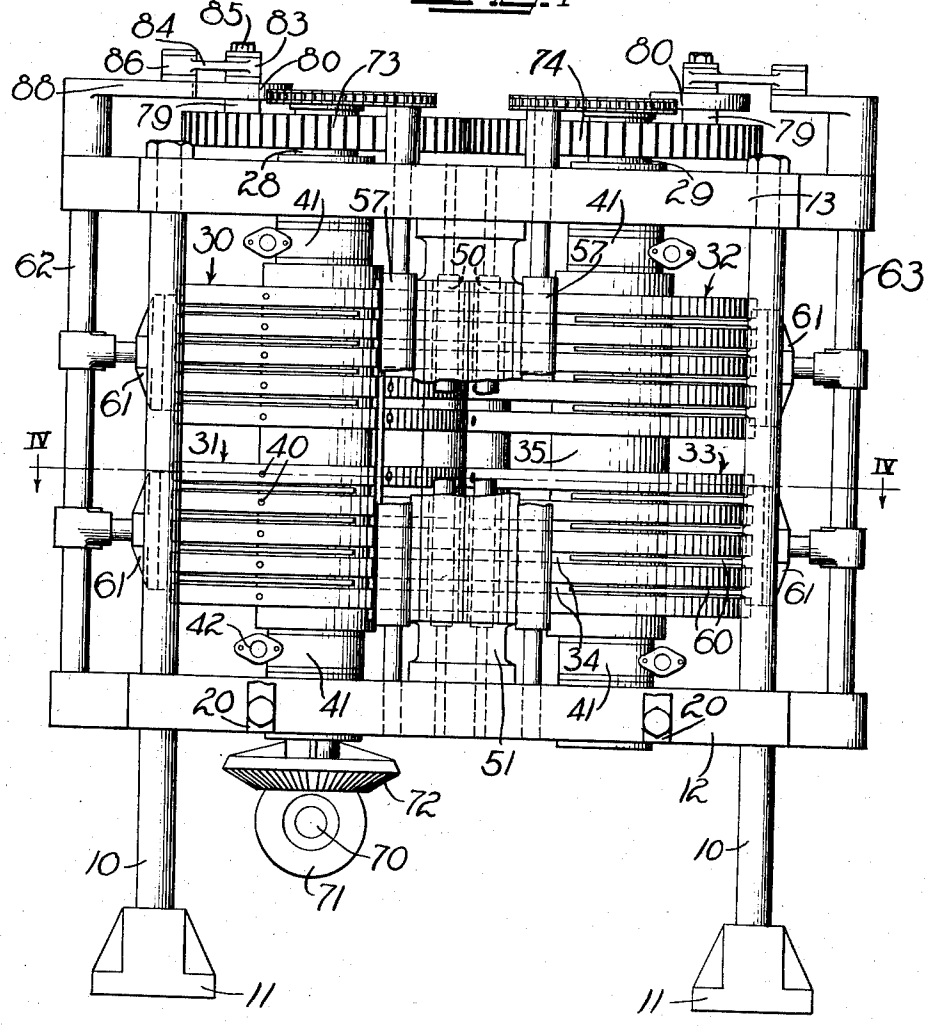
July 11, 1939. P. J. CHRISTMAN 2,165,786

