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A. SCHMIDT ET AL
APPARATUS FOR AND METHOD OF SCORING
AND SEVERING TUBED BOX BLANKS

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3 Sheets-Sheet 1

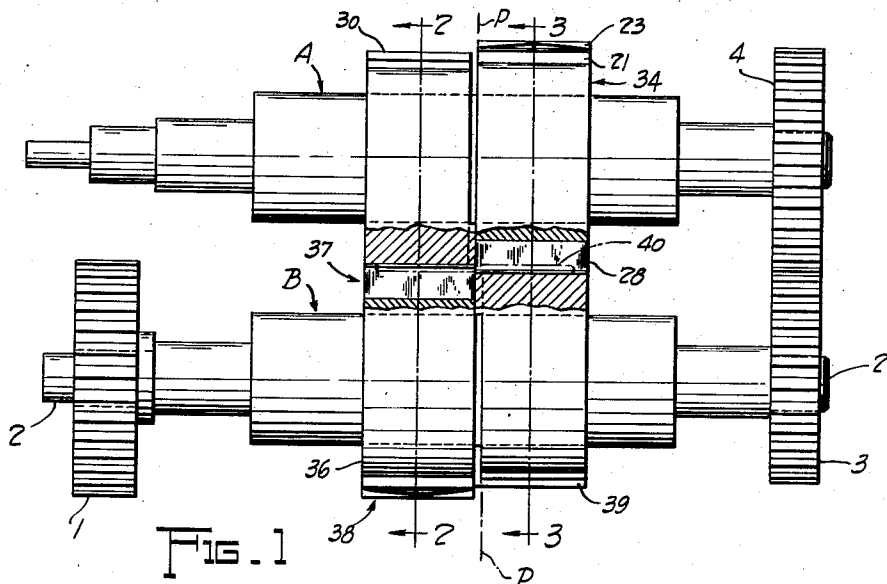


FIG. 1

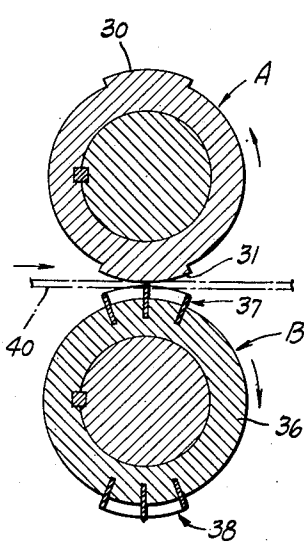


FIG. 2

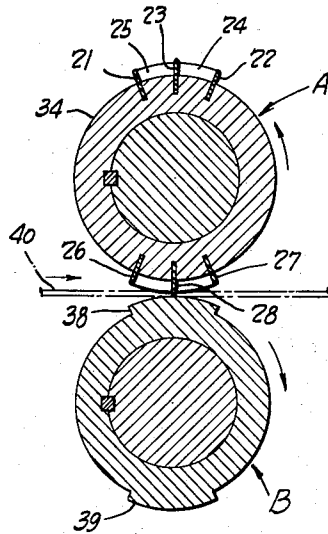


FIG. 3

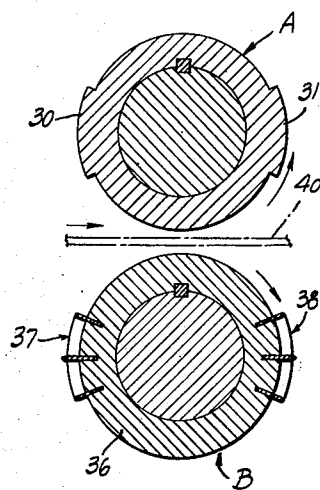


FIG. 5

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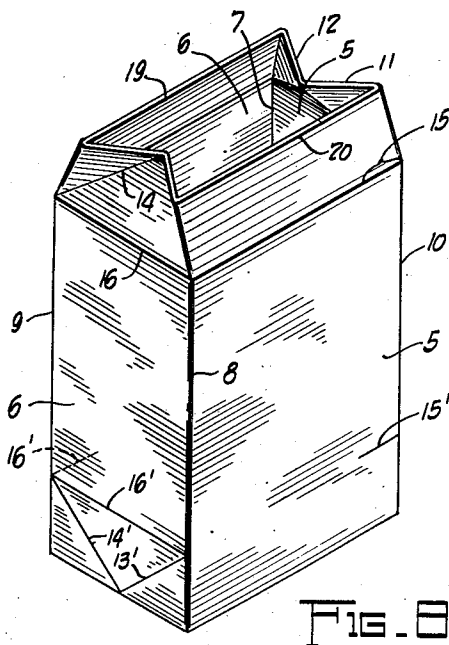
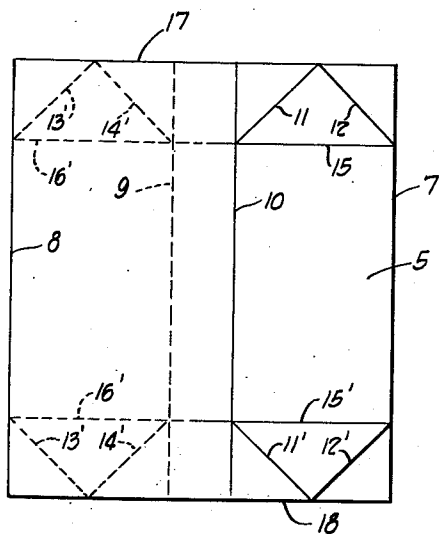
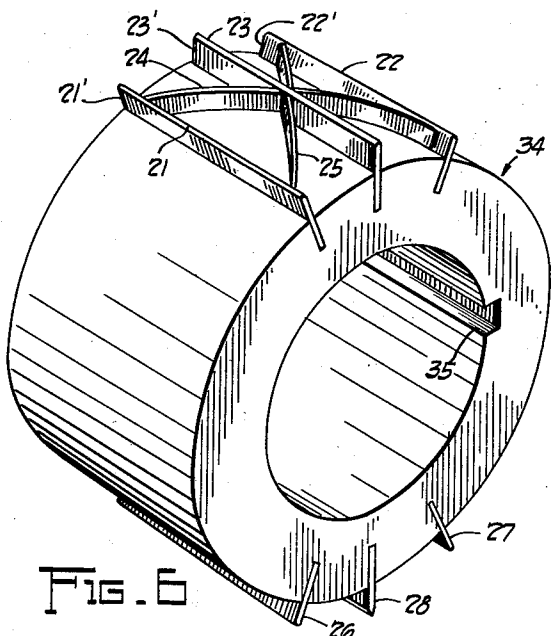
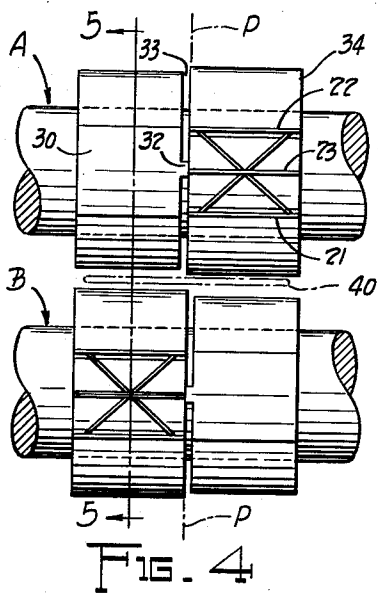
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FIG. 9

