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NAPKIN FOLDING MACHINE

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9 Sheets-Sheet 2

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9 Sheets-Sheet 5.

Inventor
Aaron Groff
By His Attorneys

Williamson & Clark
To all whom it may concern:

Be it known that I, Aaron Groff, a citizen of the United States, residing at Minneapolis, in the county of Hennepin and State of Minnesota, have invented certain new and useful Improvements in Napkin-Folding Machines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention has for its object to provide a completely automatic machine of large capacity and high efficiency especially adapted for the folding of paper napkins; and to such ends, generally stated, the invention consists of the novel devices and combinations of devices hereinafter described and defined in the claims.

It is a well known fact that paper napkins are used in enormous quantities throughout the United States and various other countries and are coming into general use in restaurants, hotels, ice cream parlors and in many other public and private places.

The most approved manner of folding these napkins is in triangular form, so that a pack thereof may be inserted endwise into a glass or a paper folder.

The present application is based on a commercially successful machine for automatically folding paper napkins into the triangular form indicated. Described in a general way, this improved machine comprises as follows:

The paper sheet from which the napkins are to be cut and folded by the machine is primarily in the form of a roll or strip of the width of the napkins. This roll is contained on a spindle which in its construction and manner of mounting, involves novel features. From the roll, the paper sheet or web is moved over a guide roll and over a former, and thence, between primary feed rollers, which cooperate to fold the sheet longitudinally, so as to thereby produce the first fold of the napkins before the sheet is cut to form the napkins.

From the primary feed rollers, the folded paper strip passes between cutting rollers and opposing endless feed belts and so-called nipping rolls. Knives on the cutting rollers cut the folded strip into individual napkins; the opposing feed belts have parallel vertical portions and are provided with flexible blades for directing the cut napkins, already once folded, as stated, directly downward; and the nipping rolls grip the napkins at about the time they are being cut from the strip and accelerate the downward movement thereof to proper position between two oppositely extended guideways of segmental form curved in a vertical plane.

Co-operating with the segmental guideways is a vibratory double-acting main folder blade, preferably of segmental form carried by an arm pivoted on axis that is concentric to the axis of the curve of the segmental guideways. This main folder blade is automatically oscillated back and forth, first into the one and then into the other of the guideways and it automatically carries a napkin, first into one guideway, and then into the other guideway, and in doing so, produces the second fold of the napkin. Napkins folded, as just noted, will be in rectangular formation of one-fourth the size of the unfolded napkin, and these napkins, in this form, will be carried, alternately, to the lower extremities of the two segmental guideways.

At the lower extremities of the segmental guideways, the napkins folded, as just noted, will be delivered in front of so-called formers in the form of plates having triangular openings. Galleys of troughlike form extend outward from the triangular openings of the two formers.

Working between the two formers and moved with a properly timed action is a plunger provided at its opposite ends with triangular former heads of a size and shape to pass freely through the triangular openings of the formers and to force the napkins through said formers into the galleys, giving a triangular bend to the same during such operation. The former heads are provided with tucker blades at their diverging edges and automatic means is provided for causing these tucker blades to slightly enlarge the triangular form of the folded napkin and to tuck the same between the last previously delivered napkin and the outer surface of the former plate, so that the last delivered napkin will always be held in place while the former head is given its receding movement.

Working adjacent to the inner surface of each former plate is a pair of reversely acting so-called final folding blades that oper-
ate, one after the other, to fold over against the triangular body of the folded napkin, the two triangular folded flaps. The invention also involves certain other devices which will be hereinafter fully described. These general statements will enable the reader to more readily follow the following detailed description of the complete machine.

In the accompanying drawings which illustrate the invention, like characters indicate like parts throughout the several views. Referring to the drawings:

Fig. 1 is a front elevation of the complete machine;
Fig. 2 is a left side elevation of the machine;
Fig. 3 is a section taken approximately on the line 3—3 of Fig. 2;
Fig. 4 is a detail view, partly in plan and partly in section, showing the paper roll spindle and its adjusting device;
Fig. 5 shows a part of the machine in section on the line 5—5 of Fig. 1 with some parts in full and some parts broken away;
Fig. 6 is a detail in section on the line 6—6 of Fig. 2;
Fig. 7 is a fragmentary horizontal section taken approximately on the line 7—7 of Fig. 2, some parts being broken away;
Fig. 8 is a fragmentary section on the line 8—8 of Fig. 1;
Fig. 9 is a fragmental horizontal section on the line 9—9 of Fig. 3;
Fig. 10 is a detail showing one end of the plunger and one of the former heads;
Fig. 11 is a fragmentary section on the line 11—11 of Fig. 5;
Fig. 12 is a side elevation of one of the former heads;
Fig. 13 is a detailed view of said former head;
Fig. 14 is an elevation of the former head shown in Fig. 12, looking at the same from the right toward the left;
Fig. 15 is a perspective view showing one of the blade-equipped arms of one of the opposing feed chains;
Fig. 16 is a detail of a detachable gear used in the machine;
Fig. 17 is a plan view showing one of the napkins laid out flat, its various folding lines being indicated by broken lines marked thereon;
Fig. 18 shows the napkin folded once;
Fig. 19 shows the napkin with its second fold;
Fig. 20 shows the napkin with one flap folded;
Fig. 21 shows the napkin completely folded;
Fig. 22 is a fragmentary view partly in diagram and partly in section, illustrating the action of the paper cutting elements carried by the drum;
Fig. 25 is a plan view illustrating a modified form of the so-called main folder blade and certain co-operating parts;
Fig. 26 is an edge elevation of the folder blade shown in Fig. 25;
Fig. 27 is a fragmentary section on the line 27—27 of Fig. 26.

