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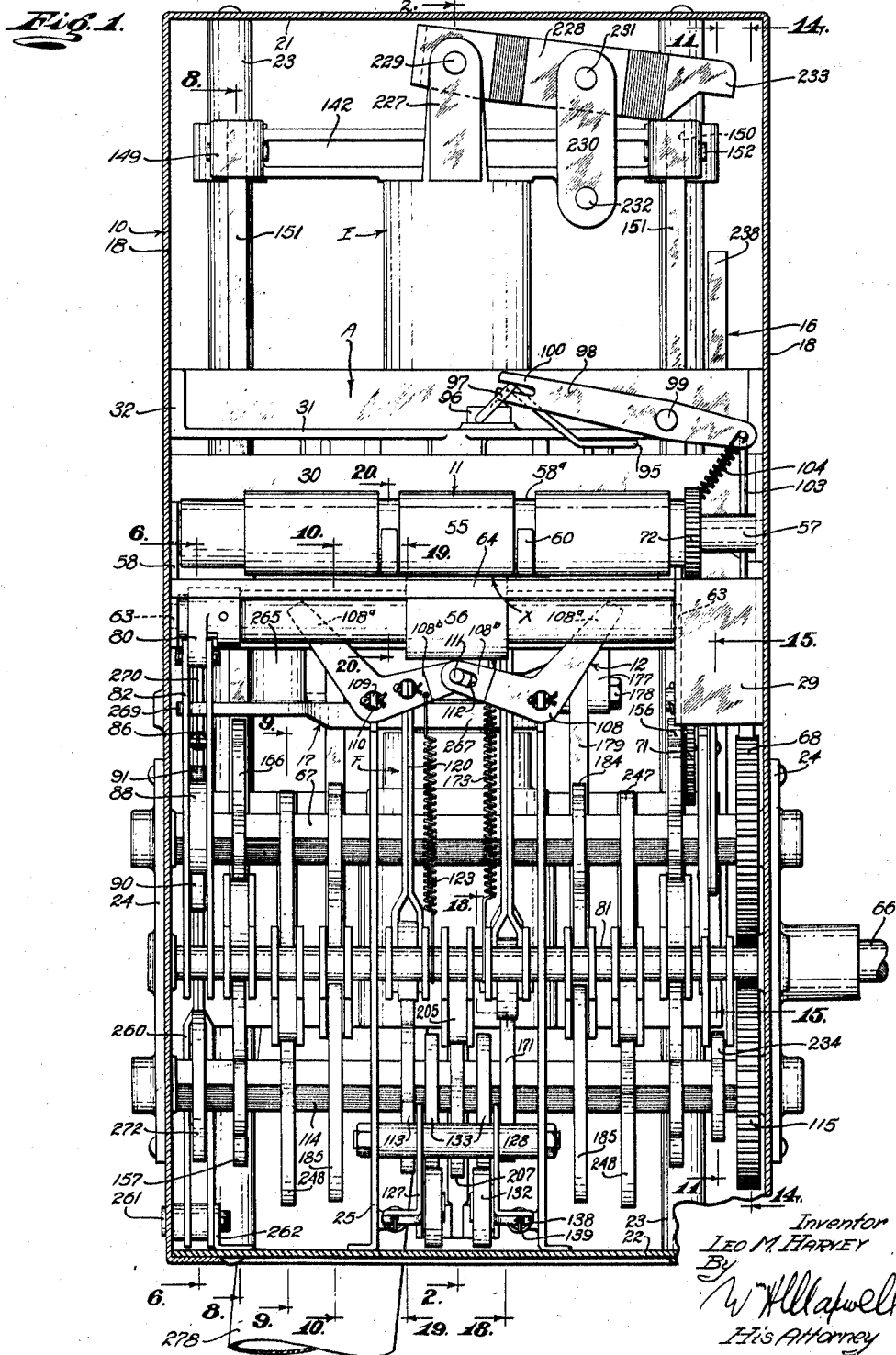
L. M. HARVEY

2,215,698

METHOD AND MACHINE FOR MAKING PAPER CUPS

Original Filed Aug. 21, 1937

13 Sheets-Sheet 1



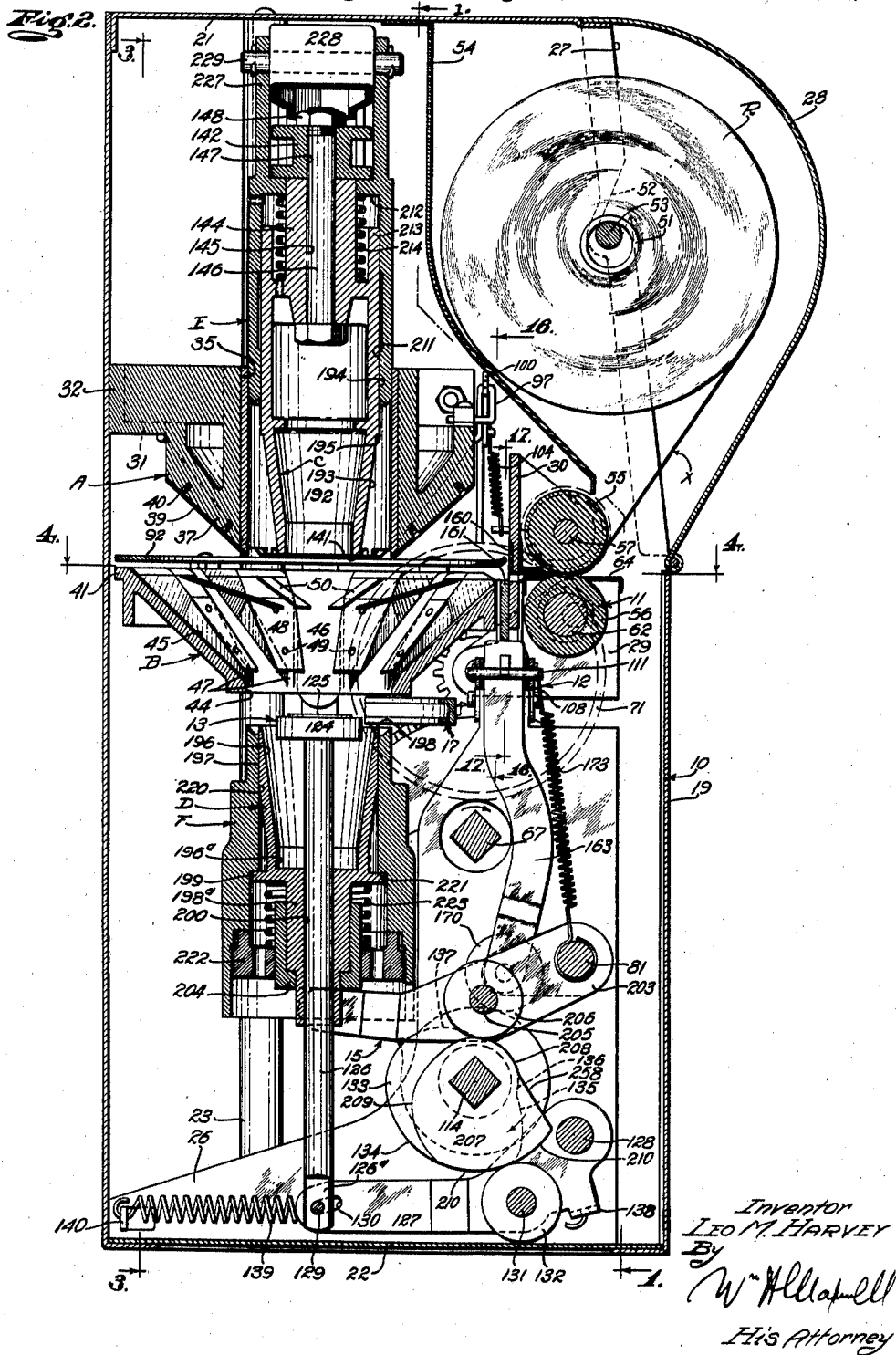
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METHOD AND MACHINE FOR MAKING PAPER CUPS

Original Filed Aug. 21, 1937 13 Sheets-Sheet 2



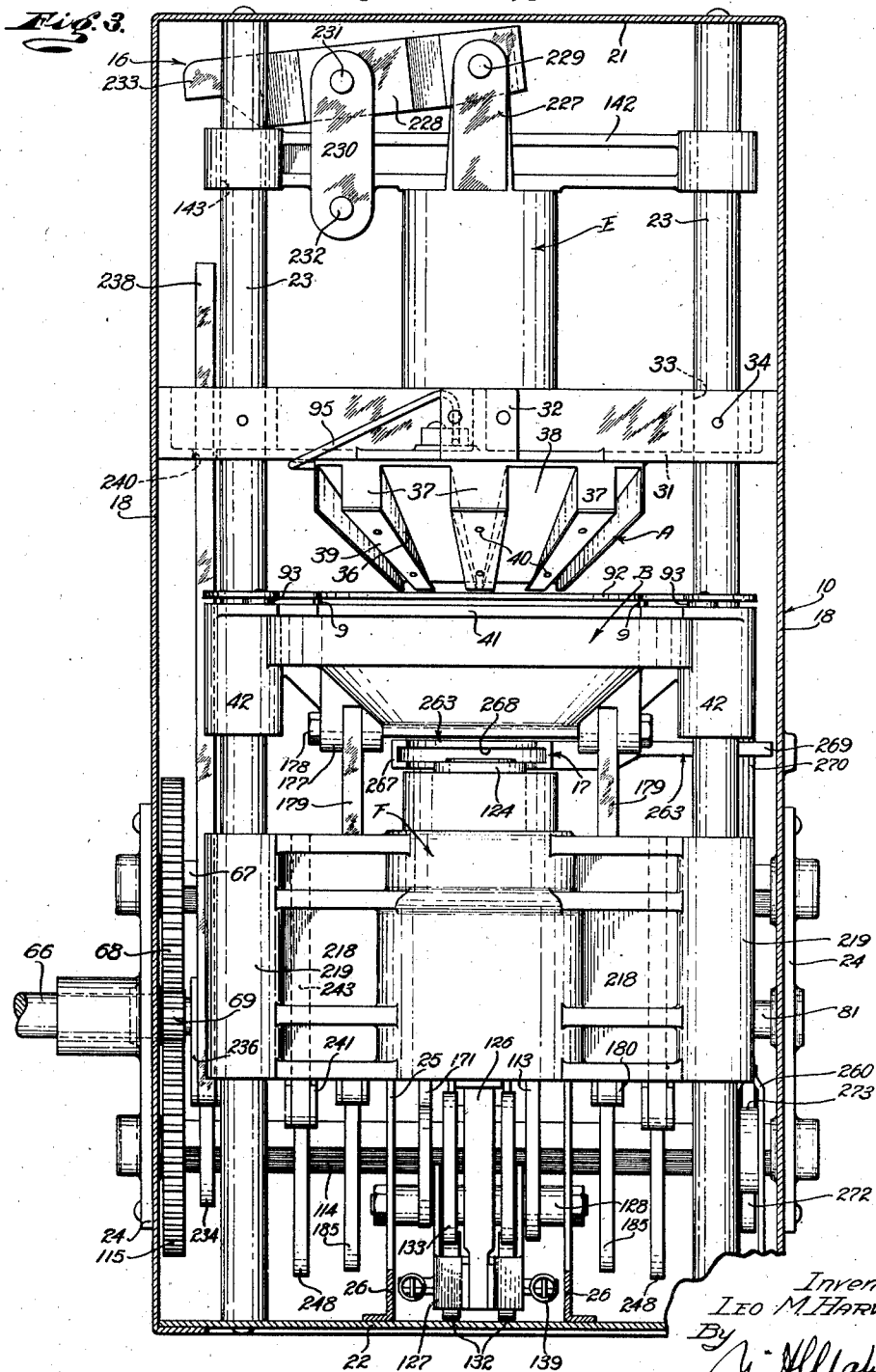
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METHOD AND MACHINE FOR MAKING PAPER CUPS

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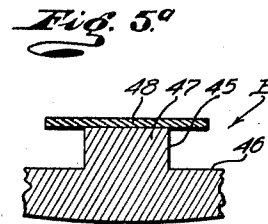
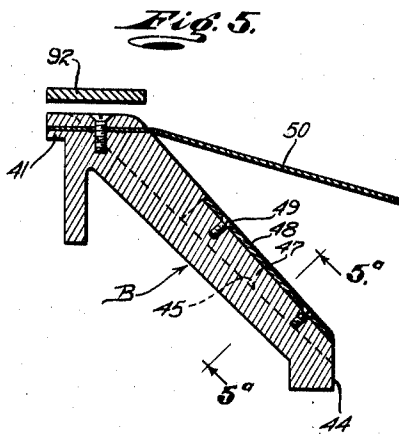
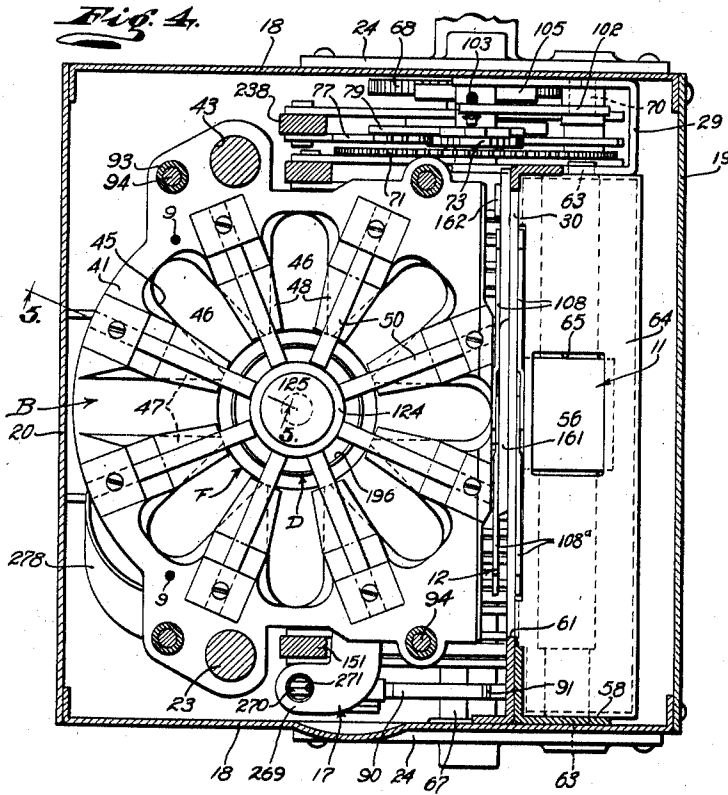
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METHOD AND MACHINE FOR MAKING PAPER CUPS

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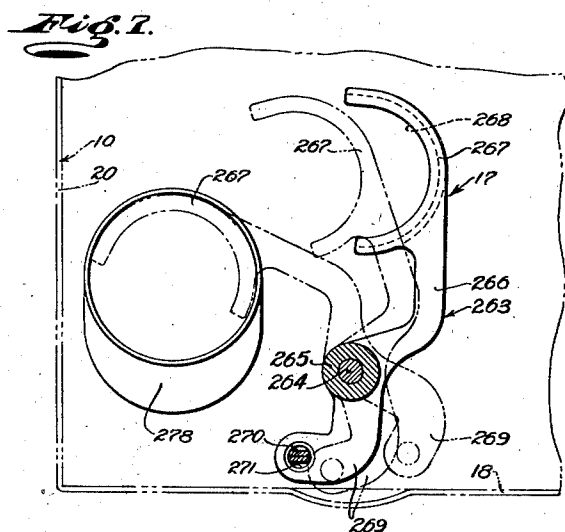
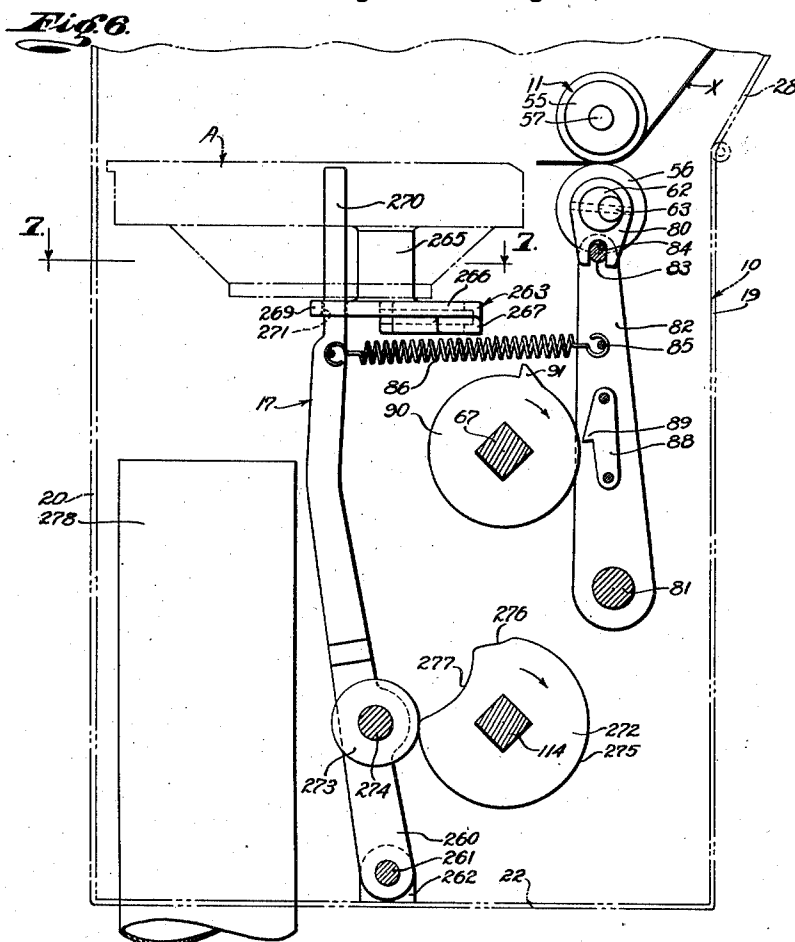
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METHOD AND MACHINE FOR MAKING PAPER CUPS