PAPER NAPKIN MACHINE

Filed May 22, 1937 4 Sheets-Sheet 1

Fig. 1



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PAPER NAPKIN MACHINE

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Fig. 2

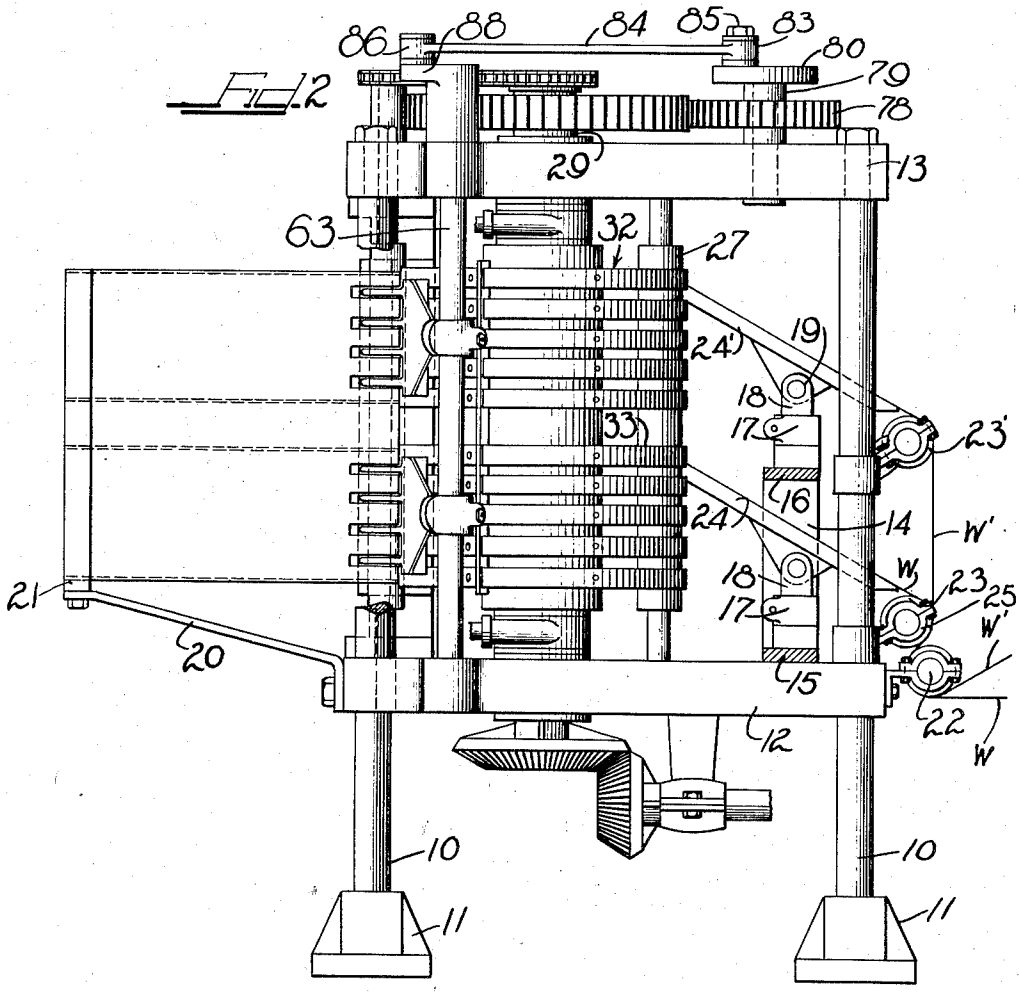
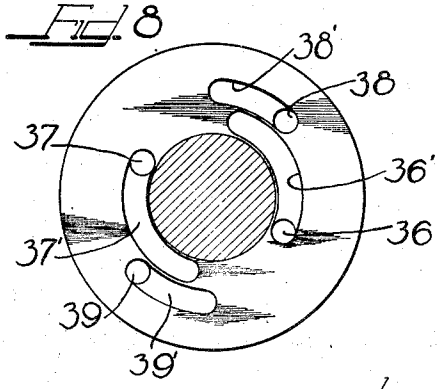


