June 21, 1960 C. A. HARLESS 2,941,798

SHEET CUTTING AND FOLDING MACHINE

Filed Dec. 18, 1958 8 Sheets-Sheet 1

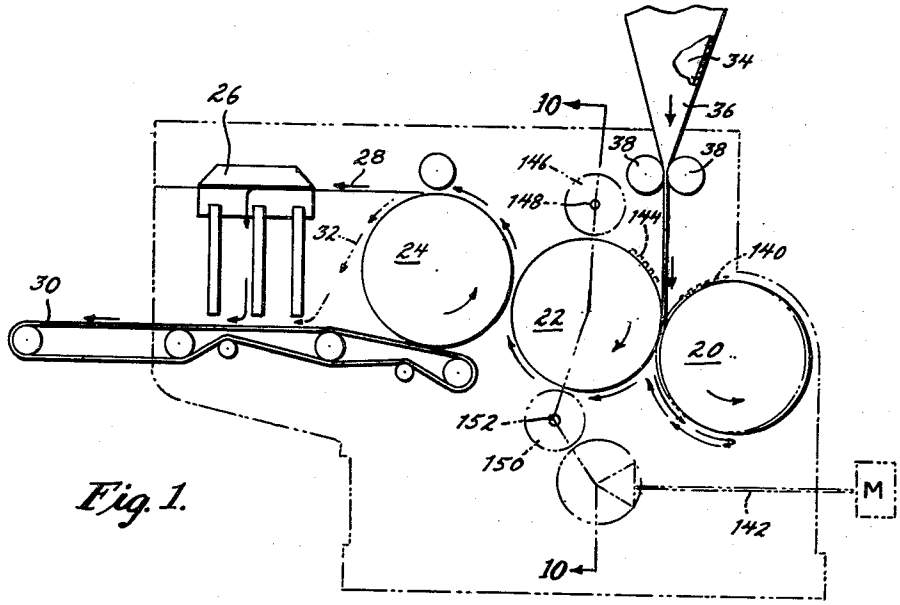


Fig. 1.

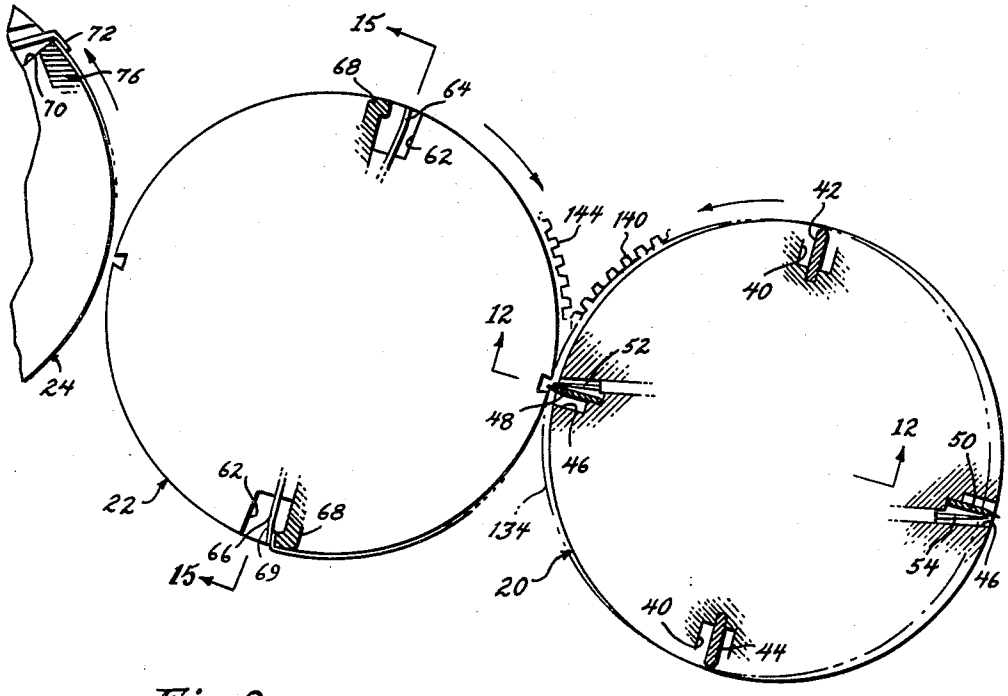


Fig. 2.

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June 21, 1960 C. A. HARLESS 2,941,798

SHEET CUTTING AND FOLDING MACHINE

Filed Dec. 18, 1958 8 Sheets-Sheet 2

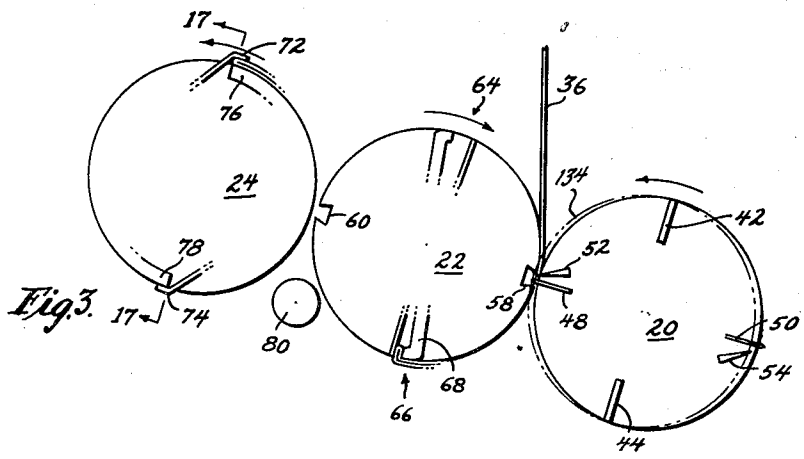


Fig. 3.

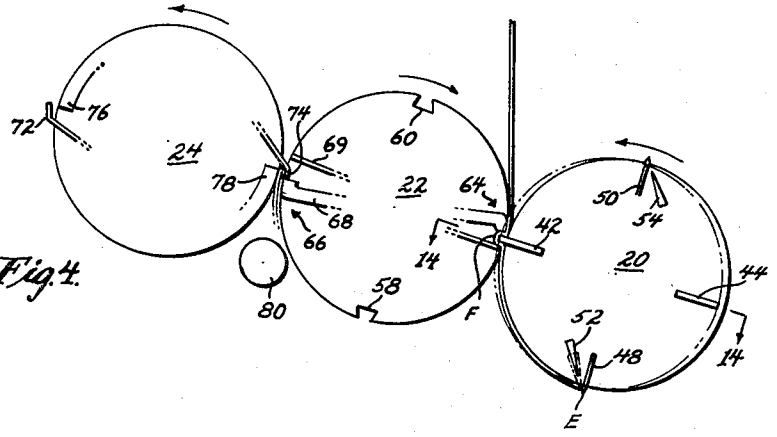


Fig. 4.