Original Filed Aug. 21, 1937 13 Sheets-Sheet 5



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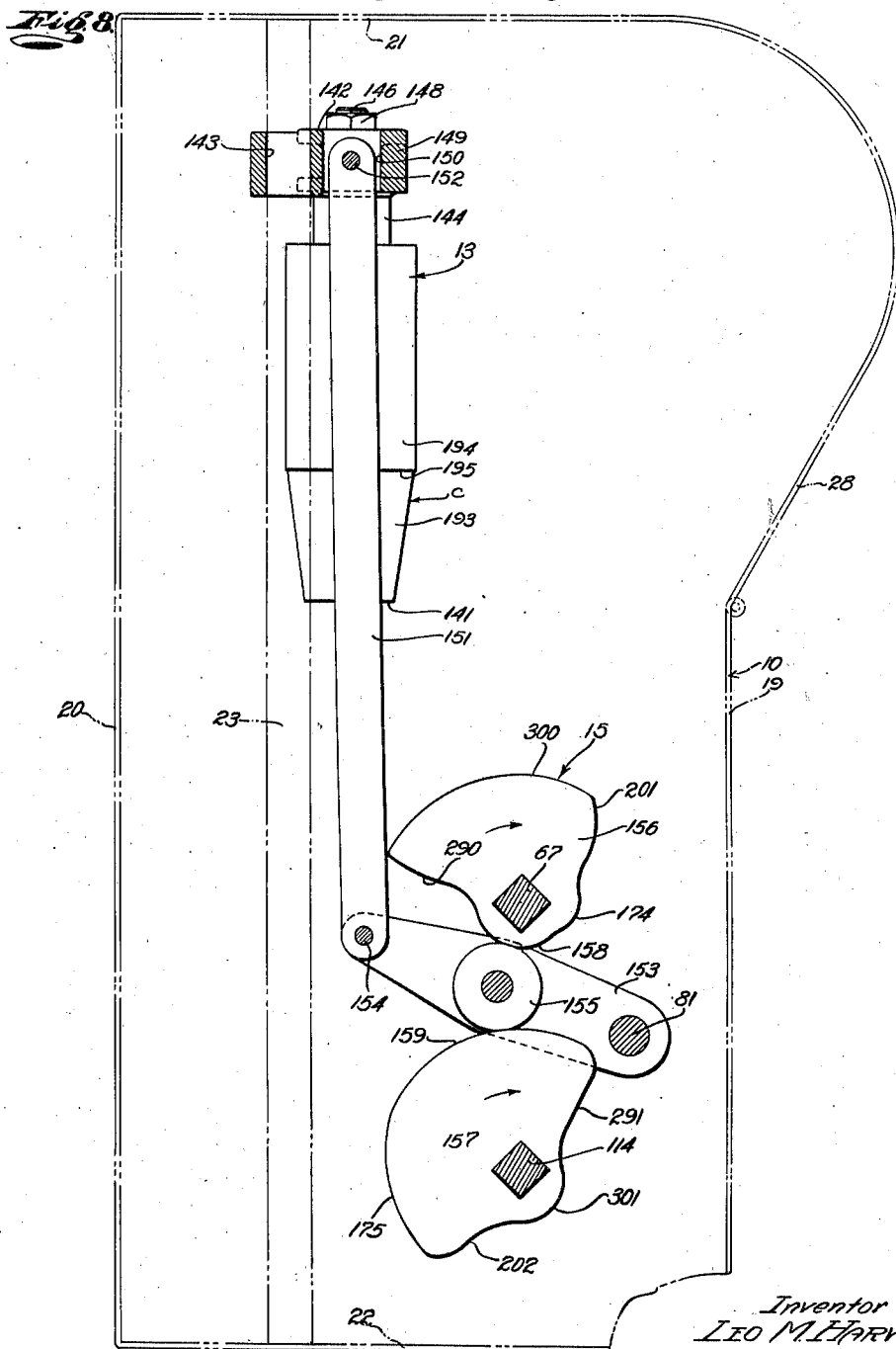
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2,215,698

METHOD AND MACHINE FOR MAKING PAPER CUPS

Original Filed Aug. 21, 1937 13 Sheets-Sheet 8

Fig. 11

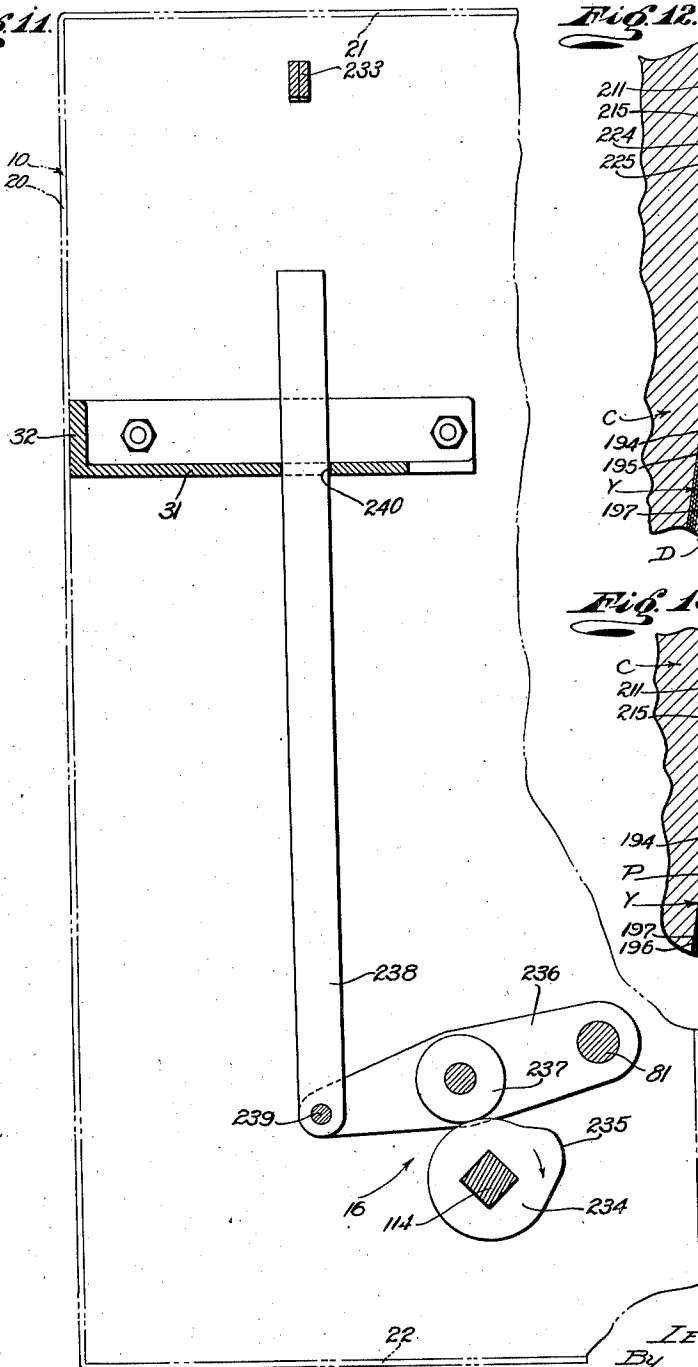


Fig. 12

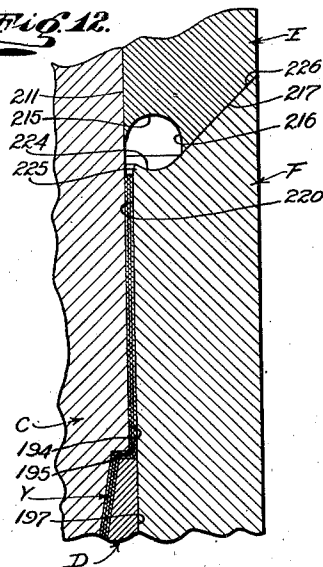
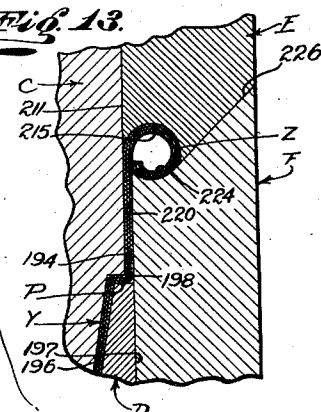


Fig. 13



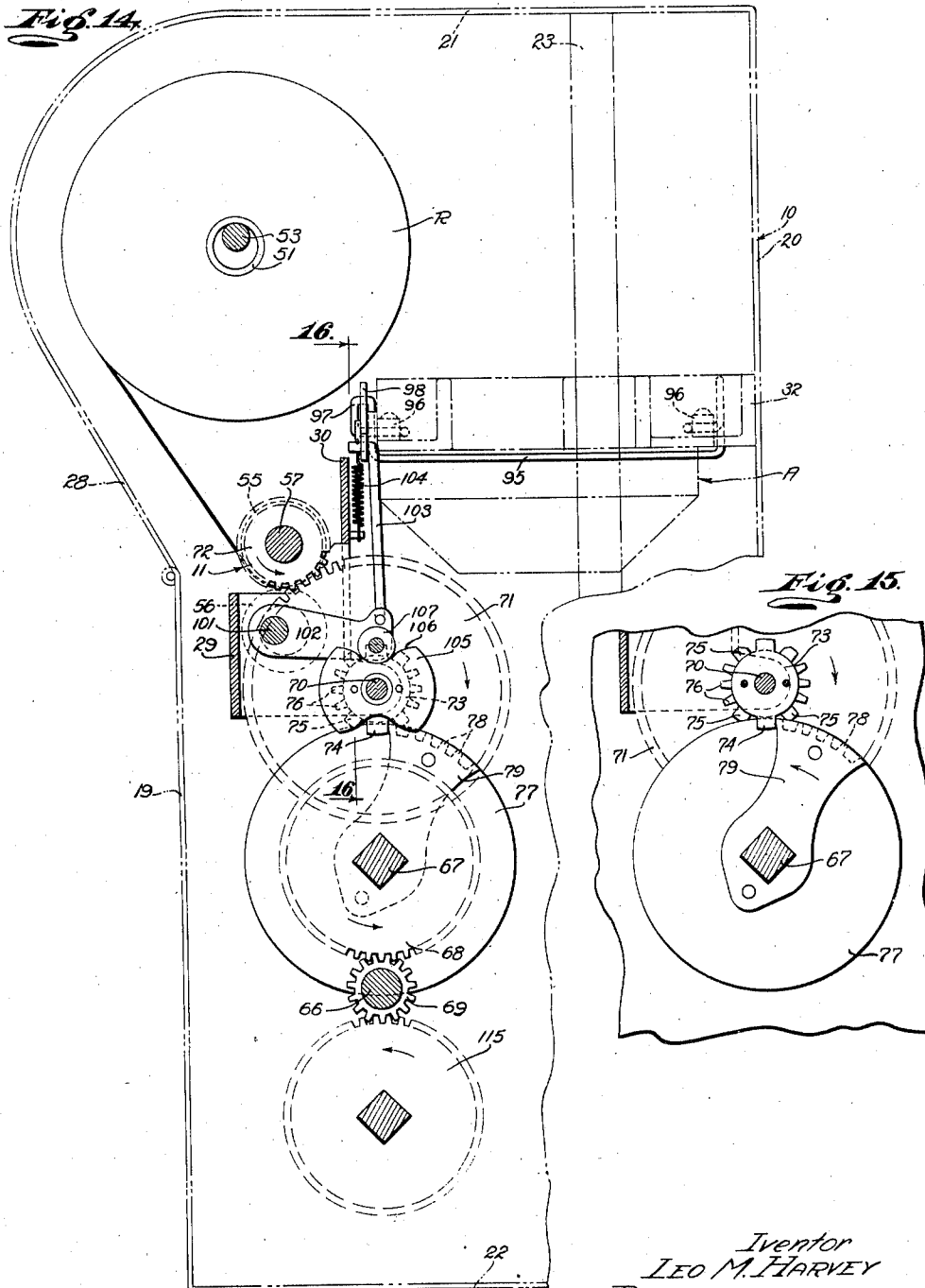
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METHOD AND MACHINE FOR MAKING PAPER CUPS

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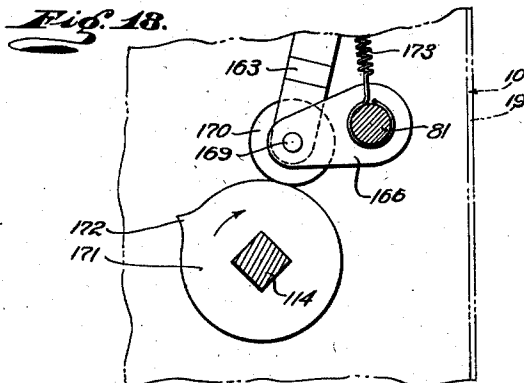
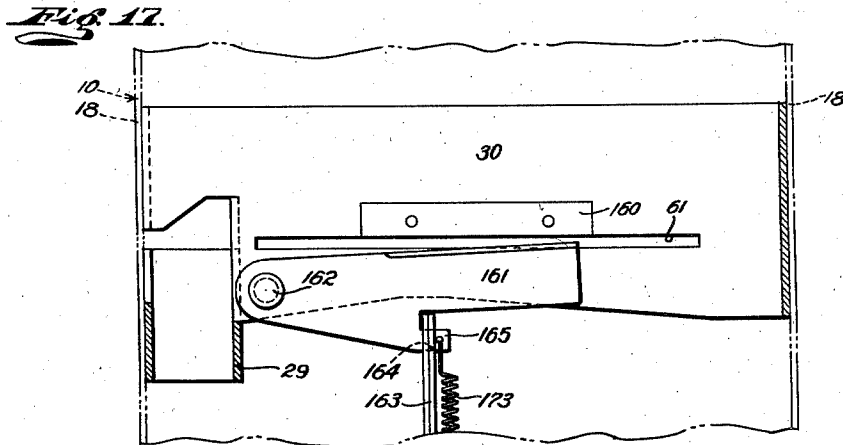
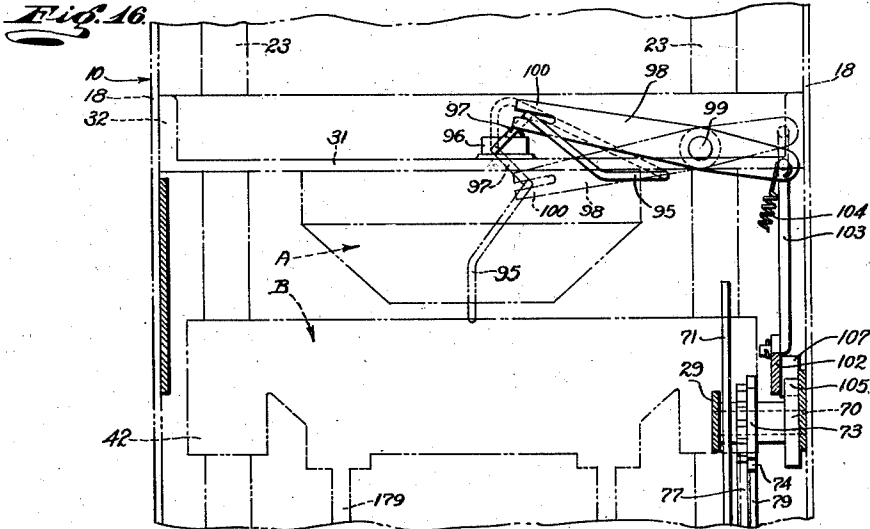
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METHOD AND MACHINE FOR MAKING PAPER CUPS