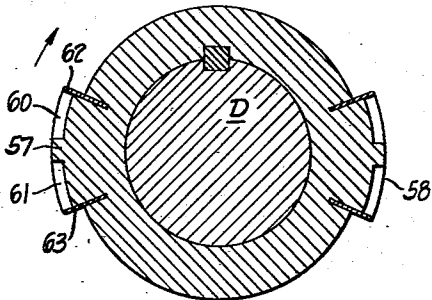
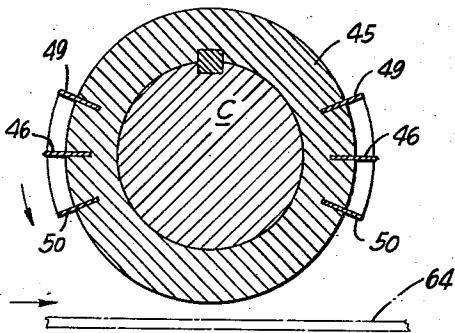
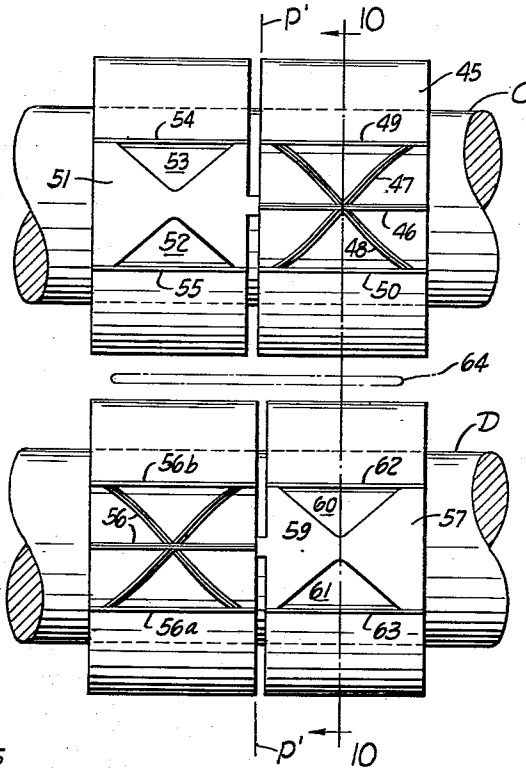


FIG. 10

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APPARATUS FOR AND METHOD OF SCORING AND SEVERING TUBED BOX BLANKS

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15 Claims. (Cl. 93—58.2)

This invention relates to methods of and apparatus for making box blanks and more particularly to improvements in the manufacture of flat tubular box blanks from a continuously moving flat tube of corrugated paper, cardboard, or the like.

Boxes or cartons have been made from single faced corrugated paper by taking a roll of the corrugated material with the corrugations extending parallel to the axis of the roll and, while feeding the strip of corrugated paper lengthwise, scoring it longitudinally, folding over the outer edge portions of the moving strip, applying adhesive to an extended flap of facing paper on one edge of the strip, and sealing this flap to the adjacent folded over opposite edge portion thus forming a continuous flat tube. When it is desired to form individual flat tubular box blanks from such a tube it is usually necessary to perform certain additional transverse and diagonal scoring operations at the end portions of the blanks and to cut off the moving tube at the proper locations relative to the transverse and diagonal score lines.

In the past difficulties have been experienced in making this type of flat tubular box blank because of variations in the location of the cut-off relative to the end portion scoring and it is an object of the present invention to provide a method of and apparatus for scoring and cutting off flat tubular box blanks from a longitudinally moving flat tube whereby the blanks are automatically and continuously severed at exactly the proper locations relative to the end scoring.

Another object of our invention is the provision of an accurate, economical and high-speed box blank forming apparatus and method which requires a minimum of parts, is economical to construct and maintain, and which requires substantially no adjustment or attention on the part of the operator during a run.

The above and other objects of the invention will appear from the following description of one embodiment of our improved method and a preferred apparatus for carrying out this method, reference being had to the accompanying drawings in which:

Figure 1 is a detached illustrative elevational view of a pair of our improved scoring and cut-off rolls between which a flat tube of corrugated paper or the like being passed.