Fig. 8



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Fig. 3

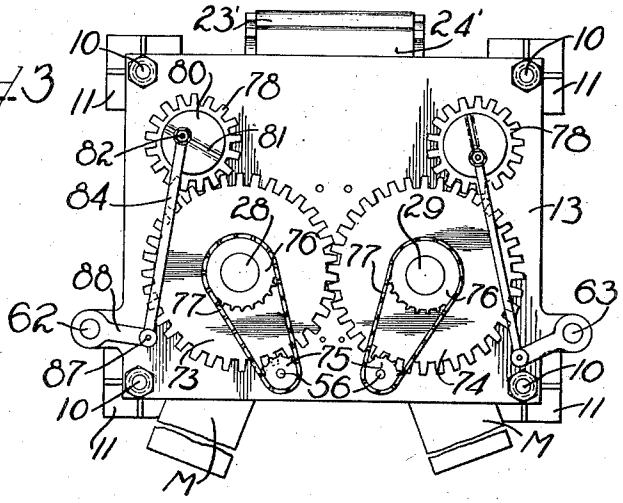


Fig. 5

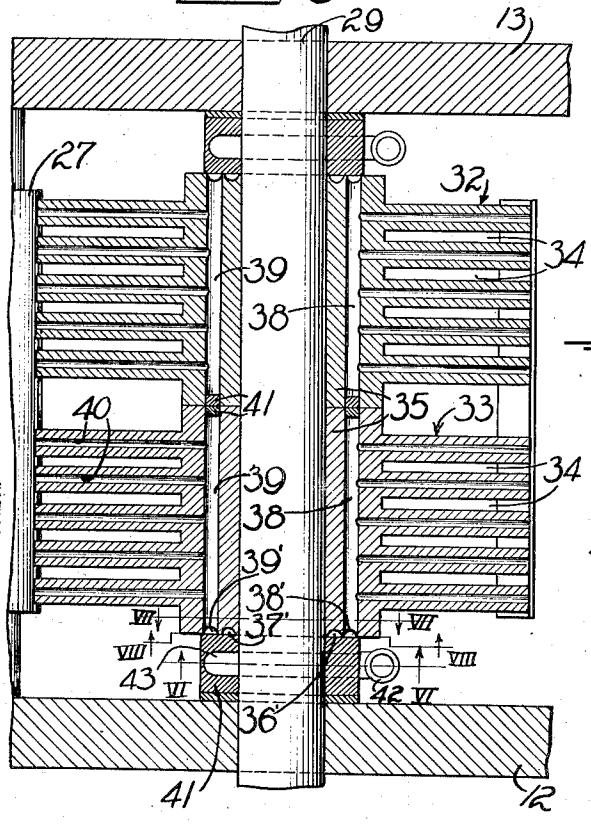


Fig. 7

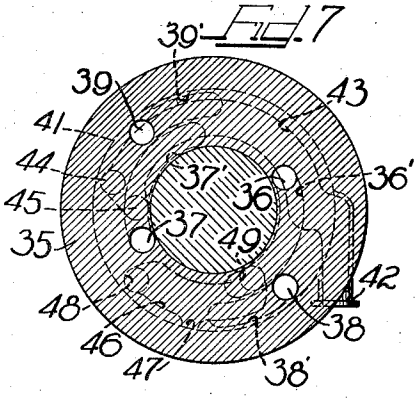
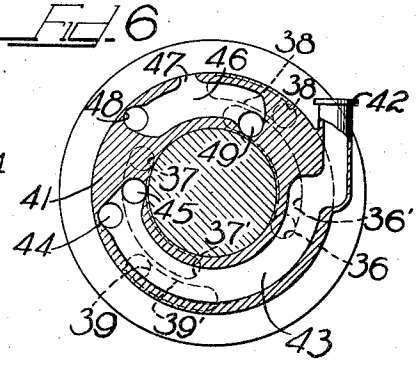