Original Filed Aug. 21, 1937 13 Sheets-Sheet 10



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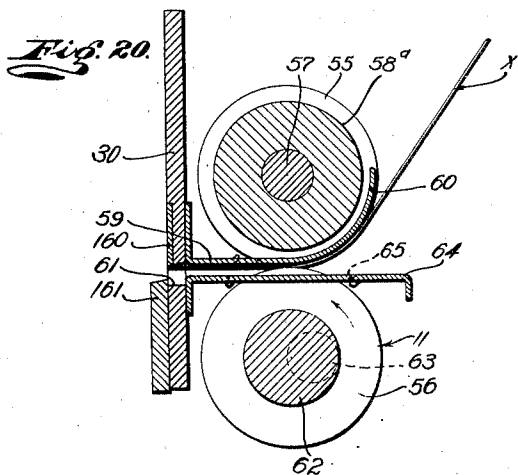
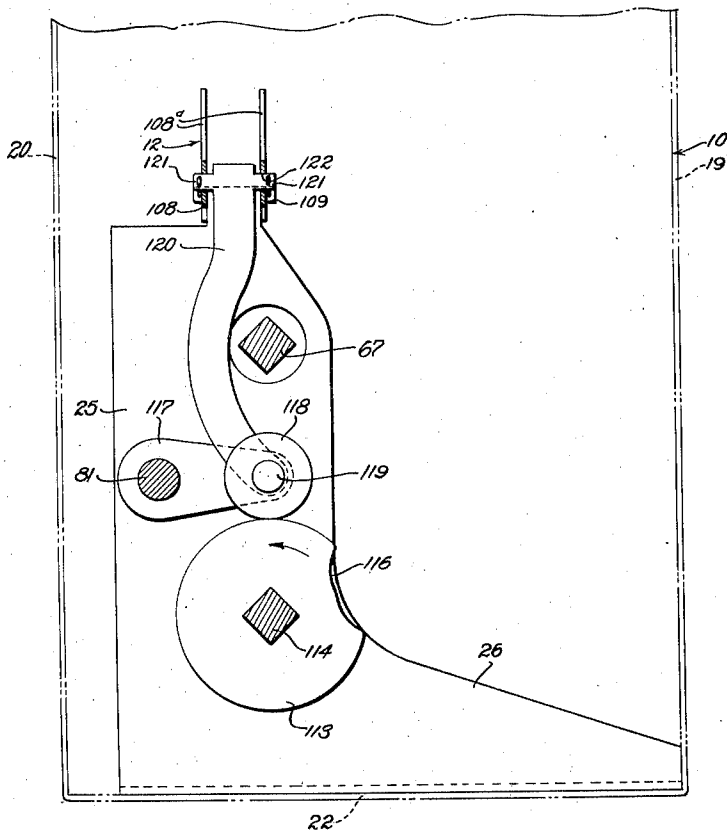
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2,215,698

METHOD AND MACHINE FOR MAKING PAPER CUPS

Original Filed Aug. 21, 1937 13 Sheets-Sheet 11

Fig. 19.



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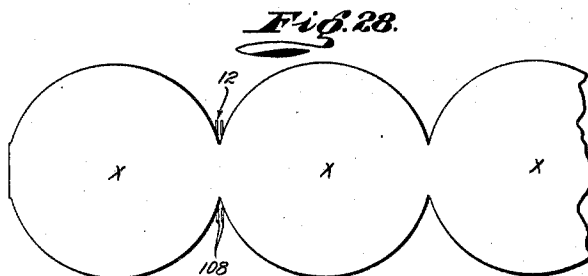
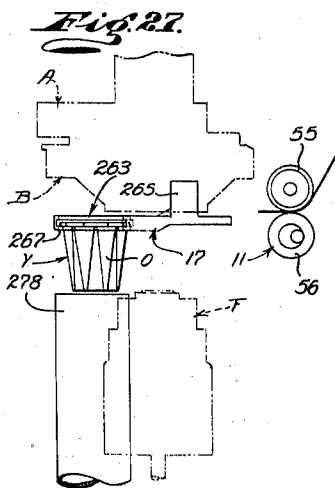
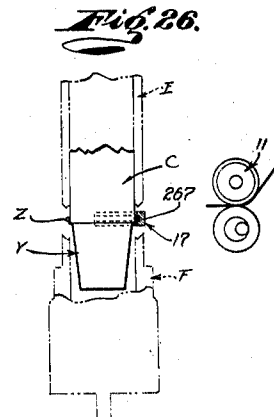
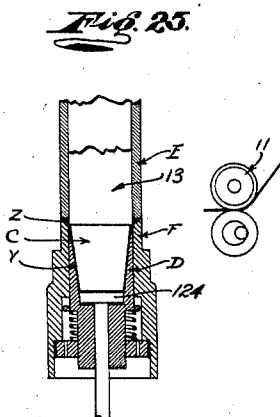
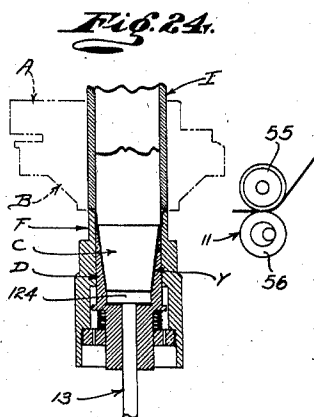
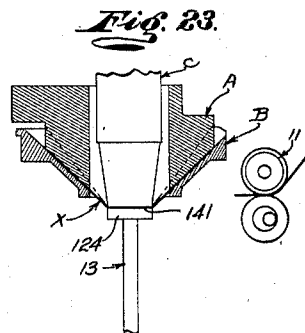
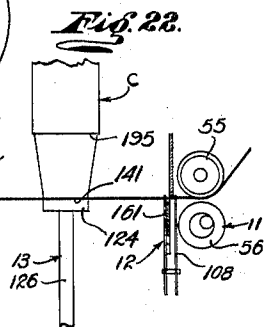
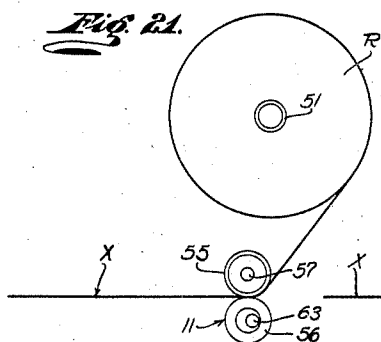
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METHOD AND MACHINE FOR MAKING PAPER CUPS

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2,215,698

METHOD AND MACHINE FOR MAKING PAPER CUPS

Original Filed Aug. 21, 1937 13 Sheets-Sheet 13

Fig. 29.

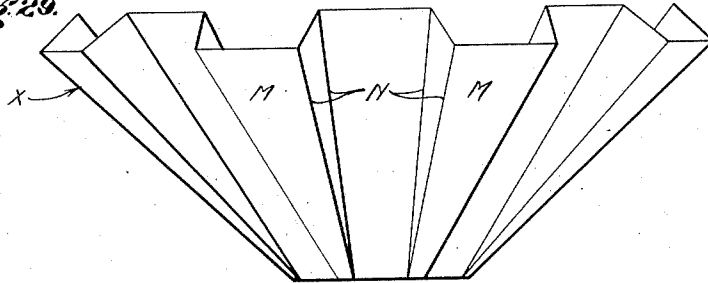


Fig. 30.

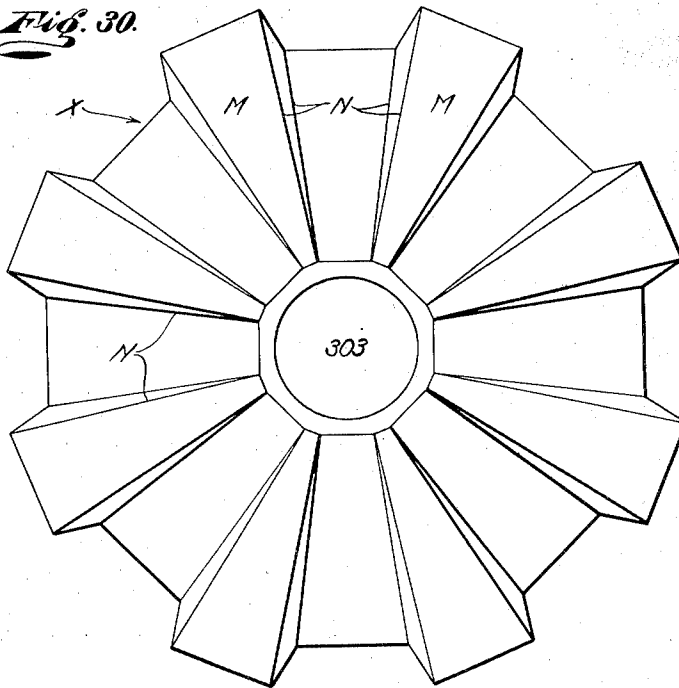


Fig. 31.

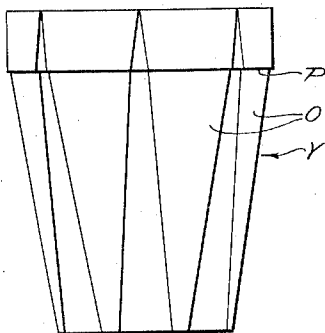
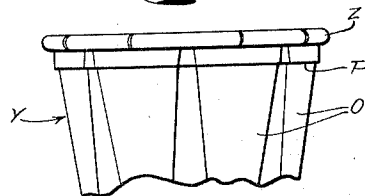


Fig. 32.



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UNITED STATES PATENT OFFICE

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METHOD AND MACHINE FOR MAKING
PAPER CUPS

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Application August 21, 1937, Serial No. 160,303

Renewed March 11, 1940

23 Claims. (Cl. 93—60)

This invention relates to a method and device for making containers or vessels and relates more particularly to a method and machine for making drinking cups of paper or similar material. An object of this invention is to provide a rapid, practical and efficient method and an improved and compact machine for making paper cups.

Another object of this invention is to provide a method for making paper cups in which the cup blank is translated or moved on a single axis without rotation throughout the entire series of operations and until the completed cup formed therefrom is delivered to the delivery outlet.

Another object of this invention is to provide a method of the character mentioned for making paper cups in which the cup blank is securely held against turning and displacement throughout the entire series of shaping, pleating and bead forming operations.

Another object of this invention is to provide a method of the character mentioned that requires a minimum of space for its performance.

Another object of this invention is to provide a novel and particularly effective method for forming an edge bead on a paper cup that assures the formation of the bead without wrinkling or distortion of the body of the cup.

Another object of this invention is to provide a machine for making paper cups that is small and compact and yet capable of producing perfect cups at a high rate.

Another object of this invention is to provide a machine of the character mentioned that embodies a cup blank locating means, a blank holding means, a blank shaping means, a blank pleating means and a bead forming means related and synchronized in such a manner that the cup blank travels a short distance on a single axis during the entire series of operations and until the complete cup is formed.

Another object of this invention is to provide a cup forming machine of the character mentioned in which the dies of the blank shaping means, the blank pleating means, and the bead forming means are in a compact telescopic relation to conserve space and to reduce the travel of the cup blank.

Another object of this invention is to provide a paper cup forming machine embodying a rapid and effective mechanism for producing a regular smooth bead on the upper edge of the cup.

Another object of this invention is to provide a machine of the character mentioned that embodies novel and particularly effective means for shaping and fluting the cup blank preparatory to the pleating operation.

Another object of this invention is to provide a cup forming machine of the character mentioned in which the pleat forming dies produce a shoulder on the cup that is gripped or engaged to posi-

tively prevent distortion and movement of the cup during the curling or forming of the bead.

A further object of this invention is to provide a machine of the character mentioned embodying an ejector that engages the completed cup during the return movement of one of the pleat forming dies to receive the cup therefrom and then deliver it to the outlet, this operation being completed without the possibility of distorting or injuring the cup.

The various objects and features of my invention will be fully understood from the following detailed description of a typical preferred form of apparatus and a typical manner of carrying out the method of the invention, throughout which description reference is made to the accompanying drawings, in which:

Fig. 1 is a vertical sectional view of the machine provided by this invention showing the principal parts of the mechanism in front elevation, being a view taken as indicated by line 1—1 on Fig. 2. Fig. 2 is a central vertical detailed sectional view taken as indicated by line 2—2 on Fig. 1. Fig. 3 is a vertical detailed sectional view taken as indicated by line 3—3 on Fig. 2 showing the principal parts in rear elevation. Fig. 4 is a horizontal detailed sectional view taken as indicated by line 4—4 on Fig. 2. Fig. 5 is an enlarged fragmentary vertical detailed sectional view taken as indicated by line 5—5 on Fig. 4. Fig. 5^a is an enlarged fragmentary sectional view taken substantially as indicated by line 5^a—5^a on Fig. 5. Fig. 6 is a fragmentary vertical detailed sectional view taken as indicated by line 6—6 on Fig. 1, illustrating portions of the paper feeding means and the cup ejecting means. Fig. 7 is a fragmentary horizontal detailed sectional view taken as indicated by line 7—7 on Fig. 6 illustrating various positions of the stripper or ejector. Fig. 8 is a fragmentary vertical detailed sectional view illustrating the means for operating the upper pleat forming die being a view taken on line 8—8 of Fig. 1. Fig. 9 is a fragmentary vertical detailed sectional view illustrating a part of the mechanism for operating the lower bead forming die taken as indicated by line 9—9 on Fig. 1. Fig. 10 is a fragmentary vertical detailed sectional view illustrating a portion of the mechanism for operating the lower flute forming die taken as indicated by line 10—10 on Fig. 1. Fig. 11 is a fragmentary vertical detailed sectional view of a portion of the mechanism for operating the upper bead forming die, taken as indicated by line 11—11 on Fig. 1. Figs. 12 and 13 are enlarged fragmentary vertical detailed sectional views of the bead forming dies and the adjacent parts illustrating the dies in different positions. Fig. 14 is a fragmentary vertical detailed sectional view of the paper feeding mechanism and adjacent parts taken as indicated by line 14—14

on Fig. 1. Fig. 15 is a fragmentary vertical detailed sectional view illustrating the intermittent movement means of the paper feeding mechanism being a view taken as indicated by line 15—15 on Fig. 1. Fig. 16 is a fragmentary vertical detailed sectional view illustrating a portion of the mechanism for guiding the cup blanks being a view taken as indicated by line 16—16 on Fig. 2. Fig. 17 is a fragmentary vertical detailed sectional view illustrating the paper cutting means being a view taken as indicated by line 17—17 on Fig. 2. Fig. 18 is a fragmentary vertical detailed sectional view illustrating part of the paper cutting means being a view taken as indicated by line 18—18 on Fig. 1. Fig. 19 is a fragmentary vertical detailed sectional view illustrating part of the means for centering the cup blank being a view taken as indicated by line 19—19 on Fig. 1. Fig. 20 is an enlarged fragmentary vertical detailed sectional view illustrating the feed rollers and the means for guiding the cup blank being a view taken as indicated by line 20—20 on Fig. 1. Figs. 6, 7, 8, 9, 10, 11, 14, 15, 16, 17, 18, 19 and 20 are partially diagrammatic views to better illustrate the mechanisms shown in these figures. Figs. 21, 22, 23, 24, 25, 26 and 27 are reduced diagrammatic views illustrating certain of the steps or operations performed by the machine and embodied in the method. Fig. 28 is a fragmentary elevation of a portion of the cup blank strip. Fig. 29 is an enlarged side elevation of the cup blank after being scored by the flute forming dies. Fig. 30 is a bottom view of the blank shown in Fig. 29. Fig. 31 is a side elevation of a cup after the formation of the pleats and Fig. 32 is a side elevation of the upper portion of a completed cup.