Figure 2 is a vertical cross-sectional view taken substantially on line 2—2 of Figure 1.

Figure 3 is a vertical cross-sectional view taken substantially on line 3—3 of Figure 1.

Figure 4 is a fragmentary view of the apparatus shown in Figure 1 but with the rolls rotated through 90° from the positions shown in Figure 1.

Figure 5 is a vertical cross-sectional view taken substantially on line 5—5 of Figure 4.

Figure 6 is a detached perspective view of the scoring and cut-off of one of our improved rolls.

Figure 7 is a plan view of a completed flat tubular box blank produced by the apparatus illustrated in Figures 1-6.

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Figure 8 is a perspective view of the box blank of Figure 7 opened into box form and with one end partially folded into closed position.

Figure 9 is an elevation, generally similar to Figure 4 but on an enlarged scale, illustrating a modified form of our improved scoring and cut-off rolls.

Figure 10 is a vertical cross-sectional view taken substantially on line 10—10 of Figure 9.

Referring now to Figure 1, my improved apparatus consists essentially of a pair of rolls generally indicated at A and B and supported with their longitudinal axes parallel by suitable bearings (not shown). The roll B carries a driving gear 1 at one end of its shaft portion 2. This driving gear may be driven from any suitable source of power such as an electric motor or the like. Interconnecting gears 3 and 4 are mounted respectively on the opposite end of shaft portion 2 and the corresponding end of shaft portion 3 of roll A. From the above description it will be apparent that when the driving gear 1 is rotated in a given direction roll B will be driven in the same direction while the roll A will be driven in the opposite direction and at the same speed because of the inter-engagement of the duplicate gears 3 and 4.

Before proceeding further with the description of our improved apparatus it will be convenient to refer to the particular flat tubular box blank which the embodiment of our apparatus illustrated in Figures 1-6 is adapted to produce. This flat tubular blank is seen in plan view in Figure 7 and Figure 8 illustrates the box structure which is formed when the blank is partially opened or erected. The flat blank consists essentially of a top wall portion 5 (seen in Figure 7) and an opposite bottom wall portion 6 immediately therebelow. In the opened position of Figure 8 the top wall 5 of the flat blank has been folded on line 10 to form the front side wall and the rear or remote end wall of the box. The bottom wall 6 of the blank folds on line 9 when the box is erected and forms the rear side wall and the front end wall of the box as is also seen in Figure 8.

As previously mentioned the flat tube from which the individual blanks are formed is made by a longitudinal scoring and folding operation. During this step longitudinal score lines are formed at 7, 8 and 9. The strip is folded on lines 7 and 8, which become the side edges of the flat tube, and its outer free edges abut at 10 and are secured by suitable overlapping flap (not shown) in well known manner.

In order to facilitate folding in the ends of the box it is necessary to provide diagonal score lines 11 and 12 on the top wall 5 of the flat tubular blank and corresponding diagonal score lines 13 and 14 on the bottom wall 6. A transverse score line 15 extends from the edge 7 of the flat blank inwardly to the longitudinal center line thereof and a corresponding transverse score line 16 on the bottom wall 6 of the flat blank extends inwardly from the edge 8 to the longitudinal center line of the blank. These transverse and diagonal score lines are made after the strip is formed into a moving flat tube and accordingly the scoring must be done from outside the tube and simultaneously with the cut-off operation in order to insure proper location of the score lines on the finished flat tubular blank.

As seen in Figure 8, when the blank is opened into box form the transverse score line 15 extends around the corner 10 for a short distance along the front wall and, in like manner, the transverse score line 16 extends around the corner 9 for a short distance along the rear wall portion as well as the complete width of the front end wall 6.

Similar score lines 11', 12' and 15' are formed at the opposite (lower as seen in Figure 7) end of the top wall 5 of the flat tubular blank and similar score lines 13'.

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14', and 16' are formed at the opposite end of the bottom wall 6 of the flat tubular blank, all as clearly indicated in Figures 7 and 8. The end or leading edge 17 of the tubular blank is cut on a transverse line which passes accurately through the intersections of the diagonal end score lines 11—12 and 13—14. In like manner the opposite end or trailing edge 18 is cut on a line which passes accurately through the intersections of score lines 11'—12' and 13'—14' at the apices of the V's formed thereby.

Accuracy in the location of the cut-off lines at the ends 17 and 18 of the flat tubular blank is essential in order to insure proper closing of the end flaps and to prevent an undesired gap or overlap at the edges 19 and 20 (see Figure 8) when the end is completely closed.

Referring back to Figures 1-6, the upper roll A may be considered to be divided into two side by side sections by a plane, indicated by dot and dash line P on Figures 1 and 4, passing through both rolls A and B normal to their longitudinal axes. The portion of roll A on the right hand (Figure 1) side of plane P has mounted on its outer surface two diametrically opposite sets of score and cut-off bars. As seen in Figures 3 and 6, one of these sets of score and cut-off bars is positioned at the top of roll A and includes a pair of circumferentially spaced parallel axially extending score bars 21 and 22 and an axially extending cut-off bar 23 disposed substantially midway between the parallel score bars 21 and 22 and projecting radially outwardly farther than the score bars. It will be noted that the outer edge of cutter bar 23 is formed with a knife edge while the outer edges of the score bars are preferably either slightly rounded or serrated to form so-called dash score lines. This set also includes a pair of crossed diagonally extending score bars 24 and 25 which are mounted on the roll A to intersect each other at the cut-off bar 23. These diagonal score bars are arranged in X-shape, extend outwardly the same radial distance as the score bars 21 and 22, and intersect or abut the longitudinally extending score bars 21 and 22 at points spaced inwardly from the ends thereof (see Figure 6).