Fig. 6



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PAPER NAPKIN MACHINE

Filed May 22, 1937 4 Sheets-Sheet 4

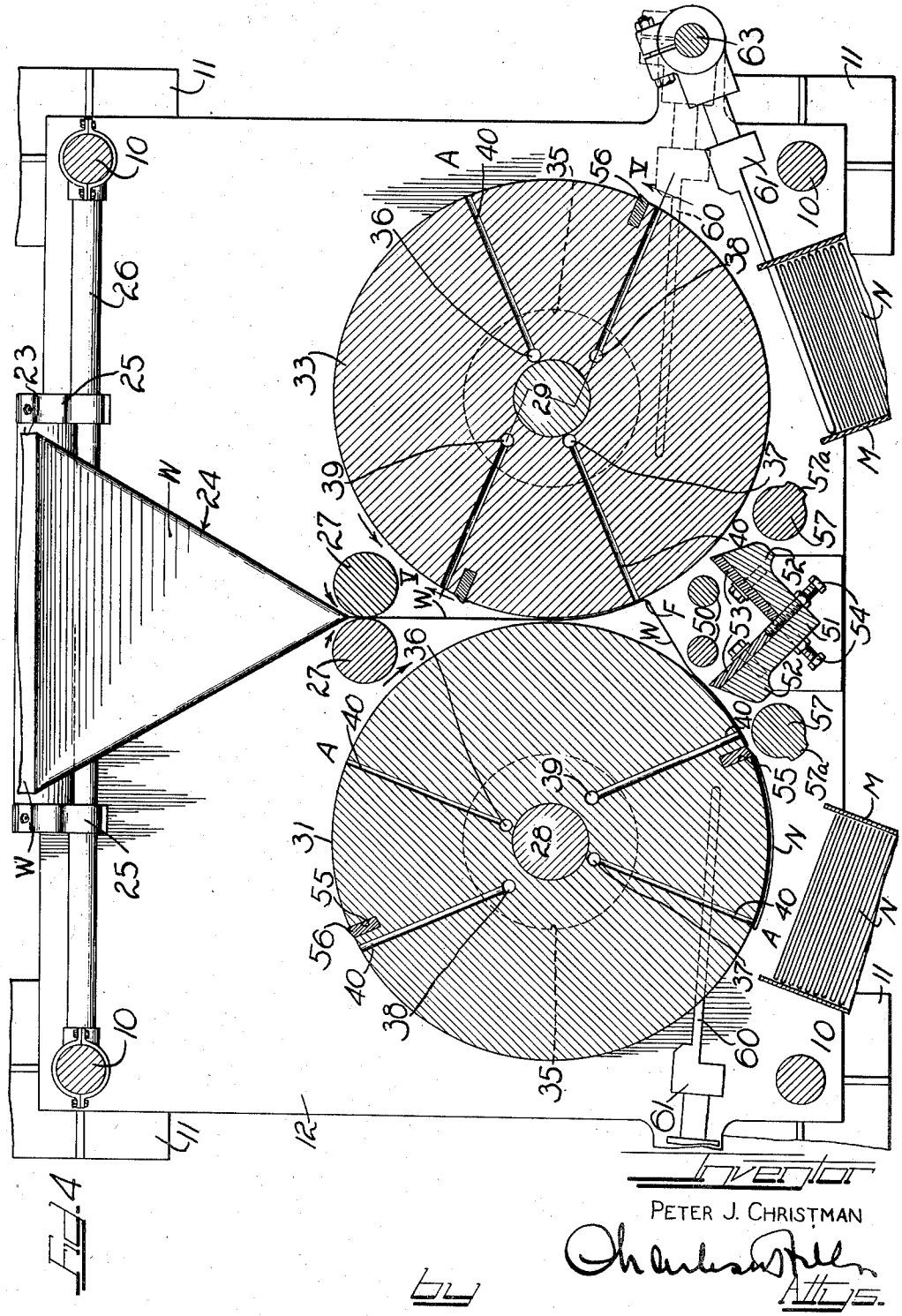


Fig. 4

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UNITED STATES PATENT OFFICE

2,165,786

PAPER NAPKIN MACHINE

Peter J. Christman, Green Bay, Wis., assignor to Paper Converting Machine Co., Green Bay, Wis., a corporation of Wisconsin

Application May 22, 1937, Serial No. 144,147

20 Claims. (Cl. 270—66)

This invention relates to a web folding and severing machine and more specifically relates to a paper napkin folding machine.

The machines of this invention include a pair of cooperating folding rolls adapted to receive a web of paper into the nip therebetween. Suction or other means are associated with each of the cooperating folding rolls for gripping selected portions of the web against the rolls. The operation of the suction means is so synchronized and arranged that the leading end of the web is folded alternately against first one roll and then the other. Thus, while the leading end of the web is held against one of the rolls, the suction means becomes effective to engage an intermediate portion of the web against the other cooperating roll. As the rolls continue to rotate, the leading end of the web is released and guided over to the roll against which the intermediate portion of the web is held to thus effect a fold in the web. A severing device is provided in the machine for severing the folded portion of the web from the remaining portion of the web while so held against one or the other of the folding rolls. Strippers effect the removal of the folded web portions after the severing operation.

The web may be fed into the nip of the cooperating rolls in a longitudinally folded form, whereupon the rolls effect a transverse fold in the longitudinally folded web.

An important feature of these machines resides in the mounting of a plurality of folding rolls in superimposed relation upon the same shaft so that a plurality of webs can be folded at the same time. While the machine will be hereinafter described as including two pairs of cooperating folding rolls, it should be understood that one pair or any number of pairs of folding rolls can be used.

It is then an object of this invention to provide a web folding machine capable of handling a plurality of webs simultaneously.

A further object of this invention is to provide a paper napkin folding machine operable at high speed without injury to the paper.

A further object of this invention is to provide improvements in machines for folding paper napkins, towels and any web material.

Another object of this invention is to provide a synchronized suction gripping mechanism on web folding machines.

A specific object of this invention is to provide a paper napkin folding machine including cooperating folding rolls, or a plurality of such rolls, for receiving a paper web into the nips therebetween, together with means for gripping the web along the anticipated lines of fold against alternate rolls and severing the so held folded portions.

Other and further objects of this invention will become apparent to those skilled in the art from the following detailed description of the annexed sheets of drawings which disclose a preferred embodiment of the invention.

On the drawings:

Figure 1 is a front elevational view of the folding machine of this invention with parts broken away.

Figure 2 is a side elevational view of the machine.

Figure 3 is a top plan view of the machine.

Figure 4 is a cross-sectional view, with parts in elevation, taken substantially along the line IV—IV of Figure 1.

Figure 5 is a cross-sectional view, with parts in elevation, taken substantially along the line V—V of Figure 4.

Figure 6 is a cross-sectional view, with parts in elevation, taken substantially along the line VI—VI of Figure 5.

Figure 7 is a cross-sectional view taken substantially along the line VII—VII of Figure 5.

Figure 8 is a cross-sectional view taken substantially along the line VIII—VIII of Figure 5.

As shown on the drawings:

The frame structure

As best shown in Figures 1 to 4 inclusive, the reference numerals 10 designate four vertical posts mounted on pedestals 11. The posts 10 support lower and upper plates 12 and 13 respectively. As best shown in Figure 2, the plate 12 carries at the back end thereof a rectangular strap 14 having a flat side 15 thereof secured to the plate 12 and a top flat side 16 spaced above the plate.

The bottom side 15 and the top side 16 of the strap 14 supports bosses 17 which receive shanks 18 of eye members 19. The shanks 18 can be vertically adjusted in the bosses 17 and the bosses 17 can be adjusted longitudinally along the sides 15 and 16 of the strap 14.

The front end of the plate 12, as best shown in Figure 2, carries forwardly extending brackets such as 20, which brackets 20 support vertical frames 21 in spaced relation in front of the main frame. The frames 21 carry the napkin receiving magazines as will be more fully hereinafter described.

The web feeding structure

As best shown in Figure 2, webs W and W' slit from a jumbo roll of paper (not shown) are directed under a guide roll 22. The web W passes around a breast roll 23 onto a triangular forming plate 24 swivelly mounted on the eye member 19. The web W' is directed around another breast roll 23' spaced above the breast roll 23 and from the breast roll 23 passes onto a triangular plate 24' swivelly carried in the eye member 19 supported on the upper side 16 of the bracket 14 as described above.