It is believed that the method of this invention will be better understood following a description of the machine. Accordingly, I will proceed with a detailed description of a typical embodiment of the machine provided by the invention and will follow such description with a disclosure of the method as carried out with the machine. It is to be understood that the invention is not to be construed as limited or restricted to the specific details about to be described, but is to be taken as including any features or modifications that may fall within the scope of the claims.

The improved cup making machine of this invention includes, generally, a body or housing 10, a pair of relatively movable shaping or flute forming dies A and B in the housing 10, means 11 for feeding a cup blank X between the dies A and B, means 12 for accurately centering or locating the cup blank X between the dies A and B, means 13 gripping the blank X and for moving the blank along an axis coincident with the axis of the dies A and B, means 14 for effecting relative movement between the dies A and B to score the blank X and make flutes M therein, cup forming dies C and D in the housing 10, means 15 for effecting relative movement between the dies C and D whereby the dies convert the flutes M into pleats O and finally shape the cup blank X into a cup Y, bead forming dies E and F, means 16 and 16^a for effecting movement of the bead forming dies E and F, respectively, to form a bead Z upon the cup Y, means 17 for stripping or removing the cup Y from the die C and for discharging the finished cup Y from the machine, and various other parts and mechanisms the functions and details of which will be hereinafter described.

The body or housing 10 is provided to carry and contain the various parts and mechanisms of

the machine. The housing 10 may be varied considerably in shape and construction without departing from the invention. In the embodiment of the invention disclosed in the drawings the housing 10 is a substantially rectangular hollow structure including sides 18, a front 19, a back 20, a top 21 and a bottom 22. The sides, front, back, top and bottom of the housing 10 are preferably comparatively heavy or thick to carry certain parts of the mechanism, as will be subsequently described. Two spaced centering and guiding posts 23 extend vertically through the interior of the housing 10. The opposite ends of the posts 23 may be suitably secured to the top 21 and the bottom 22. Bearing plates 24 are secured to the housing sides 18 adjacent their lower ends to carry certain rotating elements or shafts of the machine. Spaced substantially vertical plates 25 project upwardly from the housing bottom 22. The plates 25 are parallel with the housing sides 18 and have rearwardly projecting arms 26 engaging on the bottom 22.

The form of the machine illustrated in the drawings is adapted to receive the cup blanks X from a roll R of joined disc-shaped blanks 11 which constitute a strip as illustrated in Fig. 28 of the drawings. The housing 10 is constructed and shaped to contain the roll R of the cup blank strip. In the particular case illustrated an opening 27 is provided in the upper portion of the case front 19 and a door 28 is hinged to the front 19 to close the opening 27. The door 28 is shaped to partially receive the roll R, being rounded outwardly to have a concave inner side or socket for receiving a part of the roll. A supporting bracket 29 is mounted in the upper portion of the housing 10. The bracket 29 is substantially U-shaped when viewed from above and has one of its forks secured to a side 18 of the housing. A horizontally projecting arm 30 is provided on the other fork of the bracket 29 and extends through the housing 10 to have its outer end secured to the other housing side 18.

The dies A and B are provided to initially shape the cup blank X and to score the blank X to define the flutes M in the wall of the partially shaped cup blank. The dies A and B are relatively movable and non-rotatable. In the preferred structure illustrated in the drawings the die A is fixed or stationary and the die B is movable with respect to the die A. The die A is arranged in the upper portion of the housing 10 and includes or is provided with a head 31. The head 31 is substantially rectangular in plan elevation and is horizontally arranged in the housing 10. The head 31 has flanges 32 secured to the sides 18 and the back 20 of the housing. Openings 33 are provided in the head 31 to receive the posts 23. Screws 34 may connect the head 31 with the posts 23.

The die A proper may be integral with its head 31 and projects downwardly from the under side of the head. The die A is circular or annular in cross section surrounding a vertical opening 35 which continues upwardly through the head 31. The upper portion of the die A which joins with the supporting head 31 may have a cylindrical exterior. The major lower portion of the die A is frusto-conical being of downwardly diminishing diameter. The frusto-conical die A is ribbed or grooved to assist in the formation of the flutes in the cup blank X. Figs. 2 and 3 best illustrate the details of the die A. In accordance with the invention a multiplicity of axial or longitudinal grooves 36 is provided in the die A. The grooves 75

36 extend between the upper and lower ends of the tapered or conical portion of the die A and are equally spaced apart to leave axially extending ribs 37. The grooves 36 are identical and are rectangular in cross section having flat inner walls 38 and flat parallel side walls. The inner walls 38 of the grooves 36 are pitched at a greater angle than the outer surfaces of the ribs 37 so that the grooves 36 are of downwardly diminishing depth. From the above it will be apparent that the ribs 37 occurring between the grooves 36 are substantially rectangular in transverse cross section with parallel sides and that the ribs 37 are of downwardly diminishing width and thickness. In practice the grooves 36 have a greater width than the ribs 37. The grooves 36 and the ribs 37 extend downwardly to the lower end of the die A, the lower ends of the grooves 36 joining the opening 35.

It is preferred to provide scoring plates 39 on the outer surfaces of the ribs 37. The plates 39 preferably completely cover the outer surfaces of the ribs 37 and protrude beyond the sides of the ribs to partially overlie the grooves 36. The plates 39 are tapered, that is, they are of downwardly diminishing width. The upper ends of the plates 39 may be of the same width as the upper ends of the ribs 37 and the lower ends of the plates 39 are considerably wider than the lower ends of the ribs 37 whereby the plates have the protruding portions referred to above. The opposite longitudinal edges of the scoring plates 39 are straight and smooth to have cooperation with the paper cup blank X as will be subsequently described. The plates 39 may be fixed to the ribs 37 in any suitable manner, for example they may be secured to the ribs by screws 40.

The die B is shiftable or movable vertically relative to the die A and is complementary to the die A to coact therewith in initially forming or shaping the cup blank X. The movable blank shaping and flute forming die B is provided at its upper end with a head flange 41. The flange 41 is substantially horizontal and projects laterally or radially at the upper end of the die B. In the preferred construction the die B is guided for vertical movement by the rods 23. Bosses 42 are provided on the under side of the flange 41 and have openings 43 of substantial length slidably receiving the posts 23 so that the posts are effective in guiding the die B for vertical movement. The die B is an inverted frusto-conical member having a conical upwardly facing interior or socket. An opening 44 extends centrally through the bottom of the die B. The die B and its opening 44 are concentric to the central vertical axis of the die A. The socket or interior of the die B is adapted to receive the die A and its walls are fluted or formed to mate with the fluted sides of the die A, as best illustrated in Figs. 2 and 10 of the drawings.

A plurality of longitudinally extending grooves 45 is provided in the interior or inner side of the die B. The grooves 45 are equally circumferentially spaced and are identical in size and shape. The grooves 45 are substantially rectangular in transverse cross section having substantially parallel side walls and flat inclined bottom walls 46. The grooves 45 extend between the upper and lower ends of the die B and their lower ends are in communication with the opening 44. The circumferentially spaced grooves 45 leave or define longitudinally extending ribs 47 on the interior of the die B. Because of the shape and relationship of the grooves 45 the ribs 47 have downward-

ly convergent sides and are identical in size and shape. In practice the ribs 47 may be relatively narrow at their lower ends. The bottom walls 46 of the grooves 45 are pitched at a greater angle to the vertical than the faces or crests of the ribs 47. The pitch of the bottom walls 46 of the grooves 45 is substantially the same as the pitch of the plates 39 of the die A and the pitch of the crests of the ribs 47 is substantially the same as the pitch of the inner walls 38 of the grooves 36 in the die A.

Scoring plates 48 are preferably provided on the faces or crests of the ribs 47. The plates 48 lie flat on the ribs 47 and may be secured to the ribs by screws 49 or the like. The plates 48 have straight side edges and end edges and their side edges are preferably downwardly convergent. The upper ends of the plates 48 may be of substantially the same width as the upper portions of the ribs 47 while the lower ends of the plates 48 are of greater width than the lower portions of the ribs. Because of this relationship the plates 48 have edge portions protruding from opposite sides of their respective ribs 47, the protruding portions being of downwardly increasing width. It will be obvious that these protruding edge portions of the plates 48 partially overlie the grooves 45.

It is preferred to incorporate means on the die B to assist in providing a more uniform and better distributed pressure on the blank X and to effect an initial forming or shaping of the flutes M in the blank X before the ribs and grooves of the dies A and B come into active meshing cooperation. This means comprises spring fingers 50 secured to the die B at its upper end and projecting downwardly and inwardly into the die. In practice there is one spring finger 50 above each rib 47. The spring fingers 50 are preferably narrower than the plates 48 to be received in the grooves 36 of the die A with substantial clearance. The spring fingers 50 are normally or initially inclined at a lesser angle to the horizontal than the plates 48 to have their lower ends spaced a substantial distance above the plates.

When the die B is moved upwardly into cooperation with or into adjacent relation to the die A the spring fingers 50 first come into engagement with the blank X which is held by the means 13, as will be subsequently described, the fingers 50 being positioned to press circumferentially spaced portions of the blank X into the groove 36 of the die A. When the die B moves upwardly into cooperation with or adjacent relation to the die A the ribs 37 and 47 of the two dies mesh, that is, the ribs 47 and their plates 48 of the die B are received in the grooves 36 of the die A and the ribs 37 and their plates 39 are received in the grooves 45 of the die B. The spring fingers 50 give the blank X its initial conical shape and bend portions of the blank X into the grooves 36 of the die A to start the formation of the flutes M. The spring fingers 50 have a wiping action on the blank X and prepare the blank for fluting by the cooperating grooves and scoring plates 39 and 48. It will be apparent how the flutes M are formed in the blank X by the cooperating or meshing dies A and B and how the spring fingers 50 assist in this operation. The further shaping or forming of the blank X by the dies A and B will be subsequently described.

The means 11 for feeding the cup blank X between the dies A and B operates to deliver a blank X from a supply of such blanks and to

guide it between the dies A and B for accurate positioning by the means 12. In accordance with the broader aspects of the invention the cup blanks B may be supplied to the machine in various forms and manners, for example, the blanks X may be supplied to the machine in the form of a stack of individual disc-shaped blanks or the blanks may be cut from a strip of paper or the like by elements of the machine as it is fed to the machine. The invention contemplates the modification of the blank feeding means 11 to adapt it for handling blanks supplied in various manners. In the form of the invention illustrated in the drawings the feed means 11 is operable to handle cup blanks X which are in the form of substantially complete discs joined at diametrically opposite portions to adjacent blanks X to form a ribbon or strip such as illustrated in Fig. 28. The blanks X of this ribbon or strip may be formed of paper or other material suitable for shaping into drinking cups. The strip of blanks X illustrated in Fig. 28 is rolled into the form of the supply roll R mentioned above. The supply roll R is preferably rolled or wound on a tubular spool 51. The forward edges of the housing sides 18 are provided with upwardly and forwardly inclined notches 52 which removably support a spindle 53. The spindle 53 extends through the spool 51 to rotatably support the supply roll R. The supply roll R is supported so that its forward portion is received in the concave interior of the door 28 and so that its rear portion is received in the housing 10. A partition 54 may be provided in the housing 10 to extend downwardly to the rear of the roll R. The ribbon or strip of the cup blanks is trained downwardly and inwardly from the outer side of the supply roll R.

The feed means 11 includes two rollers 55 and 56 for advancing or feeding the paper cup blanks X inwardly between the dies A and B. The rollers 55 and 56 are mounted one above the other and the roller 55 is the driven roller while the roller 56 is an idler roller. The roller 55 is fixed on a substantially horizontal shaft 57. One end of the shaft 57 is rotatably supported by the inner fork of the bracket 29 and the other end of the shaft 57 is rotatably supported by a bracket 58 secured to the outer end of the arm 30 and the adjacent housing side 18. Longitudinally spaced circumferential grooves 58^a are provided in the roller 55 and the roller is preferably faced with rubber, or the like. A guide plate 59 is secured to the arm 30 and projects laterally toward the lower peripheral portion of the roller 55. Fingers 60 are provided on the guide plate 59 and extend into the grooves 58^a. The fingers 60 are curved to conform to the bottoms of the grooves 58^a and have suitable clearance in the grooves. The plate 59 and its fingers 60 are operable to guide the cup blank X inwardly and serve to prevent it from curling or rolling upwardly around the inner side of the roller 55. The strip of the blanks X is trained downwardly from the roll R to pass over the roller 55 and passes under the guide plate 59 to move through a slot 61 in the arm 30.

The roller 56 is tubular and is rotatably supported on a spindle 62. The intermediate portion of the roller 56 is enlarged in diameter to cooperate with the cup blank X and press it upwardly against the feed roller 55. In accordance with the invention the roller 56 is shiftable into and out of cooperation with the blank X, that is, it is movable laterally with respect to the roller 55 to move into and out of active engagement with the blank. Trunnions 63 of

reduced diameter extend from the opposite ends of the roller spindle 62. The trunnions 63 are eccentric with respect to the longitudinal axis of the tubular roller 56. One trunnion 63 is rotatably supported by the inner arm or fork of the bracket 29 and the other trunnion is rotatably supported by the bracket 58. It will be apparent that turning of the spindle 62 effects movement of the roller 56 into and out of active engagement with the blank X engaged by the roller 55. A guide plate 64 is secured to the arm 30 and extends horizontally over the roller 56. The plate 64 has an opening 65 through which the enlarged intermediate portion of the roller 56 may project to engage against the cup blank X passing under the roller 55. The plate 64 is in spaced relation to the horizontal portion of the plate 59 and the blank X is adapted to move inwardly between the plates to pass through the slot 61.

The feed means 11 includes a drive for intermittently turning the roller 55 and for shifting the roller 56 toward and away from the roller 55. The main drive shaft 66 of the machine enters one side 18 of the housing 10 and is rotatably supported by its plate 24. The main shaft 66 may be driven by any suitable power means or may be rotated by hand, as desired or found most practical. A horizontal shaft 67 extends through the housing 10 above the shaft 66 and has its opposite ends rotatably supported by the plates 24. The main intermediate portion of the shaft 67 may be polygonal. A gear 68 is fixed on the shaft 67 and meshes with a pinion 69 on the main shaft 66 so that the shaft 67 is driven by the shaft 66. An intermittent movement mechanism is interposed between the shaft 67 and the shaft 57 whereby the latter is intermittently turned by the former. Figs. 14 and 15 best illustrate the intermittent movement mechanism.

The intermittent movement mechanism of the means 11 includes a substantially horizontal shaft 70 rotatably supported by the bracket 29 above the shaft 67. A gear 71 is fixed on the shaft 70 and meshes with a pinion 72 fixed on the shaft 57 of the roller 55. An interrupted pinion or varied pinion 73 is fixed to the shaft 70. The pinion 73 has two diametrically opposite wide teeth 74 and a somewhat narrower tooth 75 at each side of each tooth 74. Sets or series of relatively narrow teeth 76 are provided on the pinion 73 on diametrically opposite portions and between the spaced teeth 75. The teeth 74 are offset outwardly or axially from the teeth 75 and 76. In practice the teeth 74 may be provided on a disc fixed to one side of the pinion 73.

The intermittent movement mechanism further includes a disc 77 fixed on the shaft 67. The disc 77 has a plain cylindrical periphery concentric with its axis of rotation. The periphery of the disc 77 is adapted to cooperate with opposing side or corner faces of the teeth 75 at opposite sides of a tooth 74 to hold the shaft 70 against rotation. A series of teeth 78 is provided or cut in the periphery of the disc 77 and is adapted to successively come into mesh with the sets of teeth 75 and 76 of the pinion 73. An arm 79 is fixed to one side of the disc 77 and its outer end is flush with the ends of the teeth 78. The forward side of the arm 79 relative to the direction of rotation of the disc 77 is adapted to cooperate with the side of a tooth 74 to advance or shift the pinion 73 to a point

where the adjacent tooth 75 meshes with the first tooth 78. This initiates the meshing engagement of the teeth 78 with the teeth 76 and the remaining tooth 75 of the series. The co-
 5 operation of the teeth 78 with a series of teeth 75 and 76 effects turning of the pinion 73 and the shaft 70 for approximately one half of one revolution. When the teeth 78 move out of en-
 10 gagement with the set of teeth 75 and 76 of the pinion 73 the periphery of the disc 77 comes into cooperation with the bevelled off corners of a pair of teeth 75 and this engagement serves to hold the pinion 73 and the shaft 70 against turn-
 15 ing throughout the major portion of the rotation of the disc 77 and until the arm 79 again comes into engagement with a tooth 74.

