending outwardly therefrom, said ridge being tapered to form a relatively narrow sharply rounded material compressing edge, a plurality of make-ready plates on the other of said rollers for cooperation with said dies, means for rotatably supporting said rollers in spaced relationship whereby said outwardly extending ridges will move in spaced relationship to said make-ready plates a distance materially less than the thickness of the material to form narrow, highly compacted brittle lines, means for feeding said material between said rollers to form successive blanks by compressing the material between said ridges and the make-ready plates to form lines of a highly compacted brittle structure, a stripper plate having one surface adjacent said material upon leaving said rollers, and means for guiding said material past the trailing edge of said stripper plate and at an angle relative thereto to fracture said compacted portions of material and separate the formed blanks from the material.

5. Apparatus according to claim 4 wherein said blank

forming dies are carried by the lower of said rollers, the upper of said rollers includes a plurality of make-ready plates moveable in phase with said dies and wherein said stripper plate is disposed above said sheet material, said sheet material being moved past the stripper plate and said guiding means moving said material upwardly past the trailing edge of the stripper plate to separate the blanks from the material.

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