All of the parts of the machine are mounted on a common framework which is indicated, as an entirety, by the numeral 25, but comprises certain elements which will be hereinafter particularly noted. So far as most of the claims of this application are concerned, the paper roll spindle may take various forms, but it is preferably of a novel construction and arrangement illustrated in the drawings, attention being here particularly called to Figs. 1, 2, and 3, wherein the roll paper is indicated by the character $y$, the folded uncut sheet is indicated by the character $y^1$ and the severed napkin by the character $y^2$. Here it is desired to state, in advance, that in Figs. 1, 9, and 21, completely folded napkins are indicated by the character $y^2$.

Referring to Fig. 4, it will be noted that the paper roll spindle comprises a shaft 26 seated in open bearings 27 rigidly secured on extensions of the main frame 25. Rigidly, but adjustably secured on the intermediate portion of the shaft 26 are sleeves 28 provided with a plurality of pivoted roller gripping fingers 29 arranged to be expanded into contact with the interior of the paper roll, by cam-acting sleeve-like nuts 30 that have threaded engagement with said shaft 28. Obviously, these fingers 29 and nuts 30 afford concentrically expansible roller gripping devices that will engage rolls of different size bore and hold the roll concentric to the shaft.

At one end, the shaft 26 is provided with a grooved collar 31 that is detachably engaged by the free end of an arm 32 pivotally mounted on a sleeve-like nut 33 that works with threaded engagement on a stud 34 rigidly projected from the adjacent side of the supplemental frame 25. By adjustments of the nut 35, shaft 26, and hence, paper roller $y$ may be shifted axially, and this, for an important reason which will hereinafter appear.

From the roll $y$ on the spindle just described, the paper sheet passes over a guide roller 35, the shaft of which is journaled in a supplemental frame 25 on the main frame 25 and is provided at one end with a grooved pulley 36. To keep the sheet taut as it moves from the roll $y$ to the roller 35, a spring pressed friction board 37 (see Fig. 2) is pivoted to the main frame and yieldingly pressed against the roller.
From the guide roller 35, the paper sheet passes between primary feed rollers 37 and 38 (see Figs. 1 and 3), said rollers being arranged below the roller 35 with their axes at right angle to the vertical plane of the axis of said roller 35; but on its way to the said primary feed rollers, the sheet passes over a V-shaped former plate or folding board 39, adjusted to face in position by slotted arms 40 clamped to part of the supplemental frame 25* by a thumb nut 41, or the like. Hence, the paper sheet, in passing from the guide roller 35 between the primary feed rollers 37 and 38, is folded double on a fold line that is longitudinally of the paper sheet and should be midway between the edges thereof. This folding adjustment may be accomplished by turning of the nut 33, so as to axially adjust the spindle 20, and hence, the paper roll.

As the folded paper strip is moved further down, it passes between cutting rollers or drums 42 and endless feed belts 43. The drums 42 are secured to shafts 44 journaled in suitable bearings on the framework 25, and are connected to run together by gears 45. One of the drums 42 carries cutting knives 46 and the other drum carries cutting blocks 47 that co-operate with the said knives to cut the napkins the desired length, twot, the width of the original strip.

The opposing feed belts 43 are in the form of chains arranged to run over sprockets 48, 49 and 50, all of which sprockets are in the same plane and in front of the drums 42 (see particular Figs. 2 and 3). The sprockets 49 are loose on the shaft 44, the sprockets 50 are idle sprockets adjustedly mounted on the frame 25, and the sprockets 48 are driving sprockets carried by parallel shaft 51 journaled on the frame 25 and on a bearing 23 secured thereto (see particularly Fig. 7), which view also shows that the said shafts 51 are geared to run together by spur gears 52 and are provided at their rear ends with the sprockets 48 just noted.

At this point, attention is called to the fact that the cutting drums 42 are spaced so that they do not pinch or frictionally feed the paper strip 31. To produce the downward feeding action of the folded paper strip, the two opposing feed belts 43 are provided at suitable intervals with transversely projecting slats 53 that are equipped with flexible feed blades 54 (see Figs. 3, 7 and 13). The blades 54 of the opposing slats 53 of the two chains 48 work in pairs and they yieldingly grip the paper sheet and pull the same downward. By reference to Figs. 2 and 7, it will be noted that these feed blades 54 are offset from the chains 48 and positioned to work immediately above the cutting drums 42.

To hold the blades 54 in action against the paper strip the front ends of the slats 53, as they move vertically downward, are arranged to pass through guide grooves of a vertical guide bar 55, which, as shown, is rigidly secured at its lower end to a head 56 which, in turn, is supported by a pair of laterally spaced rods 56a that extend from front to rear of the frame 25, and at their front and rear ends are rigidly secured thereto. Here it may be noted that the front part of the frame 25 and the head 56 support lower rods 57 a short distance below the rods 56a, but that said rods 57 terminate considerably short of the rear of the frame 25 and, approximately, as shown in Fig. 7. These rods 56a and 57 perform a special function which will presently be noted.

For action on the folded paper strip 31 just above the rods 56, there is a pair of segmental so-called nipping rollers 58 (see Figs. 3 and 6) preferably provided with rubber faces to increase the frictional action thereof on the paper strip. These segmental nipping rolls 58 are carried by shafts 59 having sprockets 60 aligned with larger sprockets 61 carried by the cutter drum 44. Here attention is called to the fact that sprockets 61 are twice the diameter of sprockets 60, so that nipper rolls 58 will be given two rotations for each rotation of the cutter drum. Obviously, this gives a proper timed action for cutter drums provided with diametrically opposite cutting elements which will cut two paper napkins for each rotation of said cutter drum. Here it may be further stated that the nipping rolls are so timed that they engage the paper strip just before the napkin has been cut therefrom, and that the peripheral speed of the said nipping rollers is such that they will give the cut or severed napkin an accelerated downward movement. This accelerated movement insures the complete severance of the napkin from the strip and is especially important because the most approved form of cutter is a blade with serrated edge which closely punctures, but sometimes does not completely sever the napkin.