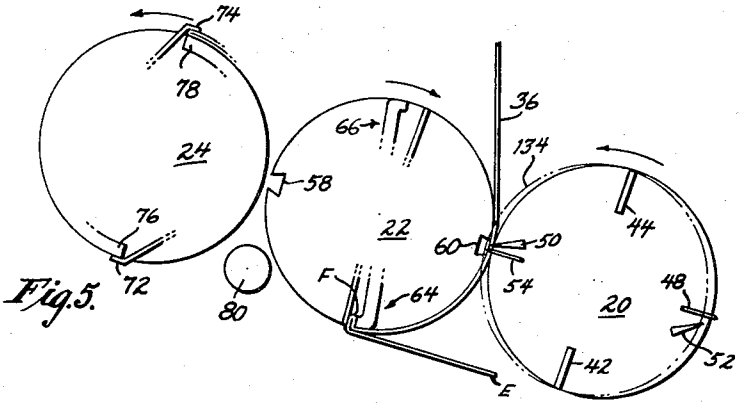


Fig. 5.

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June 21, 1960 C. A. HARLESS 2,941,798

SHEET CUTTING AND FOLDING MACHINE

Filed Dec. 18, 1958 8 Sheets-Sheet 3

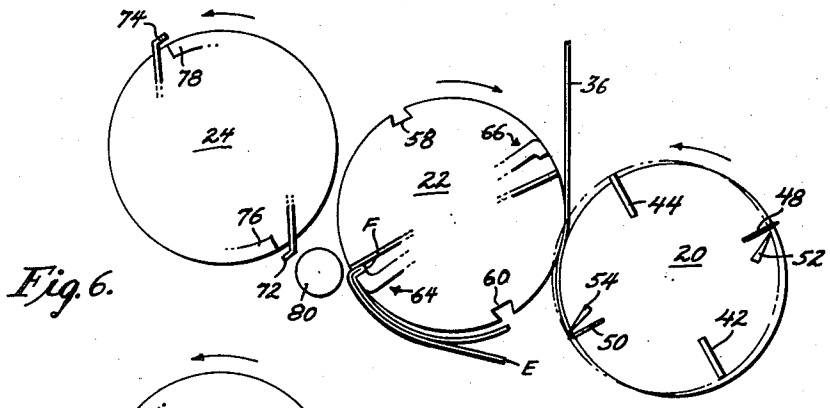


Fig. 6.

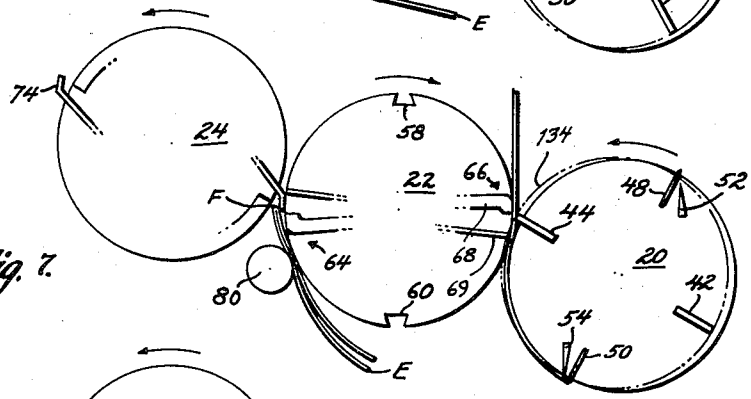


Fig. 7.

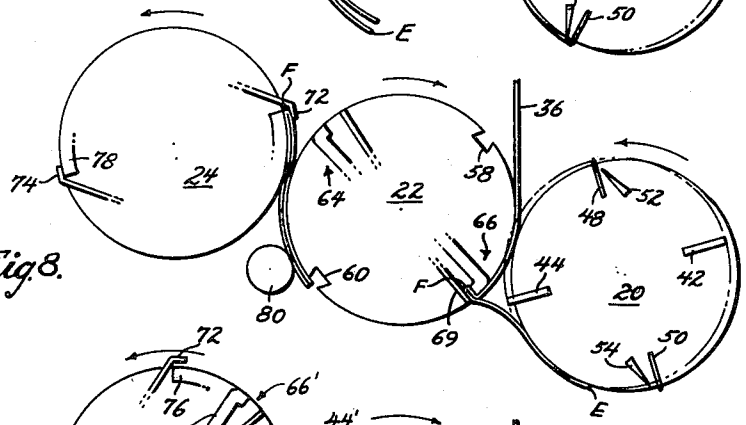


Fig. 8.

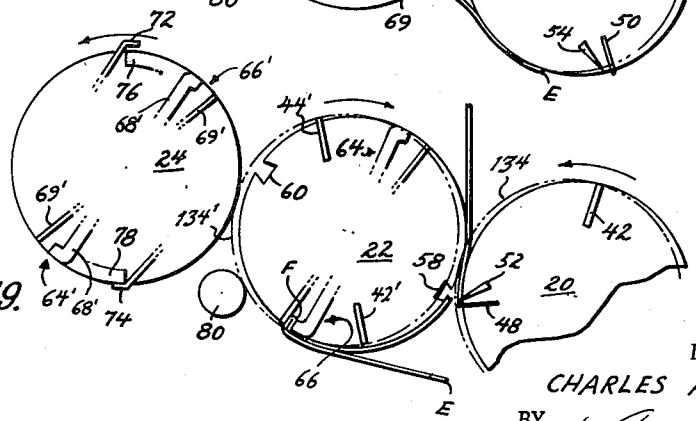


Fig. 9.

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June 21, 1960 C. A. HARLESS 2,941,798

SHEET CUTTING AND FOLDING MACHINE

Filed Dec. 18, 1958 8 Sheets-Sheet 4

Fig. 20.