It is believed that it will be apparent how the intermittent movement mechanism just de-
 20 scribed operates to impart approximately one half of a revolution to the shaft 70 for each revolution of the shaft 67. The ratio between the gear 71 and the pinion 72 is such that approxi-
 25 mately one half of a revolution of the shaft 70 effects sufficient rotation of the roller 55 to fully advance the cup blank X between the dies A and B.

The lower roller 56 is controlled to urge the blank X upwardly against the roller 55 during the feeding operation, that is, during rotation
 30 of the roller 55, and to momentarily move out of active cooperation with the blank X at the termination of the rotation of the roller 55 to permit the location of the blank X by the means
 35 12. The mechanism for controlling the roller 56 is best illustrated in Fig. 6 of the drawings. This mechanism includes a fork or yoke 80 fixed to a concentric portion of the roller spindle 62
 40 adjacent one end of the spindle. A stationary or fixed shaft 81 extends through the housing 10 and has its opposite ends carried by the plates 24. A lever is pivoted on the shaft 81 and is adapted to cooperate with the fork 80. In prac-
 45 tice this lever may comprise two spaced lever arms 82 connected at their outer ends by a pin 83. The pin 83 cooperates with the notch 84 in the fork 80. A second pin 85 extends between the lever arms 82 and a spring 86 is connected with the pin 85 to urge the arms 82 to a posi-
 50 tion where the roller 56 is urged upwardly against the blank X engaging on the roller 55 and this maintains the proper cooperation of the blank with the roller 55. It will be understood how turning of the fork 80 by the lever arms 82 will effect swinging of the tubular roller 56 about
 55 the axis of the eccentric trunnions 63.

Cam means is provided for shifting or swing-
 60 ing the lever arms 82 to momentarily move the roller 56 downwardly or away from the roller 55. A cam 88 is fixed between the spaced lever arms 82 and is provided with a single cam projection
 65 89. A disc cam 90 is fixed on the shaft 67 and has a single cam projection 91 on its periphery for cooperating with the cam projection 89. Once during each revolution of the disc cam 90
 70 the projection 91 cooperates with the projection 89 to swing the lever arms 82 in such a manner that the roller 56 is momentarily swung down-
 wardly or away from the roller 55. This retraction of the roller 56 occurs immediately follow-
 75 ing a period of rotation of the roller 55 and therefore immediately following the inward feeding of the blank X between the dies A and B.

It is preferred to provide a guide plate or ring
 92 on the upper end of the die B to assist in guid-
 95 ing the blank X as it is fed inwardly and to pre-

vent undesirable upward curling of the edge of the blank. The ring 92 may be supported on the flange 41 of the die B through spacers 93 carried on the pins 94. The ring 92 is spaced above the
 5 upper surface of the flange 41. With the parts in their normal or initial positions the space be-
 10 tween the ring 92 and the upper side of the flange 41 is directly aligned with the slot 61 to receive the blank X. This relationship is clearly
 15 illustrated in Fig. 2 of the drawings. Centering or locating pins 9 may be provided on the flange 41 of the die B to be engaged by the leading edge of the blank X. The pins 9 may assist in stop-
 20 ping and locating the blank X between the dies A and B.

The feed means 11 preferably includes means for preventing upward curling of the blank X as it passes inwardly between the dies A and B. This means includes a wire or rod 95 carried by the die A and best illustrated in Figs. 1, 3, 14
 20 and 16 of the drawings. The head 31 of the die A has diametrically opposite lugs 96 and the end portions of the rod 95 are pivotally supported in openings in the lugs 96. The rod 95 is shaped to swing or pass under the die A. The inter-
 25 mediate portion of the guide rod 95 is adapted to move downwardly into the ring 92 under the die A to lie substantially horizontal and the rod 95 is mounted so that its intermediate portion is substantially parallel with the direction of move-
 30 ment of the blank X when the blank is fed inwardly between the dies A and B. When the rod 95 is in the down position just described its inter-
 35 mediate portion is spaced above the plane of the flange 41 to allow for inward feeding of the blank X with suitable clearance but serves to prevent upward curling of the blank as it moves inwardly. One end portion of the guide rod 95 is shaped to constitute a crank 97 as illustrated in Figs. 1 and
 40 16 of the drawings.

The means for operating the blank guiding rod 95 includes a lever 98 pivotally carried by a pin 99 on the flange 32. The lever 98 has a fork 100 cooperating with the crank 97 of the guide
 45 rod 95. A stationary shaft 101 is carried by the bracket 29 and supports a pivoted lever 102. A link 103 is pivotally connected with the lever 102 and the lever 98 whereby the lever 102 is operable to turn the crank 97 and the guide rod 95. A spring 104 is connected with the link 103 to nor-
 50 mally hold the guide rod 95 in its up or elevated position illustrated in full lines in Fig. 16 of the drawings. Cam means is provided to operate the lever 102 to effect swinging of the guide rod 95. This cam means includes a cam 105 fixed on the
 55 shaft 70. In practice the pinion 73 may have a hub and the cam 105 may be attached to the hub of the pinion 73. Two diametrically opposite notches 106 are provided in the periphery of the cam 105. The inner portions of the notches 106
 60 are in diametrical alignment with the teeth 74 of the pinion 73. The notches 106 have flaring side walls. A roller 107 is carried by the lever 102 to cooperate with the notches 106.

With the parts in their normal or initial posi-
 65 tions the roller 107 is received in a notch 106 and the rod 95 is in its elevated position at the head 31 of the die A. When the pinion 73 starts to turn due to cooperation of the arm 79 with a tooth 74 the side wall of the notch 106 cooperates
 70 with the roller 107 to swing the lever 102 upwardly and thus effect downward swinging of the guide rod 95. The guide rod 95 is swung down-
 75 wardly under the die A and remains in its down position where its intermediate portion is sub-

stantially horizontal so long as the roller 107 rides on the periphery of the cam 105. The parts are related and synchronized so that the guide rod 95 assumes its down or blank-guiding position upon the start of the inward movement of the blank X by the roller 55 and remains in this position until the blank X reaches or approaches its fully introduced position. When the blank X approaches its innermost position between the dies A and B the roller 107 is received in a notch 106 and the spring 104 swings the lever 98 to move the guide rod 95 to its up or idle position. The notch 106 receives the roller 107 concurrently with the termination of a phase of movement of the pinion 73.

The means 12 is operable to accurately locate or position the cup blank X between the dies A and B immediately following its introduction by the feed means 11 and preparatory to its engagement by the gripping means 13. The centering or locating means 12 includes two pairs of positioning elements 108. The elements 108 are in the form of bell cranks or levers having angularly projecting upper arms 108^a, as best illustrated in Fig. 1. The elements 108 may be pivotally supported on the plates 25. The upper portions of the plates 25 are relatively narrow and a pair of elements 108 is supported on the upper narrow portion of each plate. In the particular construction illustrated lugs 109 project from the opposite sides of the plates 25 adjacent their upper ends and extend through openings 110 in the elements 108 to support the elements for pivotal movement. The four positioning elements 108 are preferably connected to move or pivot in synchronism. A pin 111 is carried by one pair of elements 108 and operates in slots 112 in the other pair of elements. The upper arm 108^a of one element 108 of each pair of elements normally projects upwardly and outwardly at the outer face of the arm 30 and the upper arms 108^a of the other elements 108 project upwardly and outwardly at the inner side of the arm 30 in spaced relation to the arm 30. When the elements 108 are in their normal or idle positions the upper ends of their upper arms 108^a are below the plane of the slot 61.

The blank centering or positioning means 12 includes a cam mechanism, illustrated in Figs. 1 and 19, for pivoting the elements 108 to bring their upper arms 108^a into engagement with the notches occurring between the innermost blank X and the second to the innermost blank which notches are best illustrated in Fig. 28 of the drawings. The cam mechanism for operating the elements 108 includes a cam 113 fixed on a horizontal shaft 114. The shaft 114 serves as a driving element for certain of the other mechanisms of the machine as will be subsequently described. The shaft 114 is spaced below the shaft 67 and its end portions are rotatably supported by the housing plates 24. The cam shaft 114 may be polygonal in cross section, as illustrated. The shaft 114 is driven or rotated by the main shaft 66. A gear 115 is fixed on the shaft 114 and meshes with the pinion 69 on the shaft 66. The cam 113 has a plain concentric periphery provided with a single notch 116. A forked or double lever 117 is pivoted on the shaft 81 and carries a roller 118 which rides on the periphery of the cam 113. A pin 119 rotatably supports the roller 118 and connects the outer portions of the two arms or members comprising the lever 117. A link 120 operatively connects the lever 117 with the blank positioning elements 108. The lower

end of the link 120 may be yoked and pivoted on the pin 119 of the lever 117. Laterally projecting fingers 121 are provided on the upper end of the link 120 and are pivotally received in openings 122 in one pair of elements 108. A spring 123 is connected between the lower arm 108^b of one element 108 and the shaft 81 or any other suitable part to normally hold the roller 118 down against the cam 113. The elements 108 are normally in retracted positions where their upper arms 108^a are below the plane of the slot 61 and are clear of the blank X.

At the moment that the roller 56 swings downwardly away from the roller 55 the roller 118 is received in the notch 116 of the cam 113 and the spring 123 pivots the elements 108 so that their upper arms 108^a move upwardly and inwardly to engage in the notches between the end blank X and the second to the end blank. In practice the roller 55 will have fed the end blank X inwardly a distance slightly in excess of the necessary inward movement and this excess movement will have caused the said blank to bend or bow upwardly between its opposite side edges. Two of the element arms 108^a engage the periphery of the second to the endmost blank X to draw the end blank X outwardly and thus remove this bend or bow from the blank X located between the dies A and B. The other two element arms 108^a cooperate with the periphery of the end blank X to limit this outward shifting of the end blank X. The four element arms 108^a engage in the two notches of the joined blanks X to contact the two endmost blanks X at four spaced points, as best illustrated in Fig. 28 of the drawings, and this four point engagement effectively centralizes the end cup blank X with respect to the dies A and B. The engagement of the centering element arms 108^a with the two end blanks X is only momentary for when the notch 116 moves past the roller 118 the link 120 is shifted to swing the arms 108^a out of engagement with the blanks X. The arms 108^a remain in their retracted positions until the succeeding operation.

The means 13 for gripping the blank X located and centered between the dies A and B is an important element of the machine as it serves to hold the blank X against undesired movement during the flute forming and pleat forming operations and shifts or moves the blank X along the common axis of the dies A, B, C, D, E and F during certain phases of these operations. The blank gripping and moving means 13 operates to engage or grip the blank X at its central portion or zone. The means 13 includes what I will term a punch or plunger 124 for engaging upwardly against the under side of the blank X located between the dies A and B in the manner described above. The plunger 124 is a disc-shaped member having a horizontal upper face provided with a central boss 125. The boss 125 has a flat horizontal upper face. A vertical stem 126 carries the plunger 124 and extends downwardly from the lower side of the plunger. The plunger 124 and its stem 126 have their vertical axis coincident with the common axis of the dies A, B, C, D, E and F. With the parts in their normal or idle positions the plunger 124 is spaced below the lower end of the flute forming die B as illustrated in Figs. 2 and 3 of the drawings.

The mechanism for operating or moving the punch or plunger 124 includes two spaced levers 127. The levers 127 are identical or complementary and are pivotally supported on a horizontal shaft 128 supported by the plates 25. The

outer ends of the levers 127 are in relatively close relation and the stem 126 has a flattened portion 126^a received between the outer portions of the levers. A pin 129 on the stem portion 126^a operates in slots 130 in the outer portions of the levers 127 to pivotally connect the plunger stem 126 with the levers 127. Cam means is provided for shifting or pivoting the levers 127 to move the plunger vertically. A pin 131 projects from each lever 127 and carries a roller 132. Cams 133 are fixed to the cam shaft 114 to cooperate with the rollers 132. The cams 133 are identical and of the same setting. The cams 133 are contoured or shaped to effect or allow a particular series of movements of the plunger 124. Each cam 133 has a major surface portion 134 having a substantial radius of curvature and curved concentrically about the axis of the shaft 114 and an abrupt shoulder 135 at the trailing end of the portion 134. The cams 133 have inner surface portions 136 concentric with their axes and of a small radius of curvature and connected with the advancing ends of the portions 134 by rounded or gradual shoulders 137. With the parts in their initial or normal positions the rollers 131 engage the surface portions 134 adjacent the shoulders 135 and this engagement holds the plunger 124 at or below the lower end of the die B. Spring means are provided to hold the rollers 132 in cooperation with the cams 133 and to urge the plunger 124 upwardly. In the particular construction illustrated in the drawings each lever 127 has a lug 137 and springs 139 are connected with the lugs 138. The springs 139 may be connected with relatively stationary parts, for example they may be secured to clips 140 on the portions 26 of the plates 25. The springs 139 exert a turning force on the levers 127 tending to move the plunger 124 upwardly and urging the rollers 132 toward the cams 133.

The means 13 for gripping the cup blank X further includes a part or element for engaging the upper face of the central portion of the blank X so that the blank is gripped at its center. In the preferred construction this gripping element is the lower end or face 141 of the upper pleat completing or forming die C. This gripping face 141 is substantially horizontal and is flat. The gripping face 141 is annular and its internal diameter is slightly greater than the external diameter of the boss 125 of the plunger 124.

The machine includes a mechanism for shifting the die C to maintain the gripping face 141 in cooperation with the blank X and for moving the blank X downwardly while gripped between the face 141 and the plunger 124. This mechanism may include a cross head 142 in the upper portion of the housing 11. The cross head 142 is shiftable vertically and is guided by the posts 23. The cross head 142 may have vertical openings 143 slidably receiving the posts 23, whereby the posts slidably guide the cross head. The cross head 142 extends at substantially right angles to the common axis of the dies A, B, C, D, E and F and the die C is connected with the cross head 142 to be movable therewith. A stem 144 projects from the upper end of the die C and has a central longitudinal opening 145. A bolt 146 extends through the opening 145 and passes through an opening 147 in the cross head 142. A nut 148 is threaded on the bolt 146 and engages against the cross head 142 to clamp the die C to the cross head. Lateral lugs 149 are provided on the cross head 142 adjacent its oppo-

site ends and each lug 149 has a vertical opening 150. As illustrated in Figs. 1 and 8, links 151 are received in the openings 150 and are pivotally connected to the cross head 142 by pivot pins 152 extending transversely through the openings. The links 151 extend downwardly to adjacent the shaft 81. Forked levers or double levers 153 are pivotally supported on the shaft 81 at longitudinally spaced points and pins 154 pivotally connect the outer ends of the levers 153 with the links 151. Each lever 153 carries a rotatable roller 155.

A pair of cams 156 and 157 is provided to cooperate with each lever roller 155 to effect positive downward movement of the die C and positive upward movement of the die C. Fig. 8 of the drawings illustrates one set of these cams. The cams 156 and 157 remain in cooperation with their respective rollers 155 at all times and are shaped to operate jointly in the transmission or movement of the die C. The cams 156 and 157, the levers 153, the cross head 142 and the associated parts constitute elements of the means for shifting the die C to complete or form the pleats O in the cup blank X. At present we are concerned with the mechanism for moving the die C only insofar as it operates the die to bring its gripping face 141 into gripping and holding engagement with the upper surfaces of the blank X.

In accordance with the invention the gripping face 141 and the gripping plunger 124 operate to grip the paper blank X immediately following the centering of the blank between the dies A and B and simultaneously with the return of the roller 56 into gripping cooperation with the second to the end blank X so that the blank between the dies A and B and the said second to the end blank are both gripped or held. Immediately following the operation of the locating or positioning elements 108 as described above, and while the elements 108 remain in cooperation with the blanks X, the shoulders 135 move past the rollers 132 allowing the springs 139 to move the plunger 124 upwardly. At this time the rollers 155 are engaged by concentric portions 158 of the cams 156 and concentric surface portions 159 of the cams 157 and the die C remains stationary. The plunger 124 is moved upwardly by the springs 139 until it bears upwardly against the lower side of the blank X and presses the blank against the gripping face 141, the gripping face 141 may move down slightly to meet the plunger. Because of the relative diameters of the boss 125 and the gripping face 141 the blank X is pressed upwardly between the periphery of the boss and the inner edge of the face 141 and the resultant bending or binding of the blank X effectively locks the blank against shifting. The gripping face 141 and the plunger 124 remain in gripping cooperation with the blank X throughout the operation of the dies A and B in forming the flutes M in the blank and throughout the entire pleat forming and bead forming operations. The die C presenting the gripping face 141 is shiftable along the axis of the dies A, B, C, D, E and F during certain phases of the operation of the machine, the cams 156 and 157 being shaped to effect these various movements of the die C as will be subsequently described.