As best shown in Figure 4, the plate 24 is triangular in shape with the base thereof adjacent the breast roll 23. The breast roll 23 is rotatably mounted at its ends in brackets 25 carried by a cross rod 26 secured to the back posts 10.

The plates 24 and 24' are adjusted on the eye members 19 at a proper incline so that the apices of the plates are in position to feed the webs W and W' to proper places in the machine. The plates are then locked in adjusted position.

The apices of the triangular plates 24 and 24' are disposed between vertical feed rolls 27 rotatably mounted in the frame plates 12 and 13 and driven as will be hereinafter described.

As the webs W and W' pass over the plates 24 and 24' into the nip between the rolls 27, they are folded longitudinally by being drawn over the edges of the plates, as is well known in the art.

The creased webs W and W' are directed from the feed rolls 27 into the nips of folding rolls.

The folding rolls

The plates 12 and 13 of the frame rotatably support vertical shafts 28 and 29 extending between the plates. The portion of shaft 28 between the plates 12 and 13 of the frame carries rolls 30 and 31 in spaced superimposed relation. The shaft 29 carries rolls 32 and 33 in horizontal alignment with the rolls 30 and 31.

The rolls 30 and 32 and the rolls 31 and 33 cooperate with each other to form cooperating pairs of folding rolls. The rolls 30 and 32 handle the web W' while the rolls 31 and 33 handle the web W.

Each roll 30 to 33 inclusive is provided with a plurality of circumferential slots 34 for a purpose to be hereinafter more fully described. The slots 34 terminate in spaced relation from the hubs 35 of the rolls as best shown in Figure 5. As best shown in Figure 5, the hub of the roll 32 is superimposed on top of the hub 35 of the roll 33. It should be understood that additional rolls may be superimposed on the roll 32 or disposed below the roll 33 in larger size machines without departing from the scope of this invention.

The web gripping mechanism

As best shown in Figure 4, the roll 31 has vertical bores 36 and 37 extending through the hub 35 thereof adjacent to the shaft 28 carrying the roll. The bores 36 and 37 are in substantially diametrically opposed relation.

The hub 35 of the roll 31 also has bores 38 and 39 extending vertically therethrough in diametrically opposed relation. The bores 38 and 39 are spaced further from the shaft 28 than are the bores 36 and 37.

Each bore 36 to 39 communicates with the outer periphery of the roll 31 through a plurality of horizontal bores 40. The rolls 30, 32 and 33 are of identical construction.

As best shown in Figure 5, the vertical bores through the hub 35 of the rolls such as the bores 38 and 39 do not communicate with the superimposed roll but are closed at the points where the hub 35 of the rolls contact by means of sealing rings 41.

As best shown in Figures 5 to 8, the vertical bore 36 communicates with an arcuate groove 36' at the base of the hub 35 of the roll 33. Likewise the vertical bore 37 communicates with an arcuate groove 37'; the vertical bore 38 communicates with an arcuate groove 38'; and the vertical bore 39 communicates with an arcuate groove 39'.

The roll 33 has the same construction at the base of its hub 35 while the top rolls 30 and 32 have the same construction at the tops of their hubs 35.

Stationary valves such as 41 are loosely mounted upon the roll supporting shafts 28 and 29 adjacent the arcuate grooves in the hubs of the rolls.

Each valve 41 has an outlet 42 for connection with a vacuum pump or other source of suction. The outlet 42 communicates with an arcuate chamber 43 in the valve as best shown in Figure 6. This chamber 43 has an opening 44 for communicating with the outer grooves 38' and 39' of the rolls. The chamber 43 also has an opening 45 for communicating with the inner grooves 36' and 37' of the rolls.

The valve 41 also has a chamber 46 communicating with the atmosphere at 47 in the outer periphery of the valve. The chamber 46 has an opening 48 for communicating with the outer grooves 38' and 39' of the rolls and a second opening 49 for communicating with the inner grooves 36' and 37' of the rolls.

The arcuate grooves 36' to 39' in the rolls are arranged to communicate with the suction chamber 43 of the valve and with the exhaust chamber 46 of the valve at regular predetermined periods during a revolution of a roll. The horizontal bores 40 communicating with the periphery of the roll are thus subjected to suction at the desired point during the revolution of the roll and this suction is held for the desired period of time until the suction is broken when the grooves communicating with the bores pass over the exhaust openings 48 and 49 in the valve.