The so-called main folder is in the form of a thin segmental blade 62 that has parallel edges and is rigidly secured to the upper end of an arm 63 that is arranged to vibrate to and fro transversely of the machine. The said arm 63 is pivotally supported at its lower end and is rigidly secured to a rock shaft 64 journaled in suitable bearings on the main frame 25 and provided with a spur pinion 65 (see Figs. 3 and 7), by reference to which latter figure it will be noted that the vibratory arm 63 moves freely clear of the ends of the lower rods 57. Here it should also be noted that the blade 62 is arranged to move with but slight clearance between the upper and lower rods 56 and 57.
It is now time to note that the rods 56 and 57 are arranged in pairs, one pair on each side of a plane of the vertical movement of the folded paper web, and that they constitute the turning edges of segmental guide channels referred to in the introductory part of this description and which segmental guide channels extend in opposite directions outward and downward concentric to the axis of the rock shaft 64 and, in the construction illustrated, further comprise concentrically spaced plates 66 and 67. The outer plate 66 is supported from the main frame and may extend completely across the path of movement but outward of the folder blade 62, but the inner plate 67, which is preferably supported at one edge from the co-operating plate 66 must be terminated at its other edge out of the path of movement of the vibratory arm 63.

Adjacent to the lower portion of the outer plate 66 and rigidly secured in vertical position in respect to the main frame are called former plates 68 (see particularly Figs. 2, 3 and 11). These former plates are rigidly secured to and constitute the inner end plate of oppositely extended horizontal galleys or trough-like receptacles 69 for the folded napkin 2. These former plates are provided with oblique V-shaped former passages 58, best shown in Fig. 2, the lower edges of which openings are parallel to but slightly above the supporting surfaces of the respective galleys. In line with the V-shaped former passages 58, the lower portions of the channel guide plates 66 and 67 are provided with similar but somewhat larger passages 67, best shown in Fig. 5. Preferably, the former plates, at the perimeters of their openings or passages 58 are brought to sharp edges and turned slightly outward toward the galleys so as to better frictionally hold the napkins, as will presently appear.

The napkins when first cut and when delivered to the feed belts 43 will appear as shown in Fig. 18. The napkins, in this form, will be delivered in front of one edge or the other of the vibratory folder blade 62 and will be forced by alternate movements of the said blade, first one into the one segmental guide channel and then one into the other guide channel. Thus both movements of the folder blade are rendered operative and the folding action is substantially continuous. The folder blade will engage the napkin having its first fold, as shown in Fig. 18, at the dotted center line marked on Fig. 18, and as the napkins are forced between the upper and lower rods 56 and 57 and into the respective segmental guide channels, they will be given their second fold, as shown in Fig. 19, and in such form, will be delivered, first, one in front of the one former plate, and then one in front of the other former plate.

For forcing the napkins folded, as shown in Fig. 19, through the V-shaped passages 58 of the respective former plates, and to thereby initiate the V-shaped formation of the napkin, there is provided a reciprocating plunger provided at its opposite ends with V-shaped former heads of slightly smaller size than the said V-shaped opening 58. This plunger 70 has an approximately horizontal movement and, at its ends, is pivoted to the upper ends of supporting levers 71 which, at their lower ends, are pivotally connected to the main frame (see particularly Figs. 3 and 9). Rigidly secured to but offset slightly from the ends of the plunger 70 are supplemental plunger bars 72 to which flat faced V-shaped or approximately triangular former heads 73 are rigidly secured in position to work through correspondingly shaped but slightly larger openings 68 of the vertically set former plates 68. These former plates 68, it will be remembered, are secured to the ends of the respective galleys 69.

Working on the rear faces of the former heads 73 are tucker blades 75 shown as secured to the ends of spring arms 76 carried by the supplemental plunger bars 72. At the outer ends of the arms 76 are cam surfaces 76a adapted to be engaged by the diverging cam surfaces 77a of small sliding bars 77 carried by and movable on the respective supplemental bars 72. At their inner ends, the blade actuating slides 77b provided with projecting lugs 77c that are engageable with stop lugs 78 of the bracket 78 rigidly supported by the main frame 25 (see particularly Fig. 9). The tension of the springs 76 normally holds the tucker blades 75 retracted and the slides 77 slid inward.

The napkins shown folded in Fig. 19 are, as stated, delivered to the lower ends of the segmental guideway or channels and in front of the former passages 74 of the former plates 68. The plunger 70 is reciprocated with such timed action in respect to the oscillatory movement of the arm 65 and main fold blade 62, that as soon as the said blade is moved upward out of the way, after having deposited a napkin folded, as stated, the adjacent former head 73 will be moved through the adjacent former plate 68, thereby folding the napkin on diverging lines indicated by broken lines on Fig. 19 and carrying the napkin into the galleys, substantially as indicated by dotted lines in Fig. 9. While the napkin is pressed into the galley, as just stated, or while it is completing such movement, the lug 77c on the cam slide 77 comes into engagement with the co-operating stop lug 78, thereby stop-
ping the movement of the said slide while the plunger 70 makes a slightly further movement, and this causes the co-operating cam elements 76 and 77 to force the tucker blade 75 laterally outwardly beyond the diverging edges of the former head, thereby incising the width of the triangular fold of the napkin, so that the said napkin will not follow the plunger backward through the former plate, but will be pressed against and stopped by the same under the yielding pressure exerted by the stack of napkins y². Here it may be stated that the napkins in the galleys will be packed against sliding head blocks 79 shown in Fig. 1.