As will appear from Figures 1 and 6, the inner ends 21', 22', and 23' of score bars 21 and 22 and cut-off bar 23 are disposed on the plane P and, as will appear more fully later, during operation of the apparatus these ends 21', 22', and 23' travel in a vertical plane passing through the longitudinal center line of the moving flat tube which is being scored and cut off into individual blanks.

Diametrically opposite the above described set of score bars on roll A is a second duplicate set of score and cut-off bars which is substantially identical to that just described. In Figure 6 the spaced parallel score bars of the second set are indicated at 26 and 27 and the cut-off bar at 28. The diagonal score bars of the duplicate set are not clearly seen but it will be understood that they are of the same X-form and arrangement as the diagonal score bars 24 and 25. By providing the duplicate set of score and cut-off bars diametrically opposite the first set, a single revolution of the rolls A and B produces two complete and finished flat tubular box blanks. It will be understood that in some instances it may be desirable to use only a single set of score and cut-off bars on each roll thus producing only a single blank per revolution of the rolls. Furthermore, more than two sets may be used with rolls of large diameter or where box blanks of relatively short length are to be produced.

On the opposite side of plane P from the upper set of score and cut-off bars on roll A, and in axial alignment therewith, is a back-up section 30. This is best seen in Figures 1 and 2 and 4, and has a smooth arcuate outer surface of a maximum axial length preferably equal to or greater than the length of the cut-off bar 23 and a circumferential length preferably slightly greater than the circumferential spacing between the outer scoring edges of score bars 21 and 22. A corresponding back-up

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section 31 is disposed diametrically opposite back-up section 30.

It will be seen from Figure 4 that the roll A, for convenience in manufacture, assembly and servicing, is made in two side-by-side sections or halves which are separated by the plane P. The left-hand (Figures 1 and 4) half which carries the back-up sections 30 and 31 has a projecting web or rib 32 (see Figure 4) which abuts the inner end face of the right-hand half of the roll in alignment with the cut-off bar 23. By this construction a gap or space 33 is provided between the two halves of the roll except opposite the inner ends of cut-off bars 23 and 28.

Figure 6 illustrates that the portion of the roll which carries the sets of score and cut-off bars is in the form of a collar, generally indicated at 34, which is provided with a keyway 35 whereby the collar is secured on the main body of the roll. The portion which carries the back-up sections 30 and 31 is also preferably in the form of a similar collar keyed to the main body of the roll.

Roll B, as will be observed from the drawings, is substantially identical to roll A except that it is of the opposite hand, i. e., collar 36 (Figures 1 and 2) which carries the sets of score and cut-off bars (generally indicated at 37 and 38) and is similar to collar 34 on roll A but is disposed on the opposite side of the plane P from collar 34. Likewise the back-up sections 38 and 39 on roll B are disposed on the opposite side of plane P from the back-up sections 30 and 31 of roll A.

The diameters and center-to-center spacing of rolls A and B are such that the cutting edges of the cut-off bars 23 and 28 of the top roll A just contact the face of the back-up sections 39 and 38 respectively of roll B and, in like manner, the cut-off bars of sets 37 and 38 on roll B just contact the surfaces of back-up sections 31 and 30 respectively of roll A. As the cut-off bars extend radially beyond the score bars, the latter do not engage the face of the opposed back-up section but approach it closely enough to effect the desired scoring on the advancing moving flat tube (indicated in phantom lines at 40 in the drawings).

As best seen in Figure 6 the score and cut-off bars are supported in suitable slots in the outer faces of rolls A and B. The multi-piece construction of the rolls A and B enables such replacement of these bars to be effected readily and rapidly when desired.

The operation of our improved apparatus to score and cut off flat tubular box blanks from a longitudinally moving flat tube will now be described. The pre-formed flat tube 40, bearing suitable longitudinal scoring as above described, moves from left to right between the rolls A and B as seen in Figures 2, 3 and 5. In the position of the rolls seen in Figures 1, 2 and 3 the cut-off bar 28 lies on a plane which extends through the longitudinal axes of both rolls A and B and bar 28 has just completed its cut on the advancing end portion of the moving tube 40. This cut has been made downwardly from the top wall portion of tube 40 and, as the inner end of cut-off bar 28 lies on plane P which also passes through the longitudinal center line of the tube 40 (see Figure 1), the cut-off bar 28 completely severs the right-hand half only (Figure 1) of a blank. In like manner the cut-off bar of set 37 on bottom roll B also lies on the common plane through the longitudinal center lines of rolls A and B and, in Figures 1 and 2, has just completed a cut through the left-hand half only of the tube 40 upwardly from the bottom wall portion thereof and on the opposite side of the longitudinal center line of tube 40 from the cut made by cut-off bar 28.

As the two cut-off bars just referred to are in axial end-to-end alignment when they reach the common plane through the axes of the rolls, and as their inner ends are substantially in engagement at this point, the result is a complete severing across the entire width of the moving flat tube thus cutting off a completed box blank.

As rolls A and B continue to rotate from the positions

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shown in Figures 1, 2, and 3, roll A moving in counter-clockwise direction and roll B in clockwise direction, the diagonal score bars of the lower set on roll A co-act with the backup portion 38 on roll B to impress or form the score lines 11 and 12 (Figure 7) on the upper surface of the advancing flat tube. Next the transverse score bar 26 impresses the score line 15 on the upper surface.

In like manner, and concurrently with the forming of score lines 11, 12 and 15 on the top of the tube, the diagonal score bars of the set 37 on lower roll B form score lines 13 and 14, and the transverse score bar of set 37 forms score line 16 on the bottom wall or surface of the tube 40. Thus the leading edge of the tube (seen at 17 in Figure 7) has diagonal and transverse score lines formed on the top surface thereof on one side of its longitudinal center line and has similar diagonal and transverse score lines formed on the bottom surface thereof but on the opposite side of the longitudinal center line.