In the case where the cup blanks X are supplied to the machine in a ribbon or strip, as illustrated in Fig. 28 of the drawings, the machine embodies means for cutting the end blank X free from the strip after said blank has been

located and gripped by the means 12 and 13. Figs. 17 and 18 best illustrate the cutting means. The means for severing the end blank X from the supply strip may include a stationary blade

5 160 inset or recessed in the inner side of the arm 30 to present an edge to the upper wall of the slot 61. The severing means may further include a pivoted cutting blade 161. The blade 161 may be pivotally supported by a pin 162 on the arm 30 and is adapted to swing upwardly past the blade 160 to shear the portion of the paper blank strip connecting the end blank X with the strip. The means for operating the blade 161 includes a link 163 connected with the blade. In the construction illustrated in the drawings the link 163 has an opening 164 receiving a lug 165 on the blade 161 whereby the lug serves to connect the link with the blade. A forked or double lever 166 is pivoted on the lever shaft 81 and a transverse shaft or pin 169 extends through openings in its two spaced side parts. The lower end of the link 163 is forked and arranged between the two spaced side parts of the lever 166. The pin 169 pivotally connects the forked end of the link 163 with the lever 166. A roller 170 is rotatably supported on the pin 169. The means for operating the blade 161 is in the nature of a cam means and includes a cam 171 fixed on the shaft 114 to cooperate with the roller 170. The cam 171 has a single projection 172 on its otherwise plain and concentric periphery. Immediately subsequent to the positioning of the blank X between the dies A and B by the means 12 and the gripping of the blank X by the means 13, the projection 172 cooperates with the roller 170 to swing the blade 161 upwardly to sever the end blank X from the supply strip of blanks.

It will be observed that at the time of severance 40 of the end blank X from the supply strip the said end blank is gripped by the means 13 and the second to the end blank is gripped by the rollers 155 and 156 so that the blanks cannot shift or become displaced by the action of the blade 161. The blade 161 merely swings upwardly 45 by the action of the cam projection 172 to sever the end blank from the supply strip along the line of its connection with the next blank X of the strip. A spring 173 is connected with the blade 50 161 to return it after its operation and to normally hold the blade in the retracted position. In practice the spring 173 may be connected between the lug 165 and the shaft 81. The blade 161 is normally held in a retracted position where 55 it permits the passage of the blank X through the slot 61, the normal position of the blade being illustrated in Fig. 17 of the drawings.

Following the severance of the end blank X from the supply strip of blanks the blank gripping and shifting means 13 operates to move the freed blank X downwardly along the axis of the dies A, B, C, D, E, and F to a position where it is in a plane below the lower end of the die A. The cams 156 and 157 are shaped to cause the necessary 65 downward movement of the die C and the plunger 124 to shift the blank X downwardly. The cams 156 have surface portions 174 trailing the surface portions 158 and having a radius of curvature slightly greater than the radius of curvature of the surface portions 158. The cams 157 have surface portions 175 of a smaller radius of curvature than the portions 159 and trailing the portions 159. Immediately following the severing of the end blank X from the supply strip, as just described, the surface portions 174 and 175 of the

dies 156 and 157, respectively, come into cooperation with the rollers 155 whereby the die C is moved downwardly. Downward movement of the die C of course results in downward shifting of the blank X, the blank being gripped between the face 5 141 and the plunger 124, the plunger moving downwardly with the die C. The rollers 132 move clear of the cams 133 during the downward movement of the plunger 124. The downward movement of the blank X brings it to the proper plane 10 for the pleat forming operation.

The means 14 is provided to shift or move the die B upwardly relative to the die A so that the blank X is pressed between the dies A and B to have the flutes M formed therein. The means 14 15 includes two diametrically opposite pairs of lugs 177 on the under side of the die B. Pins 178 are carried by the lugs 177 and pivotally connect the upper ends of the operating links 179 with the die B. The links 179 extend downwardly to points 20 adjacent the lever shaft 81. Two spaced double or forked levers 180 are pivoted on the shaft 81 and the lower ends of the links 179 are received in the outer ends of these levers. Suitable pins 181 pivotally connect the links 179 with their respective levers 180. Shafts or pins 182 extend between the side members of the levers 180 to connect the same. Rollers 183 are rotatably supported on the pins 182. 25

The die operating means 14 further includes 30 cams 184 fixed on the shaft 67 and cams 185 fixed on the shaft 114 to cooperate with the rollers 183. Fig. 10 illustrates one pair of cams 184 and 185 cooperating with a roller 183. The cams 184 and 185 engage the rollers 183 at substantially diametrically opposite points to effect the positive movement of the die B vertically in both directions. The cams 184 have concentric surface portions 186 of substantial radius of curvature and the cams 185 have concentric surface portions 40 187 having a small radius of curvature and the surface portions 186 and 187 cooperate with the rollers 183 during the blank feeding operation, the blank centering operation, the blank gripping operation and the blank severing operation to hold the die B stationary and below the die A during these several operations. The cams 184 have rather sharp inwardly extending shoulders 188 at the trailing ends of their surface portions 186 and the cams 185 have outwardly extending 50 surface portions 189 at the trailing ends of their surface portions 187. The shoulders 188 and the surface portions 189 of the cams cooperate with the rollers 183 to move the die B upwardly toward the die A to give the blank X its initial cup shape 55 and to form the flutes M in the blank, as will be more fully described. The trailing portions of the shoulders 188 of the cams 184 may have outwardly turned or outwardly extending surface portions 190 and curved surface portions 191 may 60 extend circumferentially and inwardly from the trailing ends of the surface portions 189 of the cams 185. The surface portions 190 and 191 if provided on the cams 184 and 185 cooperate with the rollers 183 to effect a slight downward movement or retraction of the die B from the die A to permit the withdrawal of the cup blank X from between the dies immediately following the forming of the flutes M in the blank. 65

When the die B is moved upwardly by the 70 means 14, as described above, the spring fingers 50 are the first active parts of the die B to come into cooperation with the cup blank X. The slight downward movement of the blank X by the gripping means 12 following the centering of the 75

blank brings the central portion of the blank X to a position below the peripheral portion of the blank engaging on the upper surface of the die B so that the blank is slightly frusto-conical. The spring fingers move upwardly into engagement with the slightly sloped portions of the blank X and have a wiping engagement with the blank at spaced points or lines and urge circumferentially spaced portions of the blank X into the grooves 36 of the die A. Thus when the die B proper approaches or reaches the die A the fingers 50 will have bent circumferentially spaced portions of the blank into the grooves 36. As the spring fingers 50 are much narrower than the grooves 36 they do not make the blank X conform to the grooves 36 and do not finally crease or score the blank. When the ribs 47 of the die B enter the grooves 36 of the die A and the ribs 37 of the die A enter the grooves 45 of the die B the blank X is definitely given a frusto-conical shape and has longitudinally extending portions drawn into the oppositely facing grooves 36 and 45. As the die B approaches its final or uppermost position the blank X is drawn tightly over the edges of the scoring plates 39 and 48 and when the die B reaches its final position the plates 39 and 48 shape or score the blank X along the lines N so that the flutes M are finally formed in the blank. Figs. 29 and 30 of the drawings illustrate the shape or character of the flutes M as formed by the dies A and B. The spring fingers 50 lie flat against the surfaces of the plates 48 when the die B reaches its final up position and being thin do not interfere with the proper formation of the flutes M. Due to the relationship of the grooves and ribs of the dies A and B the flutes M are alternately inwardly and outwardly projecting relative to the central vertical axis of the blank X and due to the general conical configuration of the dies A and B the blank X is given a generally frusto-conical shape. It is to be understood that the central portion of the blank X is gripped between the plunger 124 and the face 141 during the formation of the flutes M in the blank X. The flutes M extend inwardly from the periphery of the blank X to adjacent the central portion of the blank which remains substantially flat and horizontal owing to the fact that it is held between the plunger 124 and the gripping face 141. This central portion of the blank X forms the bottom of the cup Y when completed.

The cup forming dies C and D are provided to convert the flutes M of the blank X into pleats and to give the blank X its general final cup shape. The dies C and D are co-axial with the dies A and B, the die C being movable axially in the opening 35 of the die A and the die C being movable axially or vertically below the die B. The die C is the inner cup forming die being adapted to cooperate with the interior of the cup blank X and the die D is the outer cup forming die, being adapted to cooperate with the exterior of the cup blank. The die C is an elongate tubular member having a central longitudinal socket or opening 192 extending upwardly in it from its lower end. The lower end of the die C is flat and constitutes the face 141 as described above. The lower portion of the die C has an external surface 193 that is tapered downwardly and inwardly to the face 141. The upper external surface 194 of the die C is preferably cylindrical. In accordance with the invention an abrupt or horizontal downwardly facing shoulder 195 occurs at the upper end of the

tapered surface 193 serving to join the surface 193 with the surface 194.

The die D is a socket die, that is, it has a central longitudinal socket 196 entering its upper end. The major upper portion of the socket 196 has downwardly and inwardly tapered walls. The lower portion 196^a of the socket 196 preferably has a cylindrical wall. The socket 196 is adapted to receive the tapered lower portion of the die C with only sufficient clearance for the reception of the cup blank X and the pitch of its tapered wall is substantially the same as the pitch of the tapered surface 193 of the die C. The exterior of the die D has a cylindrical upper surface 197 that is slightly greater in diameter than the cylindrical upper surface 194 of the die C. Figs. 12 and 13 illustrate this relationship between the surfaces 194 and 197. The upper edge 198 of the die D is relatively narrow and is preferably flat and horizontal as best illustrated in Figs. 12 and 13. The lower external surface of the die D is preferably tapered downwardly and inwardly with respect to the longitudinal axis of the die. A reduced central hub or boss 198^a projects from the lower end of the die D. It is preferred to provide an annular outwardly projecting flange 199 on the die D at the upper end of its boss 198^a to cooperate with the die F as will be subsequently described. A central longitudinal opening 200 extends through the boss 198^a from its lower end and continues upwardly to the bottom of the socket 196. The opening 200 shiftably or slidably passes the stem 126 of the plunger 124. During certain phases of the operation of the machine the plunger 124 is received in the socket 196 and the cylindrical lower portion 196^a of the socket is proportioned to receive the plunger 124 when the dies C and D are in cooperation to form the pleats O in the blank X and to shape the blank into a cup.

The means 15 for effecting relative movement between the dies C and D operates to move these dies along the axis of movement of the blank X and in the form of the invention illustrated the dies C and D are both movable, that is, they are moved toward and away from one another. The mechanism for operating or shifting the die C includes the cross head 149, the links 151, the levers 153 and the cams 156 and 157, all described above. The cams 156 have outwardly extending shoulders 201 extending from the trailing ends of the surface portions 174 and the cams 157 have inwardly extending surfaces 202 at the trailing ends of the surface portions 175. As described above, the surface portions 174 and 175 operate to move the die C downwardly and hold it in position during the flute forming operation of the dies A and B. The shoulders 201 and 202 cooperate with the rollers 155 to move the die C downwardly at the termination of the upward movement of the die B. This downward movement of the die C results in downward movement of the cup blank X, that is, the face 141 of the die C pushes the blank X downwardly from between the dies A and B after or during the slight retraction of the die B by the action of the cam faces 190 and 191. During this downward movement of the cup blank X the sides of the flutes M are engaged by the edges of the scoring plates 39 and 48 and these edges bend the sides of the flutes laterally to start the formation or the folding of the pleats in the cup blank. The cam shoulders 201 and 202 are of sufficient extent to effect the downward withdrawal of the blank

X from between the dies A and B and to move the blank to a position clear of the dies A and B for gripping between the dies C and D. The cams 156 and 157 have substantially cylindrical surface portions 300 and 301 trailing their respective shoulders 201 and 202 to hold the die C down during subsequent operations.

The means 15 comprises a mechanism for moving the die D upwardly during the preceding operations of the machine and during the downward movement of the blank X from between the dies A and B so that the blank X is pressed or formed between the upwardly moving die D and the die C which is moving downwardly as just described. The means for moving the die D comprises a lever 203 pivoted on the shaft 81, as illustrated in Fig. 2. The lever 203 is preferably forked or double. The outer end of the lever 203 receives the lower portion of the boss 198^a and engages upwardly against a thimble 204 on the boss. A transverse pin 205 is provided on the lever 203 and carries a roller 206. The means 15 further includes a cam 207 fixed on the shaft 114 to cooperate with the roller 206. The cam 207 has a surface portion 208 having a relatively small radius of curvature and a major surface portion 209 curving outwardly and circumferentially from the portion 208. The surface portion 209 cooperates with the roller 206 before and during the flute forming operation and continues to cooperate with the roller 206 to move the die D upwardly following the flute forming operation. The parts are related and synchronized so that the plunger 124 is received in the lower portion 196^a of the socket 196 and the cup blank X is tightly pressed between the surface 193 and the wall of the socket 196 immediately following the downward withdrawal of the blank X from between the dies A and B. The cam surface portion 209 is of substantial length and its trailing end is joined by a concentric surface portion 210 which cooperates with the roller 206 when the die D reaches its final up position to retain the die D in this position throughout the bead forming operation, as will be subsequently described.

When the dies C and D move together into a telescopic relation, as just described, the flutes M are pressed or collapsed so that their sides buckle or bend along the lines N. The sides of the flutes M are tightly pressed against the internal and external surfaces of the outer and inner portions, respectively, of the pleats O to give the blank X the shape or form illustrated in Figs. 31 and 32 of the drawings. This lapping or folding of the flutes M into the form of the pleats O materially reduces the diameter of the wall of the blank X and materially increases the inclination of the cup wall of the blank. The collapsed flutes M comprising the pleats O involve the portions which are lapped one against the other and, therefore, lend considerable rigidity to the wall of the blank or cup. During the formation of the pleats O, as described above, the shoulder 195 of the die C and the upper end 198 of the die D cooperate to shape or form an annular substantially horizontal shoulder P on the cup blank X at the upper end of its pleated, inclined wall. The upper portion of the blank X extending upwardly beyond the shoulder P and beyond the upper end of the die D is received between the telescopically related surfaces 194 and 220 to assume a cylindrical shape preparatory to being shaped or formed into the bead Z, as will be subsequently described.

The dies E and F are the bead forming dies being provided to roll or curl the bead Z on the upper end of the cup Y after it has been shaped from the blank X by the dies A, B, C, and D. The die E is a tubular element telescopically related to the dies A and C. The die E surrounds the upper portion of the die C having a cylindrical socket 211 slidably receiving the cylindrical upper portion of the die C. The die E is shiftable with respect to the die C and its movement relative to the die C is limited, whereby it moves with the die C during certain phases of operation of the machine. An internal flange 212 is provided on the die E to cooperate with the lower side of the cross head 142 to limit the upward movement of the die E relative to the die C. The flange 212 is adapted to engage against an upwardly projecting rim 213 on the die C to limit the downward movement of the die E on the die C. A spring 214 is interposed under compression between the flange 212 and the upper end of the die C to yieldingly resist movement of the die E relative to the die C, normally holding the die E in a position where the flange 212 bears upwardly against the cross head 142.

The lower end of the die E is shaped to assist in curling and rolling the bead Z on the cup or the cup blank. An annular downwardly facing groove 215 is provided in the lower end of the die E. The groove 215 is partially cylindrical in transverse cross section and its cylindrically curved wall joins the wall of the socket 211 at the lower end of the die E. The groove 215 has a substantially vertical wall 216 at its outer side and the wall 216 is tangent to the main cylindrical wall of the socket. The lower surface 217 of the die E extends outwardly from the lower end of the wall 16 to the exterior of the die E. The surface 217 is inclined upwardly and outwardly and is preferably flat.

The die F is the lower bead forming die and is telescopically associated with the die D. The die F is a tubular or socketed member shiftable surrounding the die D. In accordance with the invention the die F is guided for movement along the common axis of the dies A, B, C, D and E by the posts 23. As shown in Fig. 3 webs 218 project from opposite sides of the die F and carry tubular bosses 219 of substantial length which slidably surround and bear on the posts 23 to guide the die F for vertical movement. The die F has a central vertical opening 220 entering it from its upper end. The opening 220 is cylindrical and its wall slidably cooperates with the cylindrical surface 197 of the die D. An internal downwardly facing shoulder 221 is provided on the wall of the opening 220 and is adapted to cooperate with the flange 199 of the die D to limit the downward movement of the die E on the die D. A tubular nut 222 is threaded in the lower end of the die F and slides on the thimble 204. A spring 223 is arranged under compression between the flange 199 and the nut 222 to yieldingly resist movement of the die F relative to the die D. The spring 223 normally holds the die F in a position where its shoulder 221 engages the flange 199. The die F is caused to move with the die D by the means 16^a and its upper end normally or initially is spaced below the upper end of the die D, as illustrated in Fig. 2 of the drawings.