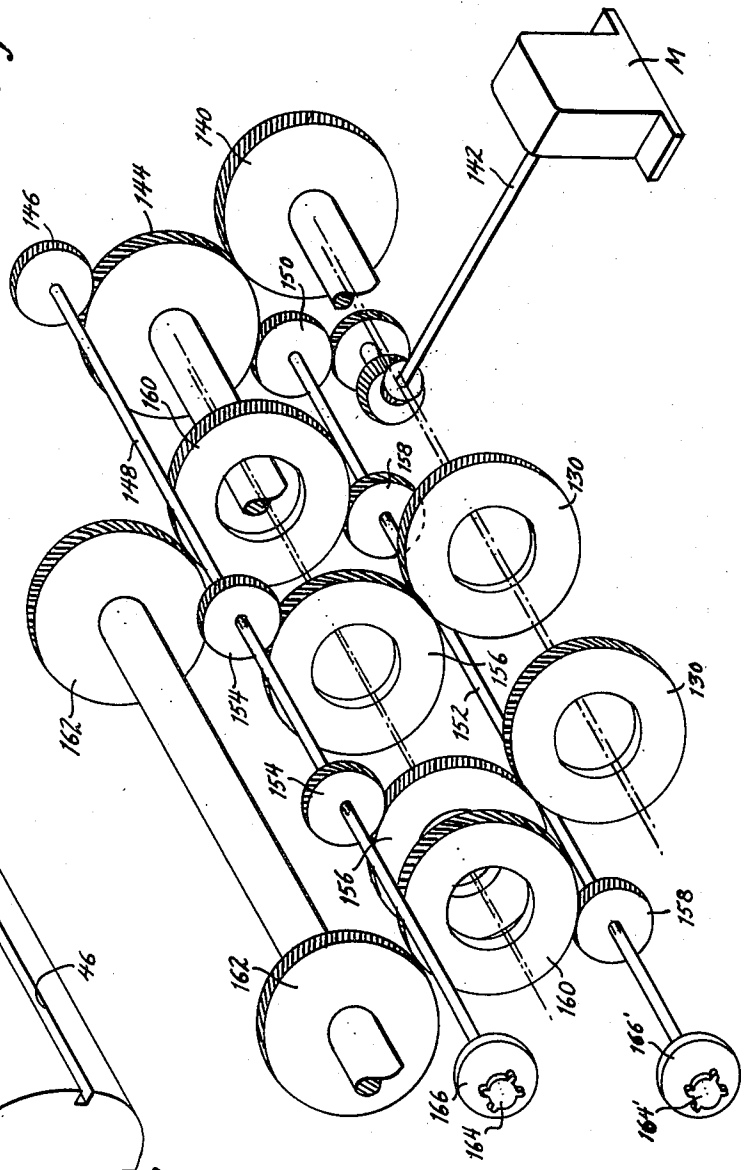
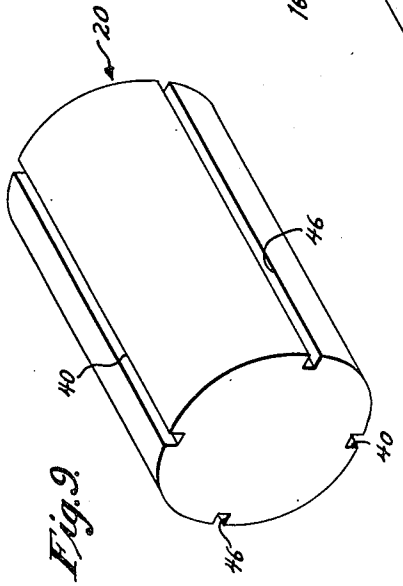


Fig. 9.



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SHEET CUTTING AND FOLDING MACHINE

Filed Dec. 18, 1958 8 Sheets-Sheet 5

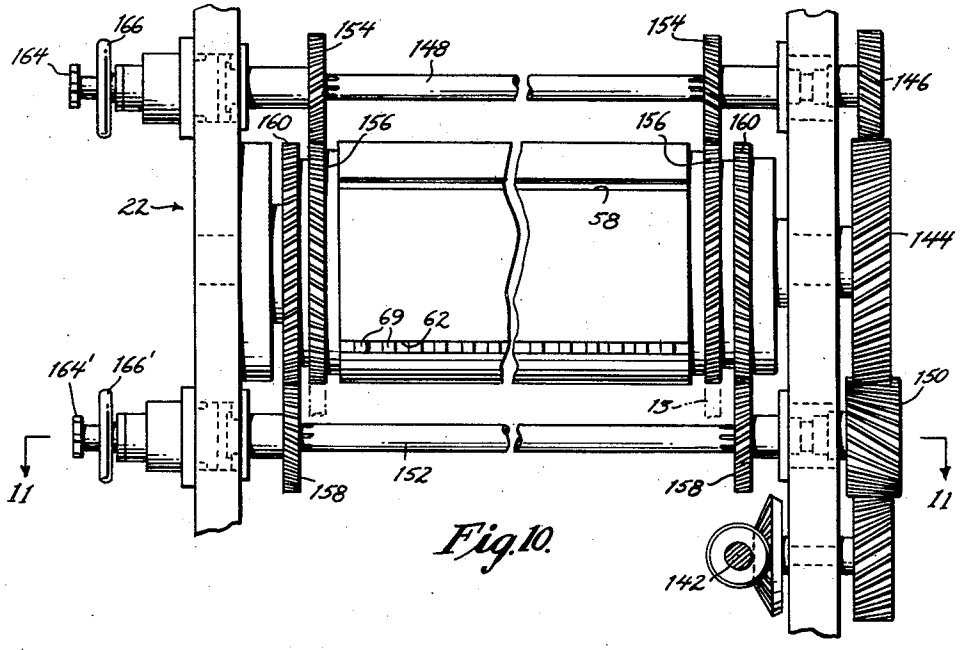


Fig. 10.

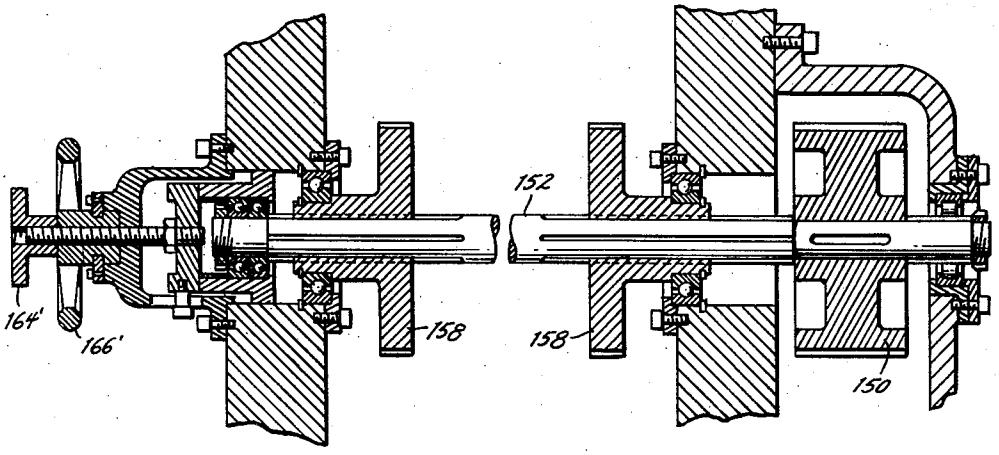


Fig. 11.