As best shown in Figure 4, therefore, as the leading end of the web W enters into the nip between the rolls 31 and 33, the vertical bore 39 of the roll 31 communicates with the vacuum chamber 43 of the valve and this leading end of the web is held or gripped on the roll. The web is then wrapped around the roll until the bores 40 communicating with the vertical bore 37 of the roll 33 rotates into position to receive a portion of the web spaced from the leading end thereof. At this moment the vertical bore 37 is subjected to suction and the web W is sucked against the roll 33. This action pulls the portion of the web spaced from the leading end thereof away from the roll 31 as shown in Figure 4 and as the rolls continue to rotate, the fold F is formed in the web W. Vertical idler rolls 50, best shown in Figure 4, are disposed adjacent each roll 31 and 33 for guiding the leading end of the web thereover as it is pulled from the roll 31.

The severing device

As best shown in Figures 1 and 4, an angle member 51 is vertically mounted between the frame plates 12 and 13 in front of the folding rolls. The angle member 51, as shown in Figure 4, has legs 52 disposed at right angles to each other and facing respectively the cooper-

ating fold rolls. Each leg 52 of the angle member 51 carries a cutting blade 53 thereon having the cutting edge thereof spaced from the cooperating rolls.

Adjusting bolts 54 are provided for spacing the cutting edge at a proper distance from the rolls.

Each roll 30 to 33 has secured in vertical slots 55 in the peripheries of the rolls, cutting knives 56 having the cutting edges thereof projecting beyond the peripheries of the rolls. The cutting knives 56 are disposed in diametrically opposed relation immediately ahead of the bores 40 communicating with the vertical bores 38 and 39 of the rolls. Therefore, as the fold F is completed on the web W, a cutting knife 56 passes over a cutter 53 to sever the folded web. Since the suction bores 38 and 39 are immediately behind the cutters on the rolls the leading edge of the web is immediately engaged against a roll by suction.

The folded napkin N, after being severed from the web W, is still held on the roll by suction as best shown in Figure 4.

The fold creasers

As the fold F of the web passes beyond the cutters 53 on a folding roll, it is creased flat by a creasing roll 57 having a raised cam portion 57*a* thereon adapted to squeeze the fold against a fold roll and iron out a crease in the fold.

The rolls 57 are rotatably mounted vertically between the frame plates as shown in Figure 1 on each side of the angle member 51.

After the crease is formed, the cutters sever a napkin N from the web.

The strippers and napkin magazines

It has been pointed out above wherein the fold rolls are provided with radial slots 34. The slots 34 receive fingers 60 therein as the rolls carry a napkin N toward a napkin receiving magazine M. The napkin receiving magazines M are carried in the frame structure 21 described in Figure 2 and extend inwardly from this frame structure into proximity with the folding rolls. As best shown in Figure 4, the magazines have open ends for receiving folded napkins N therein.

The fingers 60 are secured at their outer ends in holders 61. The holders 61 as best shown in Figure 1, are carried on vertical shafts 62 and 63 rotatably mounted between the frame plates 12 and 13.

The stripping fingers 60 are operated so as to enter the grooves 34 of the roll ahead of the folds F on the web and are moved out of the grooves to force the severed napkin N off of the roll and into the adjacent magazine M. During the stripping operation the vertical bores 36 and 37 operating through the passageways or bores 40, to hold the leading end of the napkin against the roll are exposed to the atmosphere through the opening 47 in the valve for breaking the suction and the napkin is readily removed from the roll by the strippers.

The drive mechanism

As shown in Figure 1, a horizontal drive shaft 70 extends under the frame plate 12 of the machine and has a bevel gear 71 secured thereon. The gear 71 meshes with a gear 72 secured on the vertical shaft 28 carrying the fold rolls 30 and 31. It should of course be understood that these rolls are keyed or otherwise fixedly secured to the shaft 28.

As best shown in Figure 3, the top of the shaft 28 has a large gear 73 keyed thereon above the top frame plate 13. The gear 73 meshes with a gear 74 secured on the shaft 29 carrying the fold rolls 32 and 33. The cooperating pairs of fold rolls 30 and 32; 31 and 33 are thus driven at synchronous speeds.

The tops of the creasing rolls 57 receive sprocket gears 75 thereon. Sprocket gears 76 are also secured on the shafts 28 and 29 above the large gears 73 and 74. Chains 77 are entrained around the sprocket gears 75 and 76 as shown. The sizes of the gears 75 and 76 are arranged so that the creasing rolls 56 are rotated in proper timed relation with the rotation of the fold rolls.

A gear 78 rotatably mounted on the top frame plate 13 engages with the large gear 73 on the vertical shaft 28. As shown in Figures 1 and 2, gear 78 has a boss 79 projecting upwardly from the center thereof and carrying a disc 80 disposed above the large gear 73. The disc 80 is slotted diametrically thereacross as at 81 (Figure 3). The slot 81 is preferably T-shaped in cross-section and receives the head of a bolt 82 therein. The eye end 83 (Figure 1) of a rod 84 is disposed around the bolt 82 and secured thereon by a nut 85. The other end of the rod 84 has an eye 86 thereon disposed around a pin 87 on an arm member 88 secured to the top of the shaft 62 carrying the holders 61 for the stripping fingers 60.