The upper end of the die F is shaped to cooperate with the lower end of the die E in the rolling or forming of the bead Z. An upwardly facing annular groove 224 is provided in the upper end

of the die F to directly oppose the groove 215 of the die E when the ends of the dies are brought together. The groove 224 is partially cylindrical in transverse cross section, its cylindrically curved wall having substantially the same radius of curvature as the wall of the groove 215. The wall of the groove 224 curves upwardly and inwardly to approach the internal surface 220 of the die F so that an annular lip 225 is provided at the upper inner corner of the die F. The inner surface of the lip 225 is inclined or curved upwardly and outwardly and serves to smooth or iron out the flutes in the upper portion of the cup blank X or the cup Y when the die F moves upwardly with respect to the dies C and D, as will be subsequently described. The upper end of the bead forming die F has a major upwardly and outwardly inclined face 226 extending outwardly from the groove 224 to the periphery of the die. The face 226 is tangent to the wall of the groove 224 and has the same inclination as the face 217 of the die E to evenly engage against the same. When the faces 217 and 226 of the dies E and F are in cooperation the upper edge of the lip 225 is spaced some distance below the lower inner corner of the die E to allow the wall of the cup blank X or the cup Y to be received in the annular substantially cylindrical opening defined by the two opposing grooves 215 and 224.

The means 16 is provided to move the bead forming die E downwardly with respect to the die C while the die F is moving downwardly under the action of the means 16^a so that the two downwardly moving dies operate to curl or roll the upper portion of the cup blank X into an annular bead Z. The spring 214 causes the die E to move downwardly with the die C during the downward movement of the die C when the flutes M are formed and the cup Y is shaped so that the die E is in the position illustrated in Fig. 12 of the drawings when the pleats O are formed and remains in this position until it is moved downwardly relative to the die C by the means 16. The means 16 includes spaced lugs 227 on the upper end of the die E supporting a pivoted lever 228. A pin 229 may pivotally mount the lever 228 between the lugs 227. A pair of links 230 is pivotally connected with the lever 228 at a point between its ends by a pivot pin 231. The lower ends of the links 230 are pivotally connected with the cross head 142 by a pivot pin 232. The pin 231 connecting the levers 228 and the links 230 forms a fulcrum for the lever 228 whereby the lever may be pivoted to move the die E. A finger 233 is provided on the outer end of the lever 228.

The die operating means 16 further includes a cam 234 fixed on the cam shaft 114, as best illustrated in Fig. 11. The cam 234 has a single cam projection 235, its periphery being cylindrical except for the single projection 235. A forked or double lever 236 is pivoted on the shaft 81 and carries a rotatable roller 237 which cooperates with the cam 234. A push rod 238 is operated by the lever 236. A pin 239 pivotally connects the lower end of the rod 238 with the outer end of the lever 236. The rod 238 projects upwardly from the lever 236 and passes through an opening 240 in the head 31 of the die A. The opening 240 serves to guide the rod 238 for vertical movement. The upper end of the rod 238 is adapted to cooperate with the finger 233 to pivot the lever 228 and thus move the die E downwardly with respect to the die C when the cam projection 235 cooperates with the roller 237 to lift the lever 236. The upper end of the push rod 238 is normally

spaced a substantial distance below the finger 233 and the rod does not lift the lever 228 until the die F is moved upwardly by the means 16^a which is about to be described.

The means 16^a operates to shift the die F vertically or along the common axis of the several dies A, B, C, D and E, serving to move the die F together with the die D before and after the flute forming operations and the pleat forming operations, and to move the die F upwardly with respect to the die E following these operations so that the dies E and F roll or form the bead Z on the blank or cup Y. The means 16^a, which is best illustrated in Fig. 9, is in the nature of a cam means and includes two double levers 241 pivoted on the shaft 81 at longitudinally spaced points. Each lever 241 carries a rotatable roller 242. The levers 241 are operatively connected with the die F. Links 243 are pivotally connected with the levers 241 and the die F. Pins 244 may pivotally connect the links 243 with the outer ends of the levers 241 and pins 245 may pivotally secure the upper ends of the links 243 between lugs 246 on the webs 218 of the die F.

Pairs or sets of cams 247 and 248 are provided to cooperate with the rollers 242 to pivot the levers 241 and thus shift the die F operated by the levers. The cams 247 are fixed on the shaft 67 and the cams 248 are fixed on the shaft 114. The cams 247 have rather extensive cylindrical surface portions 249 that are initially in cooperation with the rollers 242 and the cams 248 have cylindrical surface portions 250 of relatively small radius of curvature initially cooperating with the rollers. Surface portions 251 extend from the trailing ends of the surface portions 249 and surface portions 252 extend from the trailing ends of the surface portions 250 to cooperate with the rollers 242 to effect a slow or gradual upward shifting of the levers 241 and the die F. The surfaces 251 and 252 operate to move the die F upwardly as the die D is moving upwardly to form the pleats O in the blank X so that the die F remains in its original relation to the die D. Cylindrical surface portions 253 extend from the trailing ends of the surface portions 251 and the cylindrical surface portions 254 extend from the trailing ends of the surface portions 252 to cooperate with the rollers 242 to retain the die F in its initial relation to the die D during the pleat forming operation. Surface portions 255 extend from the surface portions 253 and surface portions 256 extend from the trailing ends of the surface portions 254 of the cams 247 and 248, respectively, and are adapted to cooperate with the rollers 242 to effect a rapid downward movement of the die F. This downward movement of the die F takes place simultaneously with the downward movement of the die E by the cooperation of the cam projection 235 with the roller 237.

The simultaneous downward movement of the dies E and F by the cam mechanisms rolls or forms the bead Z into the annular opening formed by the communicating grooves 215 and 224 in the abutting ends of the dies. During the downward movement of the dies E and F the shoulder 195 and the upper end 198 of the die D remain in gripping cooperation with the shoulder P of the blank or cup Y. As will be apparent from an inspection of Fig. 12 of the drawings the downward movement of the dies E and F with respect to the dies C and D brings the grooves 215 and 224 to a position where the upper edge of the blank or cup Y is receivable in the grooves. The lip 225 passes the upper edge of the cup Y and

the curved wall of the groove 215 then moves downwardly against the edge of the cup to bend or curl the same outwardly, as illustrated in Fig. 13. The inner surface of the lip 225 is inclined or shaped to iron out the grooves or flutes that may remain in the upper portion of the blank or cup Y that has been received between the cylindrical interior of the die F and the cylindrical external portion 194 of the die C. The continued downward movement of the dies E and F causes the upper portion of the blank or cup Y to curve about on the walls of the grooves 215 and 224 and spirally curl into the form of a rigid permanent bead. Downward movement of the bead forming dies E and F continues until the grooves 215 and 224 are adjacent the shoulder P thereby rolling the bead Z downwardly to adjacent the shoulder, as illustrated in Fig. 25.

Following the formation of the bead Z on the cup Y the dies E and F separate or move apart. The cam projection 235 passes the roller 237 and the spring 213 operates to move the die E upwardly with respect to the die C to assume its normal position on the die C. The surface portions 255 of the cams 247 and the surface portions 256 of the cams 248 continues to cooperate with the rollers 242 to move the die F downwardly until it assumes its normal or original down position. A shoulder 258 is provided on the cam 207 at the trailing edge of the surface portion 210 and this shoulder 258 passes the roller 202 to allow the die D to be moved downwardly together with the die F when the latter is moved by the cam surface portions 255 and 256, as just described. This operation returns or restores the dies D and F to their initial positions. The spring 139 holds the plunger 124 upwardly and urges it against the bottom of the cup Y to hold the cup on the die C during the downward movement or restoration of the dies D and F.

The ejecting means 17 operates to engage the finished cup Y before and during the upward movement or restoration of the die C to prevent upward movement of the cup with the die C, thereby disengaging the cup from the die C. The ejecting means 17 also operates to move the finished cup Y from the common axis of the dies A, B, C, D, E and F to a discharge position. In the preferred construction the ejecting means includes a forked lever 260 pivoted on a pin 261 carried by a side 18 of the housing and a bracket 262 on the bottom 22 of the housing, as illustrated in Figs. 1 and 6. The lever 260 projects upwardly in the housing 10 and its upper portion engages or cooperates with an ejector 263. The ejector 263 is carried by the die B. A pin 264 projects downwardly from the flange 41 of the die B and the ejector 263 has a bearing part 265 pivotally supported on the pin 264 whereby the ejector is turnable about an axis parallel with the axis of the die B. The ejector includes an arm 266 having a substantially semi-circular cup engaging part 267 on its outer end. The part 267 is shaped to cooperate with the bead Z of the finished cup Y and the adjacent portion of the cup. A groove 268 is provided in the inner side of the part 267 to receive the bead Z and the inner surface of the part 267 is adapted to engage the cup Y below the bead Z. The ejector 263 is operatively connected with the lever 260. In the construction illustrated the lever 260 has a relatively long finger 270 on its upper end received in an opening 271 in the ejector 263 whereby the lever is operable to swing the ejector on the pin

264. The opening 271 slidably receives the finger 270 to permit movement of the ejector 263 with the die B.

The ejecting means 17 includes a cam mechanism for operating or controlling the ejector 263. A cam 272 is fixed on the shaft 114 to cooperate with a roller 273 rotatably supported by a pin 274 on the lever 260. The major surface portion 275 of the cam 272 is cylindrical or concentric. The surface portion 275 cooperates with the roller 273 to hold the ejector 263 in its retracted position during the feeding operations, the flute forming operation, the pleat forming operation, the bead forming operation, and during restoration of the dies D, E and F. The cam 272 has a surface portion 276 for cooperating with the roller 273 to allow movement of the ejector 263 before restoration of the die C which movement brings the part 268 into cooperation with the bead Z of the cup Y. A notch 277 extends from the trailing end of the surface portion 276 and is adapted to receive the roller 273 to allow the ejector 263 to move the finished cup to a discharge position after the cup Y is freed from the die C. Spring means may be provided for operating or shifting the ejector 263 under the control of the cam 272. In the construction illustrated in the drawings the spring 86 has one end secured to the lever 260 and the spring is operable to urge the roller 273 against the cam 272 and to swing the ejector 263 under the control of the cam.

When the surface portion 276 of the cam 272 cooperates with the roller 273 the spring 86 swings the ejector 263 to bring its part 267 into cooperation with the cup Y, so that its bead Z is received in the grooves 268. The part 267 cooperates with the bead Z during the upward movement of the die C and holds the cup Y against upward movement with the die C thus freeing the cup from the die. The notch 277 then starts to pass the roller 273 and allows the spring 86 to swing the ejector 263 to its discharging position. A chute or tube 278 may be provided in the housing 10 adjacent the back 20 and one side 18 and its upper end is open to receive the finished cup Y from the ejector 263.

When the ejector 263 reaches the position where the cup Y is directly above the upper end of the tube 278 the die B moves downwardly to its original position, thereby moving the lower portion of the cup into the chute 278. The cams 184 and 185 have surface portions 279 and 280, respectively, that cooperate with the rollers 183 to hold the die B in a raised position during the pleating and bead forming operations. The cams 184 have surface portions 281 connecting the trailing ends of the portions 279 with the advancing ends of the portions 186. The cams 185 have surface portions 282 connecting the trailing ends of the surface portions 280 with the advancing ends of the portions 187. The surface portions 281 and 282 of the cams 184 and 185 cooperate with the rollers 183 to move the die B downwardly immediately following the stopping of the ejector 263 in the position where the cup is directly above the discharge tube 278 and the downward movement of the die B brings the lower portion of the cup into the open mouth of the tube. At this time the trailing wall of the notch 277 of the cam 272 cooperates with the roller 273 to return the lever 260 and the ejector 263 to their original positions. This swings the ejector part 267 out of engagement with the cup Y allowing

the cup to fall through the tube 278. The tube 278 may extend to the exterior of the housing 10 where the cups discharged therethrough are receivable or accessible.

5 The operation of the machine and the method of the invention as practiced with the machine will now be described. The operations of the several parts of the machine have been described in considerable detail in conjunction with 10 the descriptions of the respective parts and mechanisms. Accordingly, it is believed that a full understanding of the operation of the machine and the method of the invention will be completed by the following description of the 15 general steps or operations in the forming or making of a cup Y. Figs. 21 to 27, inclusive, illustrate diagrammatically several of the general or important steps of the operation of the machine and the method.

20 As illustrated in Fig. 20 the rollers 55 and 56 operate to feed a cup blank X into the machine. The roller 55 is operated by the intermittent movement mechanism best illustrated in Figs. 14 25 and 15 of the drawings, and is rotated at intervals to effect the successive inward feeding of the cup blanks. The roller 56 is maintained in proper cooperation with the blank X by the cooperation of the pin 83 with the yoke 80. Following 30 the inward feeding of the cup blank X the locating elements 108 centralize the end blank X and the second to the end blank X. The roller 56 is released from the second to the end blank X when the elements 108 cooperate with the edge 35 portions of the two blanks. The cam projection 91 cooperating with the projection 89 swings the lever 82 which in turn swings the crank 80 through the medium of the pin 83 to release the roller 56. The roller 56 is moved into cooperation 40 with the blank X, engaging the under side of the roller 55, by the spring 86 when the projection 91 passes the projection 89. At this time the plunger 124 and the die C simultaneously move together so that the inner blank X is 45 gripped between the plunger and the face 141 of the die C. Fig. 22 of the drawings illustrates the plunger 124 and the face 141 gripping the central portion of the blank X and illustrates the roller 56 released from the second to the end-most blank X as described above. The cam projection 172 then cooperates with the roller 170 to 50 actuate the cutting blade 161 which cuts the end blank free from the ribbon or strip of cup blanks. The die C and the plunger 124 then move down 55 together a short distance bringing the freed blank X into a position for the first shaping or fluting operation.

60 Following the lowering of the cup blank X the surface portions 188 and 189 of the cams 184 and 185, respectively, cooperate with the rollers 183 to move the die B upwardly into cooperation with the die A so that the dies A and B form the flutes M in the cup blank X. Fig. 23 65 of the drawings diagrammatically illustrates the dies A and B in cooperation with the blank X to form the flutes M. The action of the dies A and B in forming the flutes M has been fully described above. Figs. 29 and 30 illustrate the 70 cup blank X as shaped by the dies A and B. Immediately following the co-action of the dies A and B the die B may be moved down a short distance by the action of the surface portions 190 and 191 of the cams 184 and 185, respectively, 75 cooperating with the roller 183. This downward

movement of the die B frees the blank X for withdrawal from between the dies A and B.

Simultaneously with or immediately following the downward movement of the die B relative to the die A the die C and the plunger 124 move 5 downwardly relative to the dies A and B. The surface portions 201 and 202 of the cams 186 and 187, respectively, cooperate with the rollers 155 to effect the downward movement of the die C 10 and the lower face 141 of the die C presses downwardly against the plunger 124 through the medium of the blank X to move the spring held plunger downwardly. This downward movement 15 of the die C and the plunger 124 relative to the dies A and B draws the blank X down from between the dies A and B and completes the lines N of the flutes M and folds or partially folds the sides of the flutes M inwardly. The die C 20 continues to move downwardly through the action of the cam surface portions 201 and 202 on the rollers 155 and at this time the die D is moving upwardly, the die D being moved upwardly by the co-action of the cam surface portions 209 25 of the cams 207 with the rollers 206. This relative movement between the dies C and D brings the dies together and in cooperation with the blank X to form or fold the flutes M into the pleats O and to give the cup Y its final general 30 cup form. Fig. 24 diagrammatically illustrates the dies C and D cooperating with the cup blank X to form the pleats O and Fig. 31 illustrates the cup Y as shaped by the dies C and D. When the dies C and D come into cooperation with the cup blank X the upper end 198 of the die D and the 35 shoulder 195 of the die C forms the shoulder P on the cup blank or cup Y.