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June 21, 1960 C. A. HARLESS 2,941,798

SHEET CUTTING AND FOLDING MACHINE

Filed Dec. 18, 1958 8 Sheets-Sheet 6

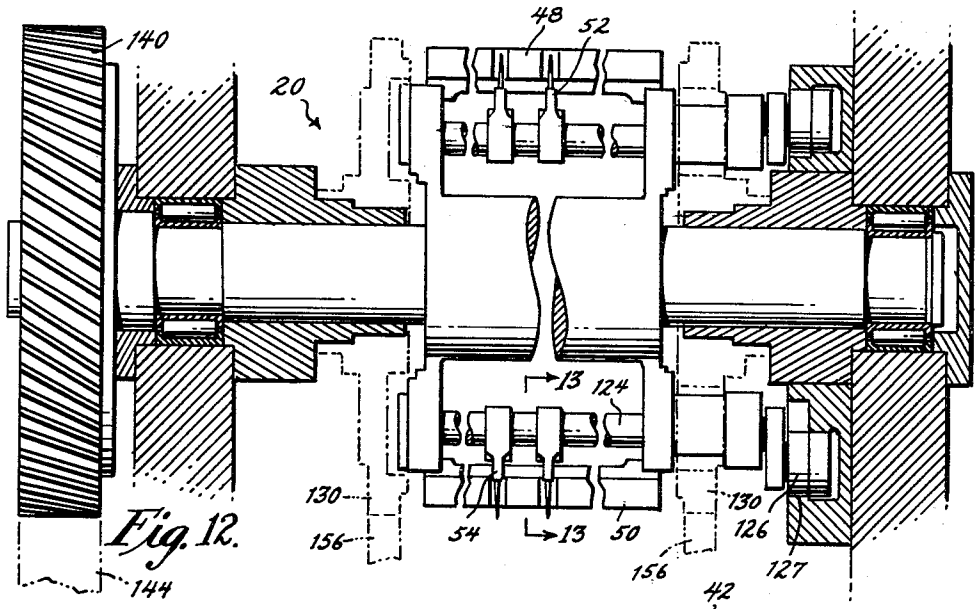


Fig. 12.

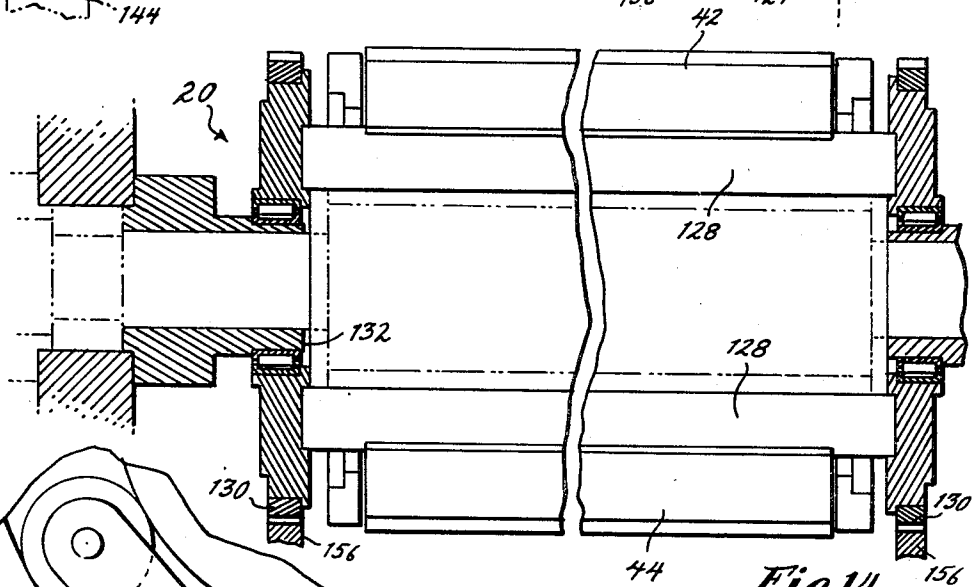


Fig. 14.

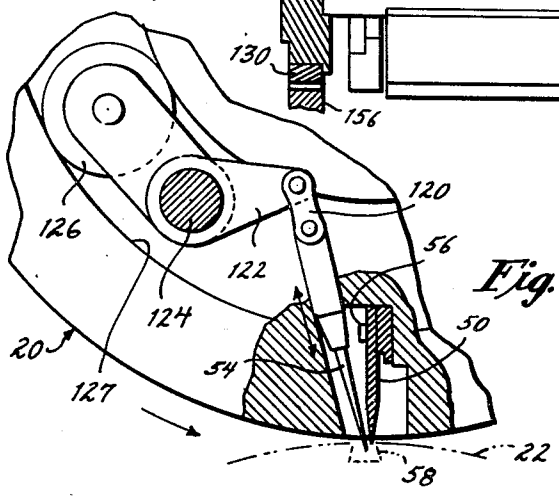


Fig. 13.

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June 21, 1960 C. A. HARLESS 2,941,798