Under return movement of the plunger, and before the former head has been drawn backward to the former plate, lug 78² will be freed from stop lug 78 and tucker blades 75 will be retracted, so that they will pass freely through the opening 58 of the former plate 68. Of course, the above described action will take place alternately, that is, there will be first a delivery of the napkins to one galley and then to the other.

To positively prevent napkins, folded as shown in Fig. 19, and delivered to the lower ends of the segmental guideways, as above described, from being carried backward with the former plate 62, there are provided so-called strippers (see particularly Figs. 3 and 11), in the form of levers 80 immediately pivoted to brackets 81 on the main frame 25 and provided with sharp pin-like bars 82 arranged to work through openings in the inner plates of the segmental runways and to pass through notches 62² in the edges of the former plate 62. The lower ends of the two levers 80 are connected by a link 83 provided with roller-equipped studs 84 acted upon by a cam 85 carried and driven as hereinafter described. Here it may be stated that the cam 85 so operates on the studs 84 that the stripper pins 82 will be forced through the napkins, first on the one side and then on the other only during a short interval of time, while the segmental former blade 62 is being forced out of the folded napkin. Of course, the two strippers described are alternately thrown into action in the manner stated.

To complete the folding of the napkin to form shown in Fig. 21, and in Fig. 3, I provide a pair of reversely acting final fold blades 86 and 87 (see Figs. 3, 5 and 9) which work, one on each side of the forming passage 74 of each former plate 68. These two blades 86 and 87 are connected, respectively, to the hubs of short arms 88 and 89 pivoted on a short shaft 90 journaled to a bracket 91 on the main frame 25. Arm 88 is spring-pressed upward and arm 89 is spring-pressed downward, and the said arms, respectively, are connected to the upper ends of links 92 and 93 (see Fig. 5) operated as hereinafter described.

Here it may be further stated that after a napkin has been delivered into a galley and a plunger has receded out of the planes of movement of the blades 86 and 87, the upper blade first moves downward to fold the outer flap of the napkin, as shown in Fig. 20 and then the lower blade 86 moves upward to fold over the lower flap of the napkin, as shown in Fig. 21, thus completing the fold of the napkin so that the next napkin can be delivered against the same. Of course, the folding movements of the blades 86 and 87 at the opposite sides of the machine are alternated and properly timed in respect to the movements of the plunger and former heads. The two blades 86 and 87 work in closely adjacent planes and the blade 86 works closely against the inner surface of the co-operating former plate 68.

It is desirable that, the folded napkins not only be counted, but that in the stack, certain thereof be marked to indicate proper size packages, such for instance, as a package of 125 napkins. This device is shown in Figs. 1, 2, 3 and 8. It comprises a marker arm 94 pivoted to a short rock shaft 95 mounted in a suitable bearing on the main frame and provided with an arm 96 that is subject to a profile cam 97, journaled by a shaft 98, also journaled in a suitable bearing on the main frame. The bearing for this shaft, as shown, is afforded by two flat plates 99 spaced apart by and secured to the main frame by bolts 100 shown in Figs. 1 and 8. Secured to shaft 98 between the plates 99 is a ratchet wheel 101 actuated by a pawl 102 carried by a lever 103 pivoted on said shaft 98. The free end of this arm 103 is connected by a link 104 (see Fig. 1) to a crank pin 105 on the front end of shaft 44.

The ratchet wheel 101 may be assumed to have 125 teeth, in which case, once for each of the 125 napkins delivered into each galley, the free end of arm 96 will drop into the notch of cam 97 and thereupon, the sharp point of arm 94, under the action of a spring 106, will be thrown against the stack of napkins and indent or mark the same. In this duplicate arrangement of the markers, shaft 95 is extended from one side to the other of the machine and the two arms 94 are secured thereto.

Shaft 98 carries a cam 107 (see Fig. 8) that acts on the lower end of a rod 108 which, in turn, operates a tally or automatic register 109 of the usual or any suitable type.

The various different devices for performing the functions stated have now been noted, but in the operation thereof, as so far described, the driving mechanism has not been specifically noted, and it has been assumed that the various devices operate
with the timed action stated. The driving mechanism for performing the functions timed, as stated, will now be described.

Power for driving the machine may be transmitted thereto from a belt 110 shown as driven by a small electric motor 111 anchored to the machine frame 25. This belt 110 runs over the pulley 112 (see Figs. 1 and 2) that is normally loose on a short countershaft 113 journaled in suitable bearings on the frame 25. By means of a clutch 114, the pulley 112 will be coupled to the countershaft 113 at will. Countershaft 113 carries a smaller driving pulley 115 that drives a belt 116. Belt 116 runs also over a larger driving pulley 117 carried by a main countershaft 118, that is journaled in suitable bearings on the lower portion of the main frame and extends from front to rear thereof.

Main shaft 118 carries a driving sprocket 119 (see particularly Fig. 5). Preferably and for a purpose hereinafter noted, this sprocket 119 is made up of two half sections detachably bolted to the flange of a hub member 119a that is rigidly secured to the shaft 118. A sprocket chain 120 runs over the sprocket 119, over a sprocket 121 on the feed roller shaft 38, and over a sprocket 122 carried by one of the shafts 51 and which sprocket is of the same size as the aligned sprocket 48 and is shown only by breaking away of a portion of said sprocket 48 in Fig. 3. The chain 120 also runs against a belt tightening pulley 133 shown in Fig. 3. The two shafts 51 are geared to run together by the intermeshing gears 52 already noted.

Means has now just been described for driving the primary feed rollers 38 and the paper feeding chains 43. At this point, however, attention is called to the fact (see particularly Figs. 3 and 6), that the shaft 37 of the feed roller shaft 37 is journaled in slightly slidable bearings 125 pressed toward the roller 38 by coiled springs 126 that re-act against anchor brackets 127.