Therefore, as the large gear 73 is rotated the gear 78 is driven to rotate the disc 80 for oscillating the rod 84 to oscillate the shaft 62 through the arm 88. The desired amount of oscillation is obtained by regulation of the head of the bolt 82 in proper spaced relation from the center of the disc 80 in the groove 81 of the disc.

The large gear 74 on the shaft 29 drives an identical gear 78 and link arrangement described above for oscillating the shaft 63 to operate the strippers adjacent the fold rolls 32 and 33.

Operation of the machine

From the above descriptions it should be understood that the webs W and W' entering the machine are folded longitudinally as they pass over the triangular shaped plates 24 and 24'. This fold is creased as the webs pass between the nip of the feed rolls 27.

The leading ends of the folded webs are gripped by suction to hold these ends alternately against one or the other of the fold rolls.

As the webs pass between the nip of the fold rolls with their leading ends held on one of the cooperating rolls, a portion of the webs spaced from the leading ends is gripped by suction against the opposite roll. This portion then moves around the opposite roll while the leading ends of the webs are released from the first roll to form a transverse fold in the webs, which is creased and ironed out by the creasers 57.

The longitudinally and transversely folded web is then severed to form the finished napkin N while the transverse fold portion of the napkin is held on the second roll.

As the folded napkin passes on the second roll adjacent to a napkin magazine, the suction gripping the napkin to the roll is broken and the strippers move the napkin into the magazine.

Therefore the napkins are alternately formed on opposite cooperating fold rolls and two napkins are folded on each roll during each revolution thereof. Thus a cooperating pair of fold rolls

folds four napkins during each revolution. Since as many pairs of cooperating fold rolls can be superimposed in machines of this invention as desired, the number of napkins folded by the machine per unit revolution of the machine is practically unlimited.

The machine can be driven at high speed and handles even the lightest weight tissue without damage.

I am aware that many changes may be made and numerous details of construction may be varied through a wide range without departing from the principles of this invention, and I, therefore, do not purpose limiting the patent granted hereon otherwise than necessitated by the prior art.

I claim as my invention:

1. A web folding machine comprising a pair of cooperating folding rolls for receiving a web into the nip therebetween, means associated with each of said rolls for sequentially holding portions of said web against said rolls, mechanism synchronizing the sequential operation of said means to fold and hold the leading end of said web first against one roll and then the other and means for severing the successively folded leading ends from the web.

2. A web folding machine comprising a pair of cooperating folding rolls for receiving a web into the nip therebetween, suction means associated with each of said rolls for sequentially holding portions of said web against said rolls, mechanism synchronizing the sequential operation of said suction means to fold and hold the leading end of said web first against one roll and then the other and means for severing the successively folded leading ends from the web.

3. A web folding machine comprising a pair of cooperating folding rolls for receiving a web into the nip therebetween, means associated with each of said rolls for sequentially holding portions of said web against said rolls, mechanism synchronizing the sequential operation of said means to fold and hold the leading end of said web first against one roll and then the other, rolls associated with said folding rolls to crease the leading edge portions of successively formed leading ends of the web, and means for severing the successively folded leading ends from the web.

4. A web folding machine comprising a pair of cooperating folding rolls for receiving a web into the nip therebetween, suction means associated with each of said rolls for sequentially holding portions of said web against said rolls, mechanism synchronizing the sequential operation of said suction means to fold and hold the leading end of said web first against one roll and then the other, means for severing the successively folded leading ends from the web, and means for stripping and stacking each severed folded leading end.

5. A napkin folding machine comprising a pair of cooperating folding rolls for receiving a longitudinally folded web, each roll being grooved peripherally and having axially and radially extending passages opening at the roll surfaces between said grooves, a suction header for each roll for the sequential application of suction to said passages to cause the leading end of said web to be folded and held against said rolls alternately, means for severing the so folded ends to form napkins therefrom and means for stripping said napkins from said rolls, said stripping means including fingers movable into and out of said grooves.

6. A napkin folding machine comprising a pair of cooperating folding rolls for receiving a longitudinally folded web, each roll being grooved peripherally and having axially and radially extending passages opening at the roll surfaces between said grooves, a suction header for each roll for the sequential application of suction to said passages to cause the leading end of said web to be folded and held against said rolls alternately, means for severing the so folded ends to form napkins therefrom, means for stripping said napkins from said rolls, said stripping means including fingers movable into and out of said grooves, common driving means for said forming rolls and mechanism actuated by said driving means for operating said fingers in synchronism with said severing means.

7. A napkin folding machine comprising a pair of cooperating folding rolls, means for feeding a longitudinally folded web to said rolls, means associated with said rolls for sequentially holding portions of said web against said rolls, mechanism synchronizing the sequential operation of said last mentioned means to fold and hold the leading end of said web first against one roll and then against the other roll, means for creasing the folded edges so formed, means for severing the successively folded leading ends while so held against one or the other of said rolls and means for stripping and stacking the thus severed folded napkins.