SHEET CUTTING AND FOLDING MACHINE

Filed Dec. 18, 1958

8 Sheets-Sheet 7

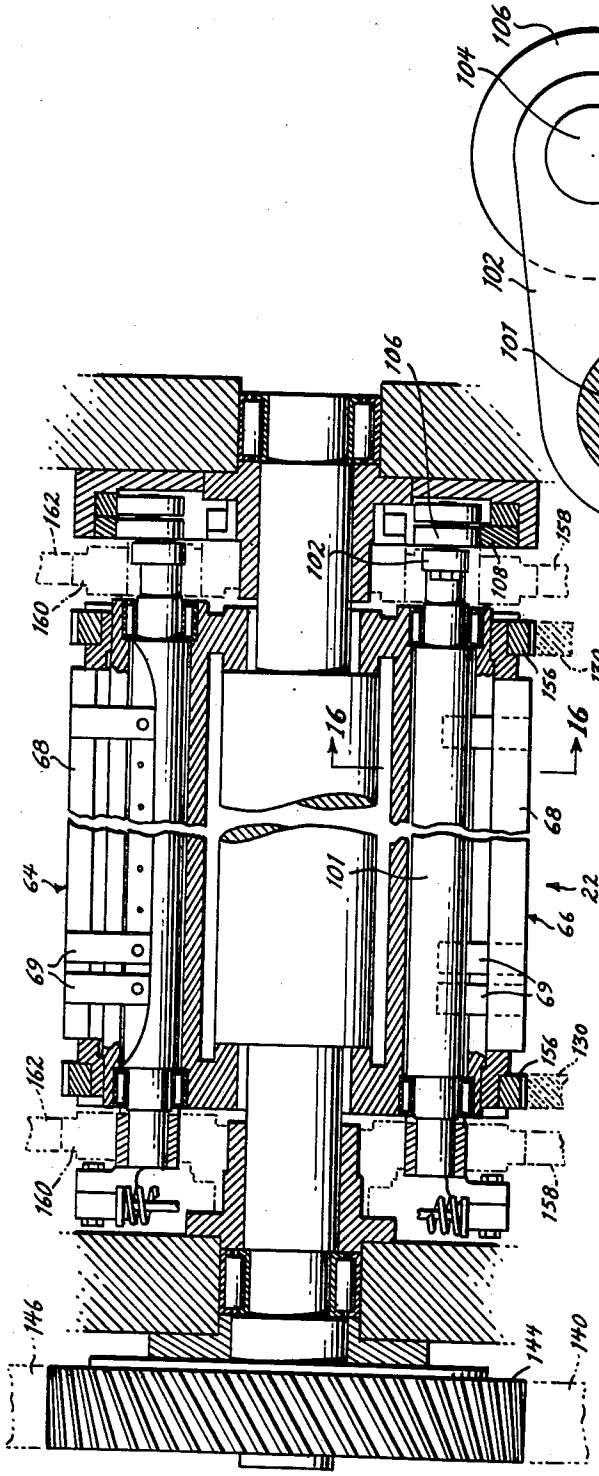


Fig. 15.

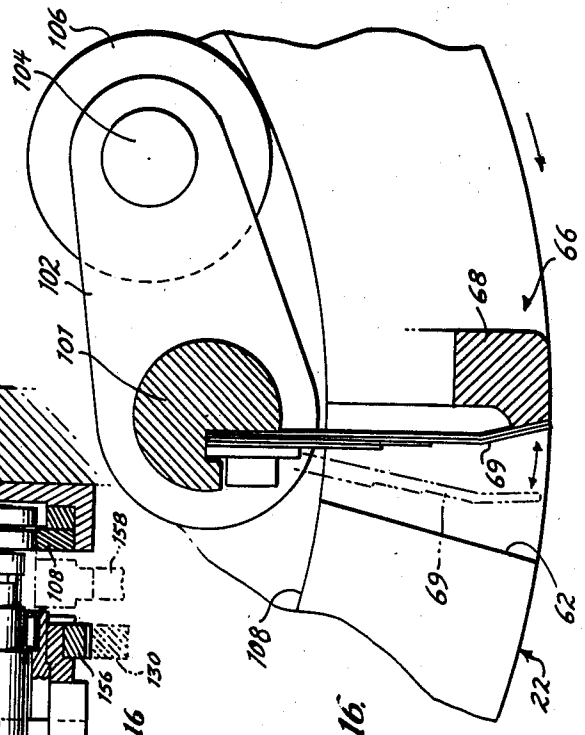


Fig. 16.

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June 21, 1960 C. A. HARLESS 2,941,798

SHEET CUTTING AND FOLDING MACHINE

Filed Dec. 18, 1958 8 Sheets-Sheet 8

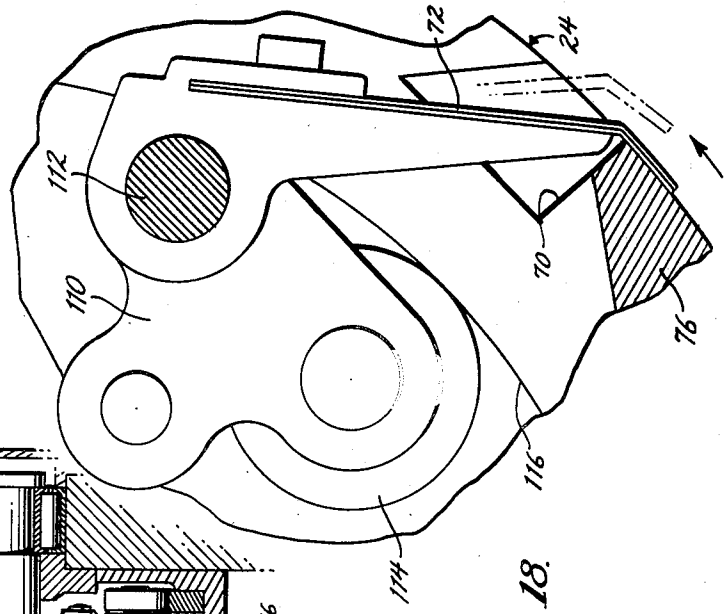


Fig. 18.

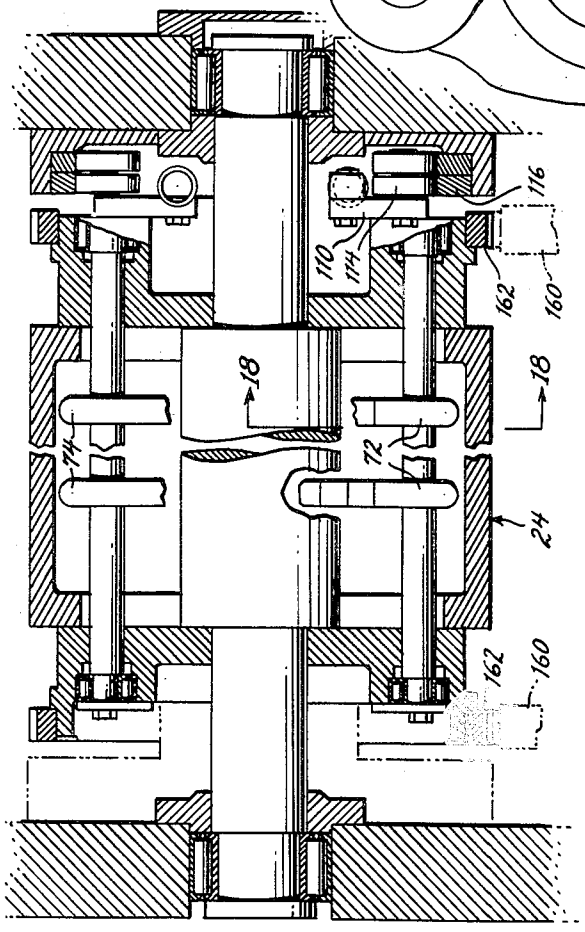


Fig. 17.