Main shaft 118 also carries a sprocket 128 that is aligned with a sprocket 129 carried by one of the cutter drum shafts 44 (see Figs. 2, 5), and thus the cutter drum shafts are driven from the main shaft.

Short sprocket chains 130 run over the aligned sprockets 61 of the cutter drum shaft 44 and the sprockets 60 of the nipper roll shaft 59 and thus the segmental tipping rollers 58 are driven as stated. (see Figs. 2 and 6).

The guide roller 35 might run idle, but as shown, its shaft is provided with a grooved pulley 131 over which a small driving belt of the cord type, or round type, is arranged to run. This belt 132 runs over idle guide sheaves 133 and over a grooved driving pulley 134 indicated by dotted lines in Figs. 1 and 2 which is on and driven by the shaft 39.

The numeral 135 indicates a hand wheel applied to the front end of one of the cutter drum shafts 44, and by means of which, the cutter drums and connected mechanism may be slowly rotated, when desired, as when first feeding the paper strip into the machine.

The gear 65 on the rock shaft 64 which carries arm 63, and hence the main feed blade 62, meshes with a gear segment 136 pivoted to the main frame, as best shown in Fig. 1. This gear segment is pivoted to one end of a pitman bar or rod 137, the other end of which is forked, so that it pivots and slides on a stud 138 secured to and projecting from the main frame. At its intermediate portion the pitman bar 137 has a vertically elongated rectangular guide loop 139 in which slides a rectangular crank sleeve 140 which, in turn, is pivoted on the crank pin of a crank arm 141 carried by the front end of the main shaft 118. Thus, under rotation of the main shaft 118, the main folding blade 62 will be oscillated back and forth with the timed action already described. By reference to Fig. 7 it will be noted that, as one means for preventing the napkin from slipping on the blade 62 while it is being forced through the segmental guide channel, the said plate is shown as provided, at its edges, with very small plungers 69. Main shaft 118 also carries an eccentric 142. The numeral 143 indicates a crank rod or pitman provided at one end with an eccentric strap 144 and pivotally connected at its other end to one of the plunger supporting arms 71; and thus the plunger bar 70 and the former heads 73 are reciprocated, as already stated. Here, however, attention is called to the fact that when the said plunger bar is in intermediate position, the two arms 71 converge slightly upward and toward each other. If the said arms were parallel, the particular former head being thrust outward or into action, would be given more or less vertical movement which would not be desirable, but with the arrangement of the arms 71 described, there will be a sort of neutralized action between the movements of the two heads with the result that the head that is being given an operative movement or forced against a napkin will be moved substantially on a horizontal line.

To operate the so-called final fold blades 86 and 87, as described, the main shaft 118 is provided with two cams 145 and 146. These cams are substantially alike, but the one is set about 180 degrees ahead of the other.

The numeral 147 indicates upper and lower relatively long levers that are intermediately pivoted on upper and lower fixed
studs 148 that are provided at their inner ends with offset rollers 149 and 151 that are engaged, respectively, with the upper and lower portions of the cams 145 and 146.

The numeral 150 indicates upper and lower relatively short levers which, at their inner ends, are pivoted, respectively, on the upper and lower studs 148, and at their intermediate portions, are provided with rollers 149 and 151 that work, respectively, against the upper and lower portions of the cams 146 and 145. The upper lever 147 and the lower lever 150 will be given positive downward movements by the engaged cams, and hence, the links 98 which operate the folder blades 87 at the opposite sides of the machine are connected to the outer ends of these two levers. The other ends of the lower lever 147 and the upper lever 150 are given positive upward movements by the cams located some distance from said ends. Hence, the links 92 that operate the two folder blades 88 at the opposite sides of the machine, are connected to the outer ends of said latter noted two levers. The said levers are spring-retracted so that their rollers will always be held in engagement with their co-operating cams, by means of coiled springs 152 and 153 shown in Fig. 5. The levers just described are also shown, to some extent, in Fig. 3. It will be noted that the levers that are connected to corresponding final folder blades at the opposite sides of the machine are subject, one to the upper and the other to the lower portion of one of the two cams 145 and 146, so that the action of corresponding blades at the opposite sides of the machine will be alternated and timed, as already above assumed.

In Figs. 25, 26 and 27, there is illustrated a modified form of the so-called main folder blade. This main folder blade, which is a substitute for the fold blade 92, above described, is indicated by the numeral 154 and is provided at its central portion with a large notched 155 through which the slats 53 and blade 54 of the feed chains 43 are adapted to pass, the said parts being timed so that this action will take place. The edges of this blade are provided with notches 156 that correspond with notches 62 of the blade 62. This blade 53 requires less movement than the blade 62 and hence, permits the machine to run at higher speed. For preventing the paper from slipping on the surface of the blade 154 I have provided small rollers 157 loosely journaled on laterally spaced fixed supporting rods 158 located, one on each side of the center of the machine. To prevent the paper from sticking by vacuum or by magnetic action to the surfaces of the blade 154, said blade is shown as provided with corrugations or ribs 159.

What I claim is:

1. A machine for severing and folding paper napkins having in combination, means for drawing a strip of paper from a roll and folding the same along a substantially central longitudinal line, means for cutting said sheet into lengths, a pair of arcuate guideways having a space therebetween, means for advancing said lengths into said space, and means for alternately moving said lengths into said guideways to fold the same.

2. A machine for folding paper napkins having in combination, a guideway, means for folding and conveying the napkins therethrough, a segmental guideway at each side of said guideway and an oscillating arm movable on an axis located at the center of the arc of the curve of said segmental guideways and provided with a folder that is movable alternately into said segmental guideways and operating to fold the napkins in the act of delivering the same alternately through said segmental guideways.