The two rolls then continue to rotate through somewhat less than 180° without any effective contact with the moving flat tube 40 (suitable feed rolls or the like being provided for maintaining the desired rate of movement thereof). An intermediate position of the rolls is seen in Figures 4 and 5 in which approximately 90° movement has taken place from the position of Figure 1. As the transverse score bar 21 on the right-hand half of roll A reaches its lower position and engages the moving tube 40, it forms the score line 15' (Figure 7) on the upper surface thereof. Next the diagonal score bars 24 and 25 form the diagonal score lines 11' and 12' respectively. Simultaneously with the formation of these score lines the corresponding score bars of the set 38 of lower roll B are forming the score lines 16', 13' and 14' on the bottom surface of the moving strip and on the opposite side of the center line thereof.

The rolls A and B are indexed relative to each other by the interconnecting gears 3 and 4 so that the cut-off bar 23 on top roll A and the cut-off bar of set 38 on bottom roll B will reach end-to-end aligned cut-off position on the plane through the axes of the rolls at the same time and thus will sever a complete and finished tubular box blank from the advancing tube. The cut-off line will be exactly at the apex or intersection of the diagonal score lines on the top and bottom of the blank. As previously noted it is important to maintain this position of the end of the blank relative to the diagonal and transverse end forming score lines so that, when the end flaps are folded in as indicated in Figure 8, the edges 19 and 20 will substantially abut and will neither overlap nor be spaced apart too great a distance.

Continuing the rotation of the rolls A and B and the feed of the flat tube 40 therebetween will result in the continuous scoring and cutting off of a succession of identical box blanks, two blanks being produced for each complete revolution of the roll.

In Figures 9 and 10 we have illustrated a modified form of our improved scoring and cut-off rolls by which a box blank similar to that illustrated in Figure 7 may be produced, but which will have the transverse score lines adjacent the ends of the blank extending substantially entirely across the entire top and bottom surfaces of the blank rather than half way across as is the case with the transverse score lines 15, 15', 16 and 16' of the blank of Figure 7. Such a score line arrangement is desirable with some types of material in order to facilitate folding in of the ends to close the box but may not be necessary with other types of material, in which case the rolls of Figures 1-6 will be satisfactory.

In Figure 9 the top roll is indicated at C and the bottom roll at D and, for reference purposes, a plane P' has been indicated extending normal to the axes of the rolls and located in the same location as the plane P of Figures 1-6. The section of the top roll on the right hand side of the plane P' consists of a collar member 45 having two sets of scoring and cut-off bars mounted thereon in diametrically opposed relation. The set seen in Figure 9

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includes the cut-off bar or blade 46, the X-shaped score bars 47 and 48, and the transverse score bars 49 and 50. These score bars are identical with those illustrated in Figure 4 on roll A except that the X-shaped bars 47 and 48 are illustrated as having a helical form in order to impress straight score lines on the blanks. The set on the opposite side of the right-hand section of roll C is identical with that just described.

The other section of roll C, on the left-hand side of plane P', includes a pair of diametrically opposite backup and transverse scoring sections, one of which is generally indicated in Figure 9 at 51. This section differs from the corresponding section on roll A of Figure 4 in that the backup portion is generally X-shaped and has cut away or relieved areas 52 and 35 (as perhaps best illustrated in Figure 10 on roll D). At the ends of the section 51 are transverse score bars 54 and 55 which extend into suitable mounting slots in the roll body and are disposed in alignment with and parallel to the transverse score bars 49 and 50, respectively. As also noted from the illustration of roll D in Figure 10, the transverse score bars of the scoring and backup sections of the rolls of Figures 9 and 10 do not project beyond the surface of the adjacent backup portions.

Roll D is substantially identical with roll C except that it is of the opposite hand, the scoring and cut-off sections (one of which is indicated at 56) being on the left-hand side of the plane P' and the backup and transverse scoring sections (which are indicated at 57 and 58) being on the right-hand side of plane P'. The section 57 of roll D, as seen in Figure 9, includes the X-shaped backup section 59, relieved or cut away portions 60 and 61, and the axially extending transverse score bars 62 and 63.

In the operation of the pair of rolls C and D to produce a series of tubular box blanks it may be assumed that the rolls are rotating in the directions indicated in Figure 10. As they rotate the transverse score bar 50 of roll C will engage the top of the moving tube 64 and will form a score line transversely across one half of the top surface of the tube. At the same time the transverse score bar 62 of roll D will engage the same half of the undersurface of the tube and will oppose and back up the upper score bar 50 and also form its own score line throughout that portion of its length which, by virtue of the cut away or relief portion 60, is free of contact with the back-up portion 59. As the transverse score bar 55 of roll C is axially aligned with score bar 50 and will engage the other half of the top surface of the tube 64, and as transverse score bar 56b of roll D is axially aligned with score bar 62 and engages the other half of the under surface of the tube at the same time as the score bar 62, score bars 55 and 56b are effective to score the other half of the blank, both on the top and bottom surfaces thereof and thus the transverse score lines on the blank produced by rolls C and D will extend entirely across the top and bottom surfaces of the blank except for short gaps caused by the space between the two halves of the individual rolls and by the portions of the score bars associated with the back-up portions which are in engagement with and do not project outwardly beyond the ends of the back-up portions.

As the rolls C and D continue to rotate the diagonal score lines are formed and the cutting off action is effected in the same manner as described in connection with Figures 1-6. Next the transverse score line is formed on the top of the tube by score bars 49 and 54 and concurrently the transverse score line is formed on the bottom of the tube by score bars 63 and 56a. Continued rotation of the rolls will, of course, produce a succession of complete, accurate, finished tubular box blanks.

