

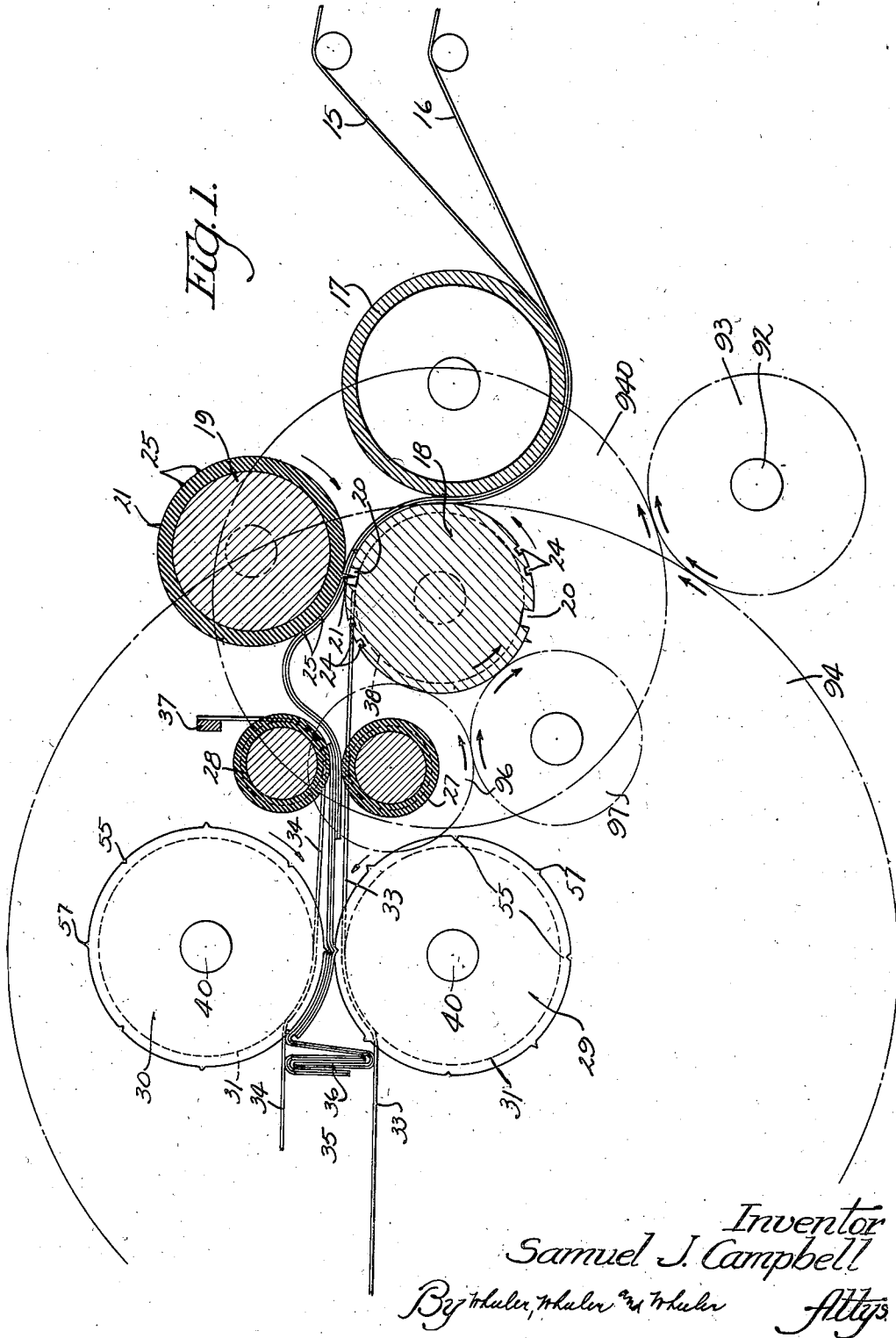
Sept. 14, 1937.

S. J. CAMPBELL
PAPER INTERFOLDING MACHINE

2,092,952

Filed Nov. 26, 1934

5 Sheets-Sheet 1



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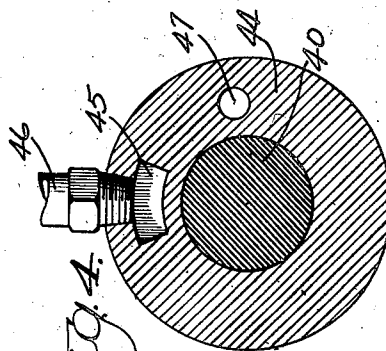
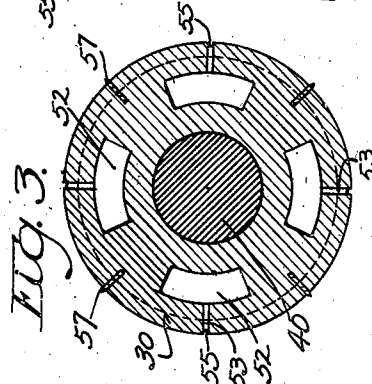
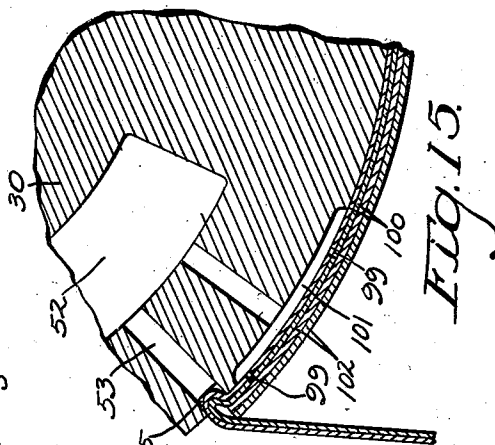