3. A machine for folding paper napkins comprising a segmental guideway, an oscillatory arm movable on an axis located at the center of the arc of the curve of said guideway and provided with a folder that is movable into said guideway and operating to fold the napkins in the act of delivering the same through said guideway, means at the delivery end of said guideway for further folding the napkins, said latter means comprising a former having an approximately V-shaped passage and a plunger having an approximately V-shaped head working through the passage of said former.

4. A machine for folding paper napkins comprising, a segmental guideway, an oscillating arm movable on an axis located at the center of the arc of said guideway and provided with a blade that is movable into said guideway and operating to fold the napkins in the act of delivering the same through said guideway, means adjacent the delivery end of said guideway for further folding the napkins, said latter means comprising a former having an approximately V-shaped passage and a plunger having an approximately V-shaped head working through the passage of said former, a galley receiving the napkins from said former, said former having tucker blades movable substantially in opposite directions, all of said elements being operated by properly timed actions.

5. A machine for folding paper napkins comprising oppositely extended arcuate guideways, means for delivering napkins between the same, a main folder movable alternately into said guideways and operative to fold the napkins in the act of delivering the same through said guideways, and means at the delivery ends of said guideways operative to further fold the napkins.

6. A machine for folding paper napkins...
comprising oppositely extended arcuate guideways, means for delivering napkins between the same, a main folder movable alternately into said guideways and operative to fold the napkins in the act of delivering the same through said guideways, means at the delivery ends of said guideways operative to further fold the napkins into approximately triangular formation, and galleys and co-operating devices receiving the napkins thus folded and holding the same in form while they are being accumulated.

7. A machine for folding paper napkins comprising oppositely extended guideways, means for delivering napkins between the same, a main folder movable alternately into said guideways and operative to fold the napkins in the act of delivering the same through said guideways, means at the delivery ends of said guideways operative to further fold the napkins, and strippers at the delivery ends of said guideways operative to prevent the napkins from returning with said main folder.

8. A machine for folding paper napkins comprising oppositely extended guideways, means for delivering napkins between the same, a main folder movable alternately into said guideways and operative to fold the napkins in the act of delivering the same through said guideways, means at the delivery ends of said guideways operative to further fold the napkins, said latter means comprising formers having approximately V-shaped passages adjacent to the delivery ends of said guideways, and alternately acting former heads movable through the passages of said formers.

9. A machine for folding paper napkins comprising oppositely extended guideways, means for delivering napkins between the same, a main folder movable alternately into said guideways and operative to fold the napkins in the act of delivering the same through said guideways, means at the delivery ends of said guideways operative to further fold the napkins, said latter means comprising formers having approximately V-shaped passages adjacent to the delivery ends of said guideways, alternately acting former heads movable through the passages of said formers, said former heads having successively acting tuckers blades at their diverging edges, and means for spreading said former blades when said heads are projected through said formers.

10. A machine for folding paper napkins comprising oppositely extended guideways, means for delivering napkins between the same, a main folder movable alternately into said guideways and operative to fold the napkins in the act of delivering the same through said guideways, means at the delivery ends of said guideways operative to further fold the napkins, said latter means comprising formers having approximately V-shaped passages, and a plunger having at its opposite ends approximately V-shaped former heads movable through the passages of said formers.

11. A machine for folding paper napkins comprising oppositely extended segmental guideways formed by spaced plates and having a common center, means for delivering the napkins between the same, an oscillatory main folder pivotally movable on an axis at the center of the curve of said guideways, alternately into said guideways and operative to deliver the napkins therethrough and to fold the same by such operations, and means at the delivery ends of said guideways for completing the folding of the napkins into approximately triangular formation.

12. A machine for folding paper napkins comprising oppositely extended segmental guideways having a common center, means for delivering the napkins between the same, an oscillatory main folder pivotally movable on an axis at the center of the curve of said guideways, alternately into said guideways and operative to deliver the napkins therethrough and to fold the same by such operations, and means at the delivery ends of said guideways for completing the folding of the napkins into approximately triangular formation.
said formers, yieldingly retracted Tucker blades on the diverging edges of said former heads, and means for spreading said Tucker blades while said heads are projected through said formers.

15. A machine for folding paper napkins comprising oppositely extended guideways, means for delivering napkins between the same, a main folder movable alternately into said guideways and operative to fold the napkins in the act of delivering the same through said guideways, means at the delivery ends of said guideways operative to further fold the napkins, said latter means comprising formers having approximately V-shaped passages, a plunger having at its opposite ends approximately V-shaped former heads movable through the passages of said formers, yieldingly retracted Tucker blades on the diverging edges of said former heads, means for spreading said Tucker blades while said heads are projected through said formers, pivoted primary and secondary final folding blades adjacent to the inner face of said formers, and means for operating the said elements with properly timed actions.

16. A machine for folding paper napkins comprising oppositely extended guideways, means for delivering napkins between the same, a main folder movable alternately into said guideways and operative to fold the napkins in the act of delivering the same through said guideways, means at the delivery ends of said guideways, said latter means comprising formers having approximately V-shaped passages, a plunger having at its opposite ends approximately V-shaped former heads movable through the passages of said formers, yieldingly retracted Tucker blades on the diverging edges of said former heads, means for spreading said Tucker blades while said heads are projected through said formers, and galleys receiving the napkins from said formers and provided with yieldingly movable abutments against which the napkins are packed.

17. A machine for folding paper napkins comprising downwardly and oppositely curved segmental guideways, means for folding the paper strip and for cutting the same into napkins and for delivering the same between the upper receiving ends of said guideways, an oscillatory folder blade movable alternately into said guide channels and operative to fold the napkins in the act of delivering the same through said guideways, and means at the delivery ends of said guideways for completing the folding of the napkins.