It will be apparent from the above description of two embodiments of our improved apparatus and of the steps which are involved in our method, that we have provided means for producing uniformly scored and cut-off flat

tubular box blanks at a rapid rate and without the necessity of coordinating speeds of rotation of various sets of rolls, spacings between rolls, etc. Although we have described the illustrated embodiments of our invention in considerable detail it will be understood that variations and modifications, such as changes in the form and arrangement of the score and cut-off bars on the rolls to form box blanks of different sizes and proportions, may be made without departing from the spirit of our invention. We do not therefore wish to be limited to the specific apparatus and procedures herein shown and described but claim as our invention all embodiments thereof coming within the scope of the appended claims.

We claim:

1. A pair of scoring and cutting off rolls for making flat tubular box blanks from a longitudinally moving flat tube including a first roll, means for supporting said roll for rotation about its longitudinal axis, said roll having a scoring and cut-off section disposed entirely on one side of a plane through said roll normal to said longitudinal axis thereof and an axially extending back-up portion disposed entirely on the opposite side of said plane, a second roll, means for supporting said second roll with the longitudinal axis thereof parallel to the longitudinal axis of said first roll, said second roll having a scoring and cut-off section disposed entirely on said opposite side of said plane, said second roll also having an axially extending back-up portion disposed entirely on said one side of said plane, and drive means for rotating said first and second rolls in opposite directions and maintaining the score and cut-off bars thereof against relative angular shifting, said scoring and cut-off sections and said back-up portions of said first and second rolls being simultaneously axially aligned once during each revolution on said rolls.

2. Apparatus for scoring and cutting off flat tubular box blanks from a longitudinally moving flat tube including a first roll, means for supporting said roll for rotation about its longitudinal axis, said roll having a pair of circumferentially spaced axially extending score bars and an axially extending cut-off bar between said score bars, said bars being disposed entirely on one side of a plane through said roll normal to said longitudinal axis thereof, and an axially extending back-up portion on the opposite side of said plane and in axial alignment with said cut-off bar; a second roll, means for supporting said second roll with the longitudinal axis thereof parallel to the longitudinal axis of said first roll, said second roll having a pair of circumferentially spaced axially extending score bars and an axially extending cut-off bar between said score bars, said last named score and cut-off bars being disposed entirely on said opposite side of said plane, said second roll also having an axially extending back-up portion in axial alignment with the cut-off bar on said second roll and disposed entirely on said one side of said plane, and means for rotating said first and second rolls in opposite directions and maintaining the score and cut-off bars thereof against relative angular shifting, said cut-off bars of said first and second rolls being simultaneously disposed, once during each revolution of said rolls, on a plane in which the longitudinal axes of both of said rolls lie.

3. Apparatus for cutting off flat tubular box blanks from a longitudinally moving flat tube including a first roll, means for supporting said roll for rotation about its longitudinal axis, said roll having a cut-off bar on one side only of a plane through said roll normal to said longitudinal axis and a back-up section on the opposite side only of said plane in longitudinal alignment with said cut-off bar, a second roll, means for supporting said second roll with the longitudinal axis thereof parallel to the longitudinal axis of said first roll, said second roll having a cut-off bar on said opposite side only of said plane and a back-up section on said one side only of said plane in longitudinal alignment with the cut-off bar

of said second roll, means for driving said rolls in opposite directions at the same peripheral speeds, said cut-off bars of said first and second rolls being disposed to be in longitudinal alignment on opposite sides of said plane as they engage a moving flat tube passing between said rolls whereby said first roll cuts inwardly from one outer surface of said tube on said one side only of said plane and said second roll cuts inwardly from the opposite outer surface of said tube on said opposite side only of said plane.

4. Apparatus for scoring and cutting off flat tubular box blanks from a longitudinally moving flat tube including a first roll, means for supporting said roll for rotation about its longitudinal axis, said roll having a scoring and cut-off section on one side of a plane through said roll normal to said longitudinal axis and a back-up section on the opposite side of said plane in longitudinal alignment with said scoring and cutoff section, a second roll, means for supporting said second roll with the longitudinal axis thereof parallel to the longitudinal axis of said first roll, said second roll having a scoring and cut-off section on said opposite side of said plane and a back-up section on said one side of said plane in longitudinal alignment with the scoring and cut-off section of said second roll, means for driving said rolls in opposite directions at the same peripheral speeds, said scoring and cut-off sections of said first and second rolls being disposed to be in longitudinal alignment on opposite sides of said plane as they engage a flat tube passing between said rolls whereby said first roll cuts inwardly from one outer surface of said tube on said one side only of said plane and said second roll cuts inwardly from the opposite outer surface of said tube on said opposite side only of said plane.

5. Apparatus for scoring and cutting off flat tubular box blanks from a longitudinally moving flat tube including a first scoring and cut-off roll, means for supporting said roll for rotation on its longitudinal axis, a set of score and cut-off bars on said first roll; said set comprising a pair of circumferentially spaced parallel axially extending score bars on the outer face of said roll and disposed entirely on one side of a plane normal to said roll axis, an axially extending cutoff bar mounted on the outer face of said roll midway between and parallel to said score bars, said cut-off bar extending radially outwardly farther than said score bars and being disposed entirely on said one side of said plane, a pair of crossed diagonally extending score bars mounted on the outer surface of said roll on said one side of said plane, said pair of diagonally extending score bars extending between said axially extending score bars and intersecting each other at said cut-off bar; a back-up portion on the opposite side of said plane in axial alignment with said set of score and cut-off bars and having an axial length not less than the axial length of said axially extending cut-off bar, a second scoring and cut-off roll, means for supporting second scoring and cut-off roll for rotation with its longitudinal axis parallel to the longitudinal axis of said first roll, said second scoring and cut-off roll having a set of score and cut-off bars on its outer surface substantially identical in form and spacing to those on said first roll but on the opposite side of said plane, said second cut-off roll also having a back-up portion substantially identical in form and location to, but disposed on the opposite side of said plane from, said back-up portion on said first roll, and drive means for rotating said first and second rolls in opposite directions and maintaining said score and cut-off bars of said first and second rolls against relative angular shifting, said cut-off bars of said first and second rolls being simultaneously aligned once during each revolution of said rolls, on a plane in which lie the longitudinal axes of both of said rolls.