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United States Patent Office 2,941,798
Patented June 21, 1960

2,941,798

SHEET CUTTING AND FOLDING MACHINE

Charles A. Harless, Riverside, Conn., assignor to Hess and Barker, a partnership composed of Robert W. Barker, Narberth, and Robert R. Barker, Wayne, Pa., Wayne MacVeagh Barker, Seaside Park, N.J., and Margaret Ridgeway and Effingham B. M. Barker, Bala-Cynwyd, Pa.

Filed Dec. 18, 1958, Ser. No. 783,760

11 Claims. (Cl. 270—72)

This invention relates to a machine for cutting a continuous web, such as paper, into sheets of a predetermined size and for folding said sheets.

When the machine is to be used for making only one cross fold in each sheet, the machine need only have a first cylinder which is known as the male cylinder and which carries impaling pins for drawing the paper, knives for cutting the paper into sheets and folding blades for folding the severed sheets, and a second cylinder, which is known as the female cylinder and which has recesses for coacting with the impaling pins and the knives and jaws for coacting with the folding blade. The machine may also include a third cylinder which has grippers for removing the fold sheets from the female cylinder and depositing them on a delivery conveyor, or the like.

When it is desired to make a second cross fold in the sheet, the female cylinder is provided with a folding blade and the third cylinder is provided with jaws for coacting with the folding blades of the second cylinder.

In practice, the paper is fed between the oppositely rotating male and female cylinders, with or without having been previously folded, and the rotation of the cylinders is so timed that, as the paper passes between the male and female cylinders, the impaling pins engage with the paper to draw a predetermined length thereof, and the knives cut the paper to the predetermined size. Further rotation causes the tucking, or folding blade on the male cylinder to fold the paper into the jaw on the female cylinder. Still further rotation of the cylinders cause the grippers to remove the folded sheet from the female cylinder for delivery to a chopper folder or to a delivery belt.

For certain requirements, it is necessary to fold the severed sheet exactly in the center so as to produce panels of equal size. For other requirements, it is necessary to fold the sheet off-center so that one panel will be longer than the other. Also, if a machine is adjusted for one requirement, or for the other, when a light stock is being run, it will be found that the machine has to be readjusted if a heavy stock is to be cut and folded. Adjusting the machine involves changing the position of the tucking blade relative to the position of the knives and impaling pins.

In a conventional machine, it is the practice to fix the tucking blades in the body of the male cylinder and to adjust the machine, it was necessary to disengage the tucking blades and relocate them and then to move the female cylinder accordingly. This was a tedious and expensive operation because it was also necessary to loosen the cylinder gears and to lock them in the new position. Furthermore, if the sheet is to be folded twice, the second, or female cylinder will also be provided with folding blades and the third blade will be provided with jaws and all these parts, too, will have to be loosened, adjusted and again locked.

It is, therefore, one object of my invention to produce an improved cutting and folding machine in which a severed sheet can be folded as desired while the machine is running and without disengaging the folding blades or the jaws and without loosening and moving and retightening the cylinders themselves. This saves time and money and insures against damage to the machine which can result from maladjustment which can happen when the adjustments referred to are made in the conventional manner.

In order that the web may be properly supported while it is being cut by the knife and impaled on the pins, it is necessary that the web be made to ride over the portion of the female cylinder at which the cutting and piercing take place. But, when the female, or second cylinder is provided with tucking blades so as to make a second fold, the web approaching the nip of the first and second cylinder will be struck by the tucking blade and the knife on the first cylinder and the web is struck again by the tucking blade on the female, oppositely rotating cylinder. This disturbance of the running web adversely affects the accuracy of the folding operation and is otherwise undesirable.

It is, therefore, a further object of the invention to mount the tucking blade for rotation about a center which is eccentric to the rotation of the corresponding cylinder whereby the tucking blades will travel inwardly of the periphery of the second cylinder while they are approaching and passing the first cylinder and whereby the folding blades will move outwardly of the periphery of the second cylinder while they are approaching and passing the third cylinder so as to tuck the web on the female cylinder into the jaws carried by the third cylinder to effect the second course referred to. Because the tucking blades on the second cylinder are disposed inwardly of the periphery of this cylinder and will not touch the paper approaching the first and second cylinders, the paper can be made to engage a portion of the surface of the second cylinder instead of being only tangent thereto.

Furthermore, by mounting the tucking blades on one center and the cutting knives on another center, the tucking blades can be regulated independently of the cutting knives and the fold line can be varied without affecting the rate at which the paper is fed or the sizes of the sheet itself which, in the printing industry, for example, is dictated by the size of the printing cylinder.

The full nature of the invention will be understood from the following specification and the accompanying drawings in which:

Fig. 1 is a fragmentary and highly diagrammatic end elevational view showing a paper folding and cutting machine of the type to which the invention is applied, the machine being adapted to produce one cross fold only.

Fig. 2 is an enlarged, diagrammatic end view of three cylinders shown in Fig. 1.

Figs. 3 to 8 inclusive are highly diagrammatic views showing the complete operation of the machine step by step.

Fig. 9 is a perspective view of the right hand cylinder of Fig. 1, shown detached.

Fig. 10 is a sectional view looking in the direction of line **10—10** on Fig. 1.

Fig. 11 is a sectional view looking in the direction of line **11—11** on Fig. 10.

Fig. 12 is a sectional view looking in the direction of line **12—12** on Fig. 2.

Fig. 13 is a sectional view looking in the direction of line **13—13** on Fig. 12.

Fig. 14 is a sectional view looking in the direction of line **14—14** on Fig. 4.

Fig. 15 is a sectional view looking in the direction of line **15—15** on Fig. 2.

Fig. 16 is an enlarged sectional view looking in the direction of line 16—16 on Fig. 15.

Fig. 17 is a sectional view looking in the direction of line 17—17 on Fig. 3.

Fig. 18 is an enlarged sectional view looking in the direction of line 18—18 on Fig. 17.

Fig. 19 is similar to Figs. 3 to 8 but showing the machine as adapted for producing two cross folds.

Fig. 20 is a schematic view showing the manner in which the various cylinders are driven.

The machine illustrated includes at least one set of cylinders 20 and 22 for cutting a continuous roll of web, such as paper, into sheets and folding each sheet and it may also include cylinder 24 for removing the cut and folded sheets from cylinder 22 to a chopper folder 26, in the direction of arrow 28, or for dropping it on a conveyor 30, in the direction of arrow 32. Above cylinders 20 and 22 is a fixed downwardly tapered former 34 over which the paper 36 to be folded and cut moves into the nip of cylinders 20 and 22. 38 designates a set of feed and guide rolls which, together with chopper folder 26, have no bearing on the present invention and will not be described.