8. A napkin folding machine comprising a pair of cooperating folding rolls, means for feeding a longitudinally folded web to said rolls, suction means associated with said rolls for sequentially holding portions of said web against said rolls, mechanism synchronizing the sequential operation of said suction means to fold and hold the leading end of said web first against one roll and then against the other roll, rolls cooperating with said forming rolls for creasing the folded edges so formed, means for severing the successively folded leading ends while so held against one or the other of said rolls and means for stripping and stacking the thus severed folded napkins.

9. In a web folding machine, a pair of roll supporting shafts in spaced relation and a plurality of individual fold rolls mounted on each shaft, the rolls on one shaft cooperating with the rolls on the other shaft to receive webs in the nips therebetween.

10. In a web folding machine, two vertical stacks of individual fold rolls, the rolls in each stack being aligned horizontally with each other to define nips therebetween for receiving separate webs therein.

11. A fold roll comprising a cylindrical member including a central hub portion, said member having slots extending radially from the hub portion to the outer periphery thereof, said hub portion having passageways axially thereof and said cylindrical member having passages communicating with said passageways and extending to the periphery of the roll for application of suction to webs coming in contact with the periphery of the roll.

12. A fold roll comprising a cylindrical member having axial passageways thru the mid-portion thereof and radial passages communicating with the passageways defining a plurality of holes in the periphery of the member.

13. In a web folding machine, a fold roll having a plurality of axial passageways and radial passages connecting the passageways with the periphery of the roll, means for rotating said roll

and a stationary valve having suction and exhaust ports adapted to register with the passageways during rotation of the roll.

14. In a web folding machine, a drive shaft, a fold roll mounted on said drive shaft having a plurality of axial passageways therein and radial passages connecting the passageways with the periphery of the roll, a valve freely disposed around said shaft adjacent said roll having suction and exhaust ports adapted to register with the passageways and means for rotating said shaft to drive the roll whereby the passages of the roll are subjected to suction for gripping a web on the periphery of the roll at predetermined time increments.

15. In a web folding machine, a shaft, a plurality of fold rolls mounted on said shaft having communicating axial and radial passageways, said radial passageways defining holes on the periphery of the rolls, stationary valves disposed around said shaft adjacent each roll having suction and exhaust ports, the faces of the rolls adjacent the valves having arcuate grooves each communicating with an axial passageway and adapted to register with the ports of the valve whereby a rotation of the shaft drives the rolls and webs coming in contact with the rolls are gripped thereon by suction for a predetermined amount of travel thereon.

16. In a web folding machine, a pair of cooperating fold rolls having longitudinal slots in the peripheries thereof, knives carried in said slots projecting beyond the rolls, a stationary member mounted adjacent the nip between the rolls, a pair of knives carried by said member each facing a roll and adapted to cooperate with the roll knives to sever a web carried on the rolls.

17. A web folding machine comprising means for forming and folding a web longitudinally, a pair of cooperating folding rolls for receiving a web into the nip therebetween, web holding means associated with each of said rolls and so arranged and synchronized that while the leading end of said web is held against the first roll an intermediate portion of said web is gripped by the second roll and said leading end immediately thereafter released to produce a folded web portion on said second roll, and means for severing said folded web portion from the web while still gripped by said second roll.

18. A web folding machine comprising a pair of cooperating fold rolls for receiving a web into the nip therebetween, web-holding means associated with each of said rolls and so arranged and synchronized that successive leading ends of said web are alternately held against the first roll and then against the second roll while portions of the web spaced from the successive leading ends are respectively held against the second roll and then against the first roll to produce a fold in the web along the thus held portion spaced from the web and means for severing the folded web portions from the remainder of the web while said portions are retained on a fold roll.

19. Paper converting apparatus comprising a pair of fold rolls for receiving a web of paper into the nip therebetween, web-holding means associated with each of said rolls and so arranged and synchronized to hold successive leading ends of the web alternately on one roll and then on the second roll and a portion of the web spaced from the leading ends on the roll not having the leading end thereon to fold the leading portion of the web, and cutting means for severing the folded portion of the web from the remainder of the web while said folded portion is held on one of said rolls.

20. A napkin folding machine comprising a pair of fold rolls, a napkin receiving magazine adjacent each fold roll to receive the napkins therefrom, web-holding means associated with each of said fold rolls so arranged and synchronized to hold successive leading ends of a web of paper alternately on one roll and then on the other roll, and a portion of said web of paper spaced from the leading ends thereof on the roll not receiving the leading end to fold the leading portion of the web, cutting means for severing the folded portion of the web from the remainder of the web, part of said web-holding means holding the severed folded portion on the roll initially receiving the portion of the web spaced from the leading ends for conveyance of the folded portion to a magazine and a stripper device associated with each fold roll to transfer a folded web thereon from the roll into the adjacent magazine.

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