18. A machine for folding paper napkins comprising means for feeding and primarily folding a paper napkin strip, oppositely and downwardly extended segmental guideways, co-operating cutting rollers operative to cut the folded strip into napkins, co-operating blade-equipped feed belts operative to carry the napkins between the upper receiving ends of said guideways, and an oscillatory arcuate main folder blade movable alternately into said guideways and operative to fold the napkins in the act of delivering the same therethrough.

19. A machine for folding paper napkins comprising downwardly and oppositely curved segmental guideways, means for folding a paper strip and for cutting the same into napkins and for delivering the same between the upper receiving ends of said guideways, an oscillatory folder blade movable alternately into said guide channels and operative to fold the napkins in the act of delivering the same through said guideways, means at the delivery ends of said guideways for completing the folding of the napkins, and co-operating segmental nipping rollers operative to accelerate the movement of the napkins from said cutting rolls to position between the receiving ends of said guideways, said main folder being timed to catch the napkins approximately at their central portions.

20. A machine for folding paper napkins comprising means for feeding and primarily folding a paper napkin strip, oppositely and downwardly extended segmental guideways, co-operating cutting rollers operative to cut the folded strip into napkins, co-operating blade-equipped feed belts operative to carry the napkins between the upper receiving ends of said guideways, an oscillatory main folder blade movable alternately into said guide channels and operative to fold the napkins in the act of delivering the same therethrough, and co-operating segmental nipping rollers operative to accelerate the movement of the napkins from said cutting rolls to position between the receiving ends of said guideways, said main folder being timed to catch the napkins approximately at their central portions.

21. A machine for folding paper napkins comprising downwardly and oppositely curved segmental guideways, means for folding the paper strip and for cutting the same into napkins and for delivering the same between the upper receiving ends of said guideways, an oscillatory arcuate folder blade movable alternately into said guide channels and operative to fold the napkins in the act of delivering the same through said guideways, and means at the delivery ends of said guideways for completing the folding of the napkins, and means at the lower delivery ends of said runways for accumulating the same.

22. A machine for folding paper napkins comprising means for feeding and primarily folding a paper napkin strip, oppositely
and downwardly extended segmental guideways, co-operating cutting rollers operative to cut the folded strip into napkins, co-operating blade-equipped feed belts operative to carry the napkins between the upper receiving ends of said guideways, an oscillatory main arcuate folder blade moveable alternately into said guideways and operative to fold the napkins in the act of delivering the same therethrough, and co-operating segmental nipping rollers operative to accelerate the movement of the napkins from said cutting rolls to position between the receiving ends of said guideways, said main folder being timed to catch the napkins approximately at their central portions, and means at the lower delivery ends of said guideways for completing the folding of the napkins, said latter means comprising former plates having approximately V-shaped passages, co-operating properly timed alternately acting approximately V-shaped former heads movable through the passages of said formers, and galleys receiving and holding the accumulated folded napkins.

25. In a machine for folding paper napkins, the combination with oppositely extended guideways spaced apart at their receiving ends, of a main folder movable alternately into said guideways, co-operating paper strip feeding and folding means, napkin cutting devices operated on the folded strip, co-operating endless feed belts having blades operative to carry the primary folded and cut napkins between the receiving ends of said guideways, and intermittently acting nippers operative on the napkins to accelerate the movements thereof to position where they will be alternately engaged by the opposite edges of said main folder, the latter serving to fold the napkins in the act of delivering the same through said guideways.

24. In a machine for folding paper napkins, the combination with oppositely extended guideways separated at their receiving ends, of a main folder movable alternately into said guideways, co-operating paper strip feeding and folding means, napkin cutting devices operated on the folded strip, co-operating endless feed belts having blades operative to carry the primary folded and cut napkins between the receiving ends of said runways, intermittently acting nippers operative on the napkins to accelerate the movements thereof to position where they will be alternately engaged by the opposite edges of said main folder, the latter serving to fold the napkins in the act of delivering the same through said guideways for preventing return of the napkins with the said main folder, and means at the delivery ends of said guideways for completing the folding of the napkins.

25. In a machine for folding paper napkins, the combination with oppositely extended guideways spaced apart at their receiving ends, of a main folder movable alternately into said guideways, co-operating paper strip feeding and folding means, napkin cutting devices operated on the folded strip, co-operating endless feed belts having blades operative to carry the primary folded and cut napkins between the receiving ends of said guideways, intermittently acting nippers operative on the napkins to accelerate the movements thereof to position where they will be alternately engaged by the opposite edges of said main folder, the latter serving to fold the napkins in the act of delivering the same through said guideways for preventing return of the napkins with the said main folder, and means at the delivery ends of said guideways for completing the folding of the napkins.

26. In a machine for folding paper napkins, the combination with oppositely extended guideways spaced apart at their receiving ends, of a main folder movable alternately into said guideways, co-operating paper strip feeding and folding means, napkin cutting devices operated on the folded strip, co-operating endless feed belts having blades operative to carry the primary folded and cut napkins between the receiving ends of said guideways, intermittently acting nippers operative on the napkins to accelerate the movements thereof to position where they will be alternately engaged by the opposite edges of said main folder, the latter serving to fold the napkins in the act of delivering the same through said guideways, alternately acting strippers at the delivery ends of said guideways for preventing return of the napkins with the said main folder, means at the delivery ends of said guideways for completing the folding of the napkins, said latter means comprising former plates having passages through which the napkins are to be forced, alternately acting former heads movable through the passages of said formers.