As will be seen from Fig. 2, cylinder 20 has opposite peripheral openings 40 in which are mounted folding blades 42 and 44, and has opposite peripheral openings 46, through which project fixed knives 48 and 50 and movable impaling pins 52 and 54. The manner in which the folding blades and the impaling pins are mounted and moved will be hereinafter described. At this point it is enough to note that knives 48 and 50 are fixed to the cylinder 20, as at 56 in Fig. 13, and that they always project beyond the periphery of the cylinder (Figs. 2 and 13); that folding blades 42 and 44 are alternately projected beyond, and retracted within, the periphery of cylinder 20 (Figs. 4, 7); and that pins 52 and 54 alternately project beyond, and are retracted within, the periphery of cylinder 20 (Figs. 2, 5, 13).

Cylinder 22 is provided with opposite peripheral openings 58 and 60 for alternately receiving fixed knives 48, 50, and movable impaling pins 52 and 54 (Figs. 2, 4), and is provided with opposite peripheral openings 62 which afford access to opposite jaws 64 and 66, each of which is formed of a fixed member 68 and a movable member 69.

The manner in which the jaws are constructed and operated is conventional, but, for convenience, it will hereinafter be briefly described. It is now sufficient to say that each of the jaws is adapted to receive and grip the fold edge of a sheet of paper pushed thereinto by one of the folding blades.

Cylinder 24 of a conventional machine includes opposite peripheral openings 70 through which project movable grippers 72, 74, which coact with the adjacent portions 76, 78 of the cylinder (Figs. 2, 3, 17, 18). The manner in which these grippers are mounted and moved is conventional, but, for convenience, it will be hereinafter briefly explained. At this point, it is sufficient to say that each of grippers 72, 74 alternately moves to the "open," or non-gripping, position, shown in solid lines in Fig. 3 and in broken lines in Fig. 18 and to the "closed" or gripping position shown in solid lines in Figs. 2 and 18.

The operation of the machine above described is as follows:

Immediately after being delivered to the nip of cylinders 20 and 22, as shown in Fig. 3, the lead edge of folded paper 36 is engaged by impaling pins 52 on cylinder 20. It will be noted that, at this moment, opening 58 on cylinder 22 is in registration with pins 52 and associated fixed knife 48. Further rotation of these cylinders causes pins 52 to pull the leading edge E of the paper down to the position shown in Fig. 4 and brings folding blade 42 on cylinder 20 and jaw 64 on cylinder 22 to the position of Fig. 4, in which they are in registration on opposite sides of the paper. It will be noted that, in this position, jaw 64 is open, as shown in solid line in Fig. 2, to receive the paper pushed thereinto by folding blade 42. As folding blade 42 withdraws, the movable member 69 of the jaw closes on the paper to produce a fold at line F. Further rotation of the cylinders brings knife 50 and pins 54 on cylinder 20 and opening 60 on cylinder 22 into registration, as shown in Fig. 5 in which knife 50 cuts the trailing panel and the impaling pins again engage the lead edge of the paper to begin a new cycle.

By this time, constantly rotating cylinder 24 will have reached the position of Fig. 5 and further opposite rotation of cylinders 22 and 24 brings them to the position of Fig. 6 in which the edge F of the folded paper passes between cylinder 22 and guide roll 80 to permit gripper 74 on cylinder 24, which is now open, to receive edge F of the paper which, as shown in Fig. 7, has "peeled" off cylinder 22 and has been engaged by gripper 72.

Further rotation closes the gripper on edge F of the paper and the folded paper is carried away by cylinder 24 to be dropped on conveyor 30 or to be delivered to chopper folder 26 for further folding.

The manner in which conventional jaws 64 and 66 are mounted and operated is shown in Figs. 15 and 16 from which it will be seen that the movable member 69 of each jaw is pivoted at 101 to a link 102 which is carried by a shaft 104 which carries a cam follower 106 which rides on fixed cam track 108 which is carried by the frame of the machine. By this arrangement, as cylinder 22 and shafts 104 carried thereby, rotate, the cam followers will alternately ride on one portion of the cam track to close the corresponding jaw, as shown in the solid line position of Fig. 15, or the cam followers will ride on another portion of the cam track to open the jaw, as shown in broken lines in Fig. 16.

The manner in which conventional grippers 72 and 74 are mounted and operated is shown in Figs. 17 and 18 from which it will be seen that each movable gripper 74 or 76 is carried by crank 110 on shaft 112 and carries a cam follower 114 which rides on a similarly mounted, fixed cam track 116. By this arrangement, as cylinder 24, and shafts 112 carried thereby, rotate, the cam followers will ride on one portion of the cam track 116 to move grippers 74, 76 alternately to the closed position, as shown in solid lines in Fig. 18, in which, as shown in Fig. 8, the fold edge E of the paper is clamped between gripper 72 and the periphery 78 of cylinder 24 and on another portion of the cam track to move grippers 74 or 76 to the open position, shown in broken lines in Fig. 18 or to the position shown in solid lines in Figs. 6 and 7 and in which gripper 74, for example, is spaced from the periphery 78 of the cylinder to release the fold edge E of the paper.

As shown in Figs. 12 and 13, pins 52 and 54 are connected by flexible elements, such as sprocket chain 120, to bell crank levers 122 which are carried on shafts 124 and which carry cam followers 126 which ride on cam track 127. By this arrangement, as a cam follower 126 rides on one portion of track 127, the pins are withdrawn inwardly of the outer edge of adjacent knife 48, as shown by the position of pins 52 at the top of Fig. 12, and are projected beyond the edge of knife 50, as shown by the position of pin 54 at the bottom of Fig. 12 and in Fig. 13, and vice versa.

Also, to the same end, and as shown in Fig. 14, folding blades 42 and 44 are carried by braces 128 which are carried by gears 130 which rotate on eccentric hub 132. By this arrangement, as gears 130 rotate, folding blades 42 and 44 and pins 52 and 54 approach the paper obliquely, or along an arcuate path, or an eccentric circle 134 (Figs. 2, 3, 4, etc.), as indicated by line 118 in Fig. 3.

Also, in a conventional machine, the action of the folding blades was so timed that the severed sheet of

paper was folded on a center line and the opposite panels thus produced were of equal length. Since, as stated, the edge of one of the panels is perforated by the impaling pins, it was necessary to cut off equal marginal portions from the opposite panels of the sheet if the perforations were to be eliminated. According to the second part of my invention, I eliminate the necessity of cutting off the marginal portion of the trailing panel which was not perforated, thus effecting considerable saving of material. This is accomplished by folding the sheet in such a manner that the lead panel, that is, the panel, the margin of which is perforated, will be a little longer than the other panel, the marginal portion of which is not perforated. By this arrangement, cutting off only the perforated marginal portion will eliminate the perforations and will equalize the lengths of the opposite panels of the folded sheet. This is accomplished by changing the position of the folding blades relative to the rotation of cylinder **20**. But, because the jaws on cylinder **22** coact with the folding blades, the position of cylinder **22** also must be changed.