6. Apparatus for scoring and cutting off flat tubular box blanks from a longitudinally moving flat tube including a first scoring and cut-off roll, means for sup-

porting said roll for rotation on its longitudinal axis, a set of score and cut-off bars on said first roll; said set comprising a pair of circumferentially spaced parallel axially extending score bars on the outer face of said roll and disposed on one side of a plane normal to said roll axis, an axially extending cut-off bar mounted on the outer face of said roll midway between and parallel to said score bars, said cut-off bar extending radially outwardly farther than said score bars and being disposed entirely on said one side of said plane, a pair of crossed diagonally extending score bars mounted on the outer surface of said roll on said one side of said plane, said pair of diagonally extending score bars extending between said axially extending score bars and intersecting each other at said cut-off bar; a back-up portion on the opposite side of said plane in axial alignment with said set of score and cut-off bars and having an axial length not less than the axial length of said axially extending cut-off bar, a duplicate set of score and cut-off bars circumferentially spaced from said first named set of score and cut-off bars and disposed on said one side of said plane, a duplicate back-up portion in axial alignment with and on said opposite side of said plane from said duplicate set of score and cut-off bars, a second scoring and cut-off roll, means for supporting said second scoring and cut-off roll for rotation with its longitudinal axis parallel to the longitudinal axis of said first roll, said second scoring and cut-off roll having sets of score bars and cut-off bars on its outer surface substantially identical in form and spacing to, but on the opposite side of said plane from, those on said first roll, said second roll also having back-up portions substantially identical in form and spacing to, but disposed on the opposite side of said plane from, those on said first roll, and drive means for rotating said first and second rolls in opposite directions and maintaining said score and cut-off bars of said first and second rolls against relative angular shifting, corresponding cut-off bars of said first and second rolls being simultaneously aligned, once during each revolution of said rolls, on a plane in which lie the longitudinal axes of both of said rolls.

7. Apparatus for scoring and cutting off flat tubular box blanks from a longitudinally moving flat tube including a first roll, means for supporting said roll for rotation about its longitudinal axis, said roll having a main scoring and cutoff section on one side of a plane through said roll normal to said longitudinal axis, said main section including transverse and diagonal score bars, a secondary scoring and back-up section on the opposite side of said plane, said secondary section having transverse score bars in alignment with said transverse score bars of said main scoring and cut-off section, a second roll, means for supporting said second roll with the longitudinal axis thereof parallel to the longitudinal axis of said first roll, said second roll having a main scoring and cut-off section on said opposite side of said plane and a secondary scoring and back-up section on said one side of said plane in longitudinal alignment with the said main scoring and cut-off section of said second roll, and means for driving said rolls in opposite directions at the same peripheral speeds, said scoring and cut-off sections of said first and second rolls being disposed to be in longitudinal alignment on opposite sides of said plane as they engage a flat tube passing between said rolls whereby said first roll cuts inwardly from one outer surface of said tube on said one side only of said plane and said second roll cuts inwardly from the opposite outer surface of said tube on said opposite side only of said plane.

8. Apparatus for scoring and cutting off flat tubular box blanks from a longitudinally moving flat tube including a first roll, means for supporting said roll for rotation about its longitudinal axis, said roll having a main scoring and cut-off section on one side of a plane through said roll normal to said longitudinal axis, said main section including an axially extending score bar and an axially

extending cutoff bar, and a secondary scoring and back-up section on the opposite side of said plane, said secondary section including an axially extending score bar in alignment with said axially extending score bar of said main scoring and cut-off section and a back-up portion in alignment with said cut-off bar of said main scoring and cut-off section, a second roll, means for supporting said second roll with the longitudinal axis thereof parallel to the longitudinal axis of said first roll, said second roll having a main scoring and cut-off section substantially identical to the main scoring and cut-off section on said first roll but on said opposite side of said plane and a secondary scoring and back-up section substantially identical to the secondary scoring and back-up section on said first roll but on said one side of said plane in alignment with the said main scoring and cut-off section of said second roll, means for driving said rolls in opposite directions at the same peripheral speeds, said scoring and cut-off sections of said first and second rolls being disposed to be in longitudinal alignment on opposite sides of said plane as they engage a flat tube passing between said rolls whereby said cut-off bar on said first roll cuts inwardly from one outer surface of said tube on said one side only of said plane and said cut-off bar on said second roll cuts inwardly from the opposite outer surface of said tube on said opposite side only of said plane.