27. In a machine for folding paper napkins, the combination with oppositely extended guideways and a main folder blade
movable alternately into the same, a pair of opposing suitably guided and driven feed belts having co-operating blades operative to carry the napkins between the receiving ends of said guideways, knife and abutment equipped co-operating cutting rolls for cutting the paper strip into napkin lengths approximately as the paper strip is delivered to the opposing portions of said feed belts, co-operating segmental nipping rolls driven with a properly timed action and operative to engage the napkins approximately at the time that they are cut from the paper strip, and to accelerate the downward movement thereof to position between the receiving ends of said guideways, the said main folder being timed to engage the received napkins alternately at opposite sides and at the intermediate portions of the napkins, and serving to fold the napkins in the act of delivering the same through said guideways.

28. In a machine for folding paper napkins, the combination with oppositely and downwardly curved guideways comprising spaced plates formed about a common center at spaced apart at their upper receiving ends, of means for delivering napkins between the receiving ends of said guideways, an oscillatory arm having a laterally projecting segmental main folder blade concentric with said guideways movable alternately into said guideways to push the napkins into said guideways to fold the same.

29. A napkin folding machine having in combination, means for drawing a sheet of paper from a roll, folding the same along a substantially central longitudinal line, means for cutting the folded sheet into lengths, oppositely disposed guideways between which said folded sheet lengths pass, and an oscillating arcuate blade adapted to fold said lengths into said guideways.

30. A napkin folding machine having in combination a pair of reversely disposed arcuate guideways having open ends spaced apart and each having parallel sides, means for feeding sheets between said guideways, and an oscillating member for moving said sheets alternately into said guideways to fold the same.

31. A machine for folding paper napkins comprising a guideway, means for delivering napkins to the receiving end of said guideway, a main folder movable into said guideway and operative to fold the napkins in the act of delivering the same through said guideway, means at the rear end of said guideway for further folding said napkins, said latter means comprising a former through which the partially folded napkins may be forced, a reciprocating folder head for forcing the napkins through said former, tucker blades carried by said folder head, a device for spreading said tucker blades when said head is forced through said former, means for retracting said tucker blades to permit said head to be moved backward through said former, a pair of final fold blades working adjacent to said former, and means for moving said final fold blades, one after the other.

32. A machine for folding paper napkins comprising a guideway, means for delivering napkins to the receiving end of said guideway, a main folder movable into said guideway and operative to fold the napkins in the act of delivering the same through said guideway, means at the rear end of said guideway for further folding said napkins, said latter means comprising a former through which the partially folded napkins may be forced, a reciprocating folder head for forcing the napkins through said former, tucker blades carried by said folder head, a device for spreading said tucker blades when said head is forced through said former, a pair of final fold blades working adjacent to said former, and means for moving said final fold blades, one after the other.

33. In a napkin folding machine, the combination with a former, of a former head movable to force partially folded napkins through said former, yieldingly retracted tucker blades on said former head, means for spreading said tucker blades when said former head is moved through said former, and means for retracting said tucker blades.

34. In a napkin folding machine, the combination with a former, of a former head movable to force partially folded napkins through said former, yieldingly retracted tucker blades on said former head, means for spreading said tucker blades when said former head is moved through said former, means for retracting said tucker blades, a galley receiving the folded napkins from said former, and final folding blades operative adjacent to said former.

35. A machine for folding napkins comprising, a folding board for folding a strip of material longitudinally, carrying rollers for advancing said folded strip, means for cutting said strip into successive sections, means for guiding said sections alternately in different directions, a moving member for moving said sections into said guiding means, forming plates to which the said member delivers the said sections, a plunger for pressing the central portion of the said sections into said forming plates, and auxiliary means adjacent each forming plate for folding the edges of said sections down and over the said central portions.

36. A machine for folding napkins comprising a folding board, creasing rolls, movable guiding members for directing the certain passage of the paper, cutting means, means for withdrawing the cutoff portion of the paper, a central folding blade...
passing across the line of travel of the cutoff portions of the paper, formers with open spaces at each end of the line of travel of the central folding member, pressing members operating through the open spaces alternately with the movement of said folding member, and auxiliary members operating respectively successively over said open spaces after the removal of the said folding member and before the withdrawal of the pressing member.

37. A machine for folding napkins, comprising a folding board, rolls, means for guiding the paper below the rolls, a revolving cutter on one of the rolls and a resilient block on the roll opposite said cutter against which said cutter impinges, means for moving the severed portion of the paper faster than the uncut portion thereof, and means for folding the cutoff portions of the paper into a plurality of folds.

38. A machine for folding napkins having in combination, a central guideway, oppositely extending guideways having open ends adjacent the end of said central guideway, a member movable alternately into said last mentioned guideways for delivering articles issuing from said central guideway therein, former plates adjacent the ends of said oppositely extending guideways, and a member having heads at each end movable alternately into said former plates for moving said articles therein.

39. In a napkin folding machine, means for feeding forward a sheet of material, means for folding said sheet longitudinally, a central guideway for said folded material, means for severing the napkins from said folded sheet, means for again folding said napkins and advancing the same alternately at each side of said guideway, means for again folding said napkins which have been advanced at each side of said central guideway into triangular form and delivering the same to holding means.

40. A napkin folding machine having in combination, spaced oppositely disposed segmental open-ended flat conduits curved about a common center, a curved blade centrally disposed between said conduits and carried on an arm pivoted at the center of said conduits, means for moving a folded napkin between said blade and the adjacent ends of said conduits, and means for oscillating said blade alternately to carry said folded napkins into and through said conduits to further fold said napkins.

41. A machine for folding napkins having in combination, means for preliminarily folding a napkin into substantially rectangular form, former plates adjacent said means having openings therethrough, and plunger-carried heads shaped similarly to said openings and movable through said openings to push and fold napkins therethrough and further fold the same.

In testimony whereof I affix my signature.

AARON GROFF.