The manner in which this is accomplished is shown in Figs. 10 and 20 from which it will be seen that cylinder **20** is driven at a constant speed by gear **140** which, in turn, is driven by shaft **142** of motor M through a gear train which is clearly shown in Fig. 20 and is, therefore, not described in detail. Gear **140** meshes with gear **144** which drives pinion **146** on shaft **148** and pinion **150** on shaft **152**. Shaft **148** carries pinions **154** which mesh with gears **156** which drive cylinder **22**. Gears **156** mesh with gears **130** which carry folding blades **42**, **44**. Shaft **152** carries pinions **158** which drive gears **160** which drive gears **162** to rotate cylinder **24**. It will be noted that shaft **148** is splined and movable relative to pinions **154** and that the teeth of the gears are of a herringbone pattern. Therefore, movement of pinion **146** to the right, or to the left, relative to gear **144**, as viewed in Fig. 20, causes shaft **148** to turn about its axis, thus changing the positions of gear **130** which carries the folding blades and the position of gears **156** which rotate cylinder **22** and, hence the position of cylinder **22** itself. Shaft **148** is provided with adjusting handle **164** which is threaded in fixed hub **166** so that, by turning handle **164**, pinion **146** is moved relative to gear **144**. By this arrangement, the folding blades can be set, relative to the rotation of cylinder **20**, to fold a severed sheet of paper at its exact center so that the opposite panels will be equal, or the folding blades, and cylinder **22** can be displaced so that the leading panel of the folded sheet will be longer than the trailing panel by an extent sufficient to permit removal of the perforated marginal portion without having to cut anything off from the trailing panel. By adjusting shaft **152**, the position of cylinder **24** may be also shifted in the same manner.

It will be noted that handle **164** can be turned to adjust pinion **146** relative to gear **144** while the machine is still running.

In the foregoing, only those parts of a conventional machine which are related to the invention which resides in eccentrically moving the impaling pins and the tucking blades and in shifting the folding blades, have been described. All other parts which have been shown, but have not been described, have no bearing on the invention.

For more details of a conventional machine of this type to which the invention is applied, reference may be had to Patent No. 1,966,885.

What I claim is:

1. A continuous web cutting and folding machine including a first cylinder, means for rotating said cylinder about a first center, impaling pins, spaced circumferentially of, and rotatable with said first cylinder for engaging and drawing said web, fixed cutting blades carried by said first cylinder, and spaced circumferentially thereof for cutting said web into pieces of a predetermined length, folding blades associated with said first cylinder and spaced circumferentially thereof, means rotating said folding blades about a second center spaced from said first center, a second cylinder coacting with said first cylinder, means rotating said second cylinder about a third center of rotation, and jaws associated with, and spaced circumferentially of said second cylinder, said second cylinder having circumferentially spaced recesses therein the spacing of said centers being in such amount and direction as to provide a degree of eccentricity sufficient to cause said recesses to coact with said pins and said cutting blades and to cause said folding blades to penetrate said jaws to fold the pieces of web severed by said cutting blades.

2. The structure recited in claim 1 and means for shifting said folding blades relative to the circumference of said first cylinder and for simultaneously, and to the same extent, shifting said second cylinder to maintain said jaws in proper position relative to said folding blades.

3. The structure recited in claim 1 and a third cylinder, means rotating said third cylinder about a fourth center of rotation, and means on said third cylinder for removing the folded pieces of web from said second cylinder.

4. The structure recited in claim 3 and additional folding blades associated with said second cylinder and spaced circumferentially thereof, means mounting said additional blades for rotation about a fourth center of rotation spaced from said third center, and additional jaws associated with, and spaced circumferentially of said third cylinder, the spacing of said third and fourth centers being in such amount and direction as to provide a degree of eccentricity sufficient to cause said additional folding blades to penetrate said additional jaws to produce a second fold in each piece of said web.

5. The structure recited in claim 4 and means for shifting said additional folding blades relative to said second cylinder and for simultaneously, and to the same extent, shifting said third cylinder relative to its axis of rotation, to maintain said additional jaws in proper relation to said additional folding blades.

6. The structure recited in claim 1 and means mounting said impaling pins for eccentric movement relative to said first cylinder.

7. A continuous web cutting and folding machine including a first and a second cylinder, means for passing the web to be cut and folded between said cylinders, impaling pins associated with, and spaced circumferentially of, said first cylinder, folding blades associated with said first cylinder and spaced circumferentially thereof, jaws associated with said second cylinder and spaced circumferentially thereof, the spacing of said jaws affording cooperation between said jaws and said pins, cutting blades carried by said first cylinder and spaced circumferentially thereof, means for rotating said cylinders about spaced centers of rotation and in opposite directions to sever said web into sheets of a predetermined size, and means for rotating the folding blades about a center spaced from the center of rotation of said first cylinder, the amount and direction of said spacing providing a degree of eccentricity sufficient to cause said folding blades to engage and disengage said jaws.

8. The structure recited in claim 7 and means for shifting said folding blades relative to the circumference of said first cylinder and for simultaneously, and to the same extent, shifting said second cylinder.

9. The structure recited in claim 7 and a third cylinder, means for rotating said third cylinder about a center of rotation spaced from the centers of rotation of said first and second cylinders, additional folding blades associated with said second cylinder and spaced circumferentially thereof, means associated with said second cylinder for rotating said additional folding blades about a center spaced from the center of rotation of said second

cylinder, and additional jaws carried by said third cylinder, the spacing of said centers being in such amount and direction as to provide a degree of eccentricity sufficient to cause said additional blades to penetrate said additional jaws to produce a second fold in each of said sheets.

10. The structure recited in claim 9 and means for simultaneously shifting said additional folding blades relative to the circumferences of said second cylinder and for simultaneously, and to the same extent, shifting the circumference of the second and third cylinder relative to their respective centers of rotation.

11. A continuous web cutting and folding machine including at least two co-acting cylinders, means associated with one of said cylinders for drawing the web between said cylinders, cutting means associated with one of said cylinders and spaced circumferentially thereof for severing the web into sheets of a length which is equal to the spaces between said cutting means, complementary sheet folding means carried by, and spaced circumferentially of, said cylinders, such complementary sheet folding means being normally disposed substantially midway between said cutting means for folding each sheet at least once, and means for shifting said folding means circumferentially of the respective cylinders to shift the fold line of a sheet away from the center of the sheet and without changing the size of the sheet.

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