9. Apparatus for scoring and cutting off flat tubular box blanks from a longitudinally moving flat tube including a first scoring and cut-off roll, means for supporting said roll for rotation on its longitudinal axis, a main set of score and cut-off bars on said first roll; said set comprising a pair of circumferentially spaced parallel axially extending score bars on the outer face of said roll and disposed entirely on one side of a plane normal to said roll axis, an axially extending cut-off bar mounted on the outer face of said roll midway between and parallel to said score bars, said cut-off bar extending radially outwardly farther than said score bars and being disposed entirely on said one side of said plane, a pair of crossed diagonally extending score bars mounted on the outer surface of said roll entirely on said one side of said plane, said pair of diagonally extending score bars extending between said axially extending score bars and intersecting each other at said cut-off bar; a secondary scoring and back-up section on the opposite side of said plane having axially extending score bars in axial alignment with said axially extending score bars of said main set of score and cut-off bars and having a back-up portion in axial alignment with said cut-off bar of said main set, a second scoring and cut-off roll, means for supporting said second scoring and cut-off roll for rotation with its longitudinal axis parallel to the longitudinal axis of said first roll, said second scoring and cut-off roll having a main set of score bars and cut-off bars on its outer surface substantially identical in form and spacing to said main set on said first roll but on the opposite side of said plane, said second cut-off roll also having a secondary scoring and back-up section substantially identical in form and location to, but disposed on the opposite side of said plane from, said secondary scoring and back-up section on said first roll, and drive means for rotating said first and second rolls in opposite directions and maintaining said score and cut-off bars of said first and second rolls against relative angular shifting, said cut-off bars of said first and second rolls being simultaneously aligned on a plane extending through the longitudinal axes of both of said rolls once during each revolution of said rolls.

10. The method of scoring and cutting a continuously moving flat tube to form individual flat tubular box blanks which includes the steps of diagonally scoring and transversely cutting downwardly from the top surface of said continuously moving tube at longitudinally spaced intervals on one side only of the longitudinal center line of said tube and simultaneously diagonally scoring and transversely cutting upwardly from the bottom surface of said

tube on the opposite side only of said longitudinal center line.

11. The method of cutting a continuously longitudinally moving flat tube to form individual flat tubular box blanks which includes the steps of cutting downwardly only from the top surface of said continuously moving tube at longitudinally spaced intervals on one side only of the longitudinal center line of said tube and simultaneously cutting upwardly only from the bottom surface of said tube on the opposite side only of said longitudinal center line.

12. The method of making flat tubular box blanks which includes the steps of continuously longitudinally moving a flat tube having top and bottom wall portions, successively forming in spaced relation diagonal score lines on the outer surface of said top wall portion on one side only of the longitudinal center line of the continuously moving flat tube, simultaneously forming in corresponding spaced relation diagonal score lines on the outer surface of said bottom wall portion on the opposite side only of said center line, and successively severing said continuously moving flat tube on transverse lines having fixed and definite positions relative to said diagonal score lines by cutting through said flat tube downwardly from said top wall portion on said one side only of said center line and simultaneously cutting through said flat tube upwardly from said bottom wall portion on said opposite side only of said center line.

13. The method of making flat tubular box blanks from a continuously longitudinally moving flat tube having top and bottom wall portions which includes the steps of forming a series of longitudinally spaced generally X-shaped score lines on the outer surface of said top wall portion of said continuously moving flat tube on one side only of the longitudinal center line of said moving tube, simultaneously forming a corresponding series of longitudinally spaced generally X-shaped score lines on the outer surface of said bottom wall portion of said continuously moving flat tube on the opposite side only of said longitudinal center line and in transverse alignment with said first named series of spaced generally X-shaped score lines, and, simultaneously with the forming of said X-shaped score lines into said top and bottom walls, cutting off said moving flat tube into individual box blanks by cutting downwardly through said continuously moving flat tube from the top thereof at the mid-point of each of said X-shaped score lines on said top wall portion on said one side only of said center line and simultaneously cutting upwardly through said moving flat tube from the bottom thereof at the mid-point of the transversely aligned X-shaped score lines on said bottom wall portion on said opposite side only of said center line.

14. The method of scoring and cutting off a box blank from the leading end of a continuously longitudinally moving flat tube having top and bottom wall portions which includes the steps of forming a V-shaped score line on the outer surface of said top wall portion on one side of the longitudinal center line of said continuously moving

flat tube and with the apex of the V at the leading edge of said flat tube, simultaneously forming a second V-shaped score line on the outer surface of said bottom wall portion on the opposite side of said longitudinal center line and with the apex of the V also at the leading edge of said flat tube, forming a third V-shaped score line on said outer surface of said top wall portion longitudinally spaced from and aligned with said first named V-shaped score line in said top wall portion but with its apex pointing in the opposite direction, forming a fourth V-shaped score line on said outer surface of said bottom wall portion simultaneously with said third V-shaped score line, said fourth V-shaped score line being longitudinally aligned with said second V-shaped score line and transversely aligned with said third V-shaped score line, and transversely severing said moving flat tube through the apices of said third and fourth V-shaped score lines and concurrently with the formation thereof by cutting downwardly on said one side of said center line and upwardly on said opposite side of said longitudinal center line.

15. The method of scoring and cutting off a box blank from the leading end of a continuously longitudinally moving flat tube having top and bottom wall portions which includes the steps of rolling a V-shaped score line into the outer surface of said top wall portion on one side of the longitudinal center line of said continuously moving flat tube and with the apex of the V at the leading edge of said flat tube, simultaneously rolling a second V-shaped score line into the outer surface of said bottom wall portion on the opposite side of said longitudinal center line and with the apex of the V also at the leading edge of said flat tube, rolling a third V-shaped score line into said outer surface of said top wall portion longitudinally spaced from and aligned with said first named V-shaped score line in said top wall portion but with its apex pointing in the opposite direction, rolling a fourth V-shaped score line into said outer surface of said bottom wall portion simultaneously with said third V-shaped score line, said fourth V-shaped score line being longitudinally aligned with said second V-shaped score line and transversely aligned with said third V-shaped score line, transversely severing said moving flat tube through the apices of said third and fourth V-shaped score lines and concurrently with the formation thereof by cutting downwardly on one side of said center line and upwardly on the other side of said center line, said severing forming a new leading edge on said moving flat tube, and repeating said scoring and severing operations while continuously moving said flat tube.

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