The bead forming dies E and F are moved with the dies C and D respectively, during the above described pleat forming operation. Immediately 40 following the stopping of the dies C and D in their pleat forming positions the die F is moved upwardly relative to the die D by the cam surface portions 251 and 252 of the cams 247 and 248, 45 respectively, cooperating with the rollers 242. This upward movement of the die F relative to the die D partially irons out the upper portion of the cup blank or cup Y making the upper wall 50 portion of the cup substantially cylindrical and brings the end face 226 of the die D into cooperation with the end face 217 of the die E. Figs. 55 12 and 24 of the drawings illustrate the dies E and F in the positions where their end faces are in engagement preparatory to the bead forming operation. The dies E and F are then moved 60 downwardly relative to the dies C and D to form and roll the bead Z on the cup Y. The cam projection 235 cooperates with the roller 237 to move the die E downwardly. The cam surface 65 portions 255 and 256 of the cams 247 and 248, respectively, cooperate with the rollers 242 to effect the downward shifting of the die F. The manner in which the dies E and F form or roll the bead Z on the cup Y has been fully described 70 above. Fig. 13 illustrates the dies E and F forming the bead Z.

Upon the completion of the bead Z the dies E and F separate. The die E is restored to its original position relative to the die C by the spring 214 when the cam projection 235 passes 75 the roller 237. The die F continues to move downwardly by the action of the cams 247 and 248 cooperating with the rollers 242. The die D at this time moves downwardly with the die F under the action of the surface portions 258 of the cam 207 which cooperates with the roller 206. 76

During these movements of the dies E, F and D the plunger 124 is urged upwardly against the bottom of the cup Y holding it upwardly against the lower face 141 of the die C. The ejector 5 263 is then swung to the position where its part 267 cooperates with the bead Z of the completed cup Y. The cam surface 276 cooperates with the roller 273 to move the ejector to this position. Fig. 26 of the drawings shows the ejector 10 part 267 in cooperation with the bead Z. Following the engagement of the ejector part 267 with the bead Z the die C is moved upwardly by the cooperation of the surface portions 290 and 291, respectively, of the cams 156 and 157 15 with the rollers 155. During this upward movement of the die C the surface portion 134 of the cam 133 cooperates with the roller 132 to hold the plunger 124 against upward movement with the die C. The upward movement of the 20 die C releases the die from the cup Y held by the ejector part 267 engaging its bead Z. The cam notch 277 then cooperates with the roller 273 to swing the ejector 263 to a position where the unfinished cup Y is directly over the discharge tube 278. Fig. 27 of the drawings illustrates the ejector in this position. The die B is then restored to its down or initial position and this downward movement of the die B moves the lower portion of the finished cup Y into the 30 tube 278. The surface portions 281 and 282 of the cams 184 and 185, respectively, cooperate with the rollers 183 to move the die B downwardly. The trailing wall of the notch 277 then cooperates with the roller 273 to swing the ejector 263 out of cooperation with the finished cup. This allows the finished cup to drop through the tube 278. The ejector 263 returns to its normal position relative to the die B before the die B reaches its full down position, as best illustrated in Fig. 2 of the drawings.

From the above it will be seen that the method provided by the present invention includes, generally, the provision of a cup blank X, feeding of the blank X between the initial shaping and 45 flute forming dies A and B, the locating of the blank X between the dies A and B, the gripping of the cup blank X for movement along a single axis, moving the dies A and B with respect to one another along said axis to cooperate with the blank X to shape the same and form the flutes M therein, the drawing of the blank X from between the dies A and B by moving the same along the said axis, moving two cup shaping and pleat completing dies C and D relative 55 to one another along said axis to cooperate with the fluted blank X to form the flutes M into the pleats O and to give the blank its final cup shape, the moving of the dies E and F along the said axis with respect to one another to iron out the edge portion of the cup blank X, the moving of the dies E and F in the same direction along said axis to roll the bead Z on the cup Y formed as above, and the ejection of the finished cup Y by moving it laterally from said axis.

It is to be particularly noted that the cup forming machine and the method provided by the invention produce or form a cup by translating the cup blank along a single axis without rotation of the blank. The several dies for producing or shaping the cup are in telescopic relation and are co-axial with the axis of movement of the cup blank, conserving space and materially simplifying the mechanism or mechanisms for operating the dies. The cup blank is securely 75 gripped at all times during the forming opera-

tions and cannot possibly slip or shift to become distorted by the dies. The bead Z is formed on the blank or cup Y while the same is held between dies C and D and while the shoulder P is securely gripped between the upper end 198 5 of the die D and the shoulder 195 of the die C, so that the wall or body of the cup is not distorted during the forming of the bead. The several parts and mechanisms of the machine are synchronized so that the machine may be operated to produce the paper cups at a high rate 10 of speed.

The cups Y produced by the machine of the invention are strong and self-sustaining. The bead Z of a cup Y prevents the opening or unfolding of the folds or pleats O and reinforces the upper edge of the cup. The folds or pleats O greatly strengthen the side wall of the cup. The bottom of the cup Y is flat and of sufficient diameter to properly support the cup in 20 an upright position when it contains a liquid. It is to be particularly noted that the machine of the invention is very compact. The several dies A, B, C, D and F are all concentric with a single axis and are in telescopic relation, conserving space. The various cams for operating the dies are fixed to two adjacent shafts 67 and 114 and the levers operated by the cams are pivoted on the single shaft 81. Accordingly, the mechanisms for operating the various dies of the 30 machine occupy a minimum of space. The dies A, B, C, D and F are each operated by two spaced levers or rods which in turn are operated by separate cams, this arrangement assuring the smooth proper movement of the dies. The boss 125 and the opening 192 form a central strengthening shoulder 303 on the bottom of the cup Y to increase the strength of the cup.

Having described only a typical preferred form of apparatus of my invention and a typical manner of carrying out the method of my invention, I do not wish to be limited or restricted to the specific details herein set forth, but wish to reserve to myself any variations or modifications that may appear to those skilled in the art or fall within the scope of the following claims:

Having described my invention, I claim:

1. The method of making a cup comprising, providing a substantially flat blank of flexible material, translating the blank along an axis, 50 shaping and folding the blank into a pleated cup during the course of such translation, supporting the upper wall portion of the cup against downward and inward collapse while the cup is on said axis, and rolling a bead on the upper edge 55 of the cup while so supported.

2. The method of forming a rim bead on a cup of flexible material comprising confining the side wall of the cup against lateral inward and outward distortion, and rolling the upper edge 60 portion of the cup into a bead while said wall is confined by entering the upper edge of the wall between two dies and then simultaneously moving the dies longitudinally of said wall in the same direction to cause the reception and the 65 shaping of the said edge portion between the dies.

3. The method of forming a rim bead on a cup of flexible material comprising confining the side wall of the cup against lateral inward and outward distortion and against longitudinal displacement, and forming the upper edge portion of said wall into a bead while the wall is so confined by simultaneously moving two abutting dies along said wall, the dies defining a space that receives and shapes the said upper edge portion. 70

4. The method of making a cup comprising, providing a blank of flexible material, translating the blank along an axis, shaping and folding the blank into a folded cup during the course of such translation, confining the wall of the cup against distortion and longitudinal displacement, and rolling a rim bead on said wall while so confined by entering the upper edge of the wall between two dies and then simultaneously moving the dies longitudinally of said wall in the same direction to cause the reception and the shaping of the said edge portion between the dies.

5. The method of forming a rim bead on a cup of flexible material comprising confining the side wall of the cup against lateral inward and outward distortion and against longitudinal displacement, and forming the upper edge portion of said wall into a bead while the wall is so confined by rolling the said portion down upon the outer side of the wall from the upper edge of the wall by simultaneously moving two abutting dies along said wall, the dies defining a space that receives and shapes the said upper edge portion.

6. The method of making a cup comprising, providing a thin disc of flexible material, translating the disc along an axis, shaping and folding the disc into a folded cup having a transverse shoulder on its side wall during the course of such translation, confining the side wall of the cup against distortion, engaging said shoulder to prevent longitudinal displacement of the cup, and rolling the upper edge portion of the cup wall into a bead while the wall is confined and the said shoulder is engaged by simultaneously moving two abutting dies along said wall, the dies defining a space that receives and shapes the said upper edge portion.

7. In a cup making machine, two initially spaced dies, means for introducing a flexible disc between the dies, means gripping the disc for translation along an axis, means for effecting relative movement between said dies along said axis whereby the dies grip the disc to form flutes in the disc while the disc is stationary, two cup shaping dies, means for shifting the disc along said axis while held by the gripping means to draw it from between the first mentioned dies, and means for effecting relative movement between the last mentioned dies along said axis whereby they convert the flutes into folds and shape the disc into a cup.

8. In a cup making machine for handling a flexible cup blank, the combination of, means for holding the central portion of the blank for the translation of the blank along an axis, means acting on the blank to form it into a folded cup, the last named means including relatively shiftable pairs of relatively movable dies substantially concentric with said axis, and means intermittently translating the blank along said axis during its formation into a cup.

9. In a cup making machine for handling a flexible cup blank, the combination of, means for holding the central portion of the blank for the translation of the blank along a single axis, means acting on the blank to form it into a folded cup, means forming a bead on the rim of the cup, the two last mentioned means comprising telescopically related relatively shiftable sets of dies coaxial with the said single axis, and means translating the blank and cup along said axis during the cup forming and bead forming operations.

10. In a cup forming machine for handling a flexible cup blank, the combination of, two

grooved dies initially spaced apart, means for introducing a cup blank between the dies, means in coaxial telescopic relation to the dies for holding the central portion of the blank, and means for effecting relative movement between the dies to bring them into cooperation with the blank to give the same a generally frusto-conical fluted shape while its central portion is held stationary by the second mentioned means.

11. In a cup forming machine for handling a flexible cup blank, the combination of, two dies initially spaced apart and adapted to be received one in the other, the dies including ribs separated by grooves, the ribs of one die being receivable in the grooves of the other die, parts overhanging the opposite longitudinal sides of the ribs, means for introducing a cup blank between the dies, means for effecting relative movement between the dies to bring them into pressing cooperation with the blank to make the blank frusto-conical and to form flutes in the blank, and means for drawing the blank from between said dies whereby said overhanging parts bend in the sides of the flutes.

12. In a cup forming machine for handling a flexible cup blank the combination of, two dies initially spaced apart and adapted to be received one in the other, the dies including ribs separated by grooves, the ribs of one die being receivable in the grooves of the other die, parts overhanging the opposite longitudinal sides of the ribs, means for introducing a cup blank between the dies, means for effecting relative movement between the dies to bring them into pressing cooperation with the blank to make the blank frusto-conical and to form flutes in the blank, spring fingers on one die for initially bending portions of the blank into the grooves of the other die upon said relative movement between the dies, and means for drawing the blank from between said dies whereby said overhanging parts bend in the sides of the flutes.

13. In a cup forming machine for handling a flexible cup blank, the combination of, two grooved dies initially spaced apart, means for introducing a cup blank between the dies, means for holding the central portion of the blank, means for effecting relative movement between the dies to bring the dies into pressing cooperation with the blank to give the blank a fluted frusto-conical shape, a pair of male and female cup shaped dies, the first mentioned dies and the male and female dies being in coaxial relation, means for moving the blank along the common axis of the dies from between the first named dies into the female die, and means for effecting relative movement between the male and female dies along said common axis whereby they cooperate with the blank to convert its flutes into folds.

14. In a cup forming machine for handling a flexible cup blank, the combination of, two grooved dies initially spaced apart, means for introducing a cup blank between the dies, means for holding the central portion of the blank, means for effecting relative movement between the dies to give the blank a fluted frusto-conical shape, a pair of male and female cup shaped dies, means for drawing the blank from between the first named dies into the female die, and means for effecting relative movement between the male and female dies whereby they cooperate with the blank to convert its flutes into folds, the first mentioned dies and the second mentioned dies being coaxial and in telescopic relation.

15. In a cup forming machine for handling a

flexible cup blank, the combination of, two grooved dies initially spaced apart, means for introducing a cup blank between the dies, means for holding the central portion of the blank, means for effecting relative movement between the dies to give the blank a fluted frusto-conical shape, a pair of male and female cup shaped dies, means for drawing the blank from between the first named dies into the female die, means for effecting relative movement between the male and female dies whereby they cooperate with the blank to convert its flutes into folds, and a pair of dies surrounding and shiftable on the second mentioned dies to roll a bead on the edge of the blank while the blank is held between the second mentioned dies, the first and second mentioned dies being coaxial and in telescopic relation.

16. In a cup forming machine for handling a flexible cup blank, the combination of, two grooved dies initially spaced apart, means for introducing a cup blank between the dies, means for holding the central portion of the blank, means for effecting relative movement between the dies to give the blank a fluted frusto-conical shape, a pair of male and female cup shaped dies, means for drawing the blank from between the first named dies into the female die, means for effecting relative movement between the male and female dies whereby they cooperate with the blank to convert its flutes into folds, means for forming a bead on the edge of the folded blank, and an ejector carried by one of the first mentioned dies cooperable with the bead.

17. In a cup forming machine for handling a flexible cup blank, the combination of, two grooved dies initially spaced apart, means for introducing a cup blank between the dies, means for holding the central portion of the blank, means for effecting relative movement between the dies to give the blank a fluted frusto-conical shape, a pair of male and female cup shaped dies, means for drawing the blank from between the first named dies into the female die, means for effecting relative movement between the male and female dies whereby they cooperate with the blank to convert its flutes into folds, means for forming a bead on the edge of the folded blank, means for moving the said second mentioned dies apart, and cup ejecting means comprising an element on one of the first mentioned dies for engaging the bead when the said second mentioned dies separate.

18. In a cup forming machine for handling a flexible cup blank, the combination of, two grooved dies initially spaced apart, means for introducing a cup blank between the dies, means for holding the central portion of the blank, means for effecting relative movement between the dies to give the blank a fluted frusto-conical shape, a pair of male and female cup shaped dies, means for drawing the blank from between the first named dies into the female die, means for effecting relative movement between the male and female dies whereby they cooperate with the blank to convert its flutes into folds, means for forming a bead on the edge of the folded blank, means for moving the said second mentioned dies apart, and cup ejecting means comprising an element on one of the first mentioned dies for engaging the bead when the said second mentioned dies separate, and means for moving the said element to eject the cup.

19. The method of making a cup comprising gripping the central portion of a cup blank to hold the blank, moving dies one toward the other to form flutes in the blank while the same is so held, moving said dies apart, translating the blank from said dies along a given axis, moving second dies one toward the other along said axis to convert the flutes into pleats and to shape the blank into a cup, holding the cup between said second dies, and moving third dies along said axis to roll a bead on the upper edge of the cup while the cup is held and confined by said second dies.

20. The method of making a cup comprising gripping the central portion of a cup blank to hold the blank, moving dies one toward the other to form flutes in the blank while the same is so held, moving said dies apart, translating the blank from said dies along a given axis, moving second dies one toward the other along said axis to convert the flutes into pleats and to shape the blank into a cup during said translation of the blank, holding the cup between said second dies, and moving third dies along said axis in surrounding relation to the said second dies to form a bead on the lip of the cup while the cup is confined and held by the said second dies.

21. The method of making a cup comprising holding a cup blank on a given axis, moving first dies one toward the other along said axis to form flutes in the blank and to partially shape the blank while the same is being held, translating the blank from the first dies along said axis, moving second dies one toward the other along said axis to convert the flutes into plates and to shape the blank into cup form, holding and confining the cup between the second dies with its edge portion exposed, and moving third dies in telescopic relation to the second dies while the blank is held by the second dies to roll said edge portion into a bead.

22. The method of making a cup comprising holding a cup blank against movement, moving first dies one toward the other to form flutes in the blank and to give the blank its initial cup shape, translating the blank along a given axis to draw the blank from the first dies, moving second dies along said axis and one toward the other to press the flutes into folds and to shape the blank into cup form while the cup blank is translated, stopping said second dies to hold the cup against movement and in a confined condition with its edge portion exposed, and acting on said edge portion to form a bead on the cup while the cup is held by the stopped second dies.

23. The method of making a cup comprising holding a cup blank against movement, moving first dies one toward the other to form flutes in the blank and to give the blank its initial cup shape, translating the blank along a given axis to draw the blank from the first dies, moving second dies along said axis and one toward the other to press the flutes into folds and to shape the blank into cup form while the cup blank is translated, stopping said second dies to hold the cup against movement and in a confined condition with its edge portion exposed, and moving third dies into engagement to receive the edge of the cup, and then moving said third dies along said axis and in the same direction to roll said edge portion into a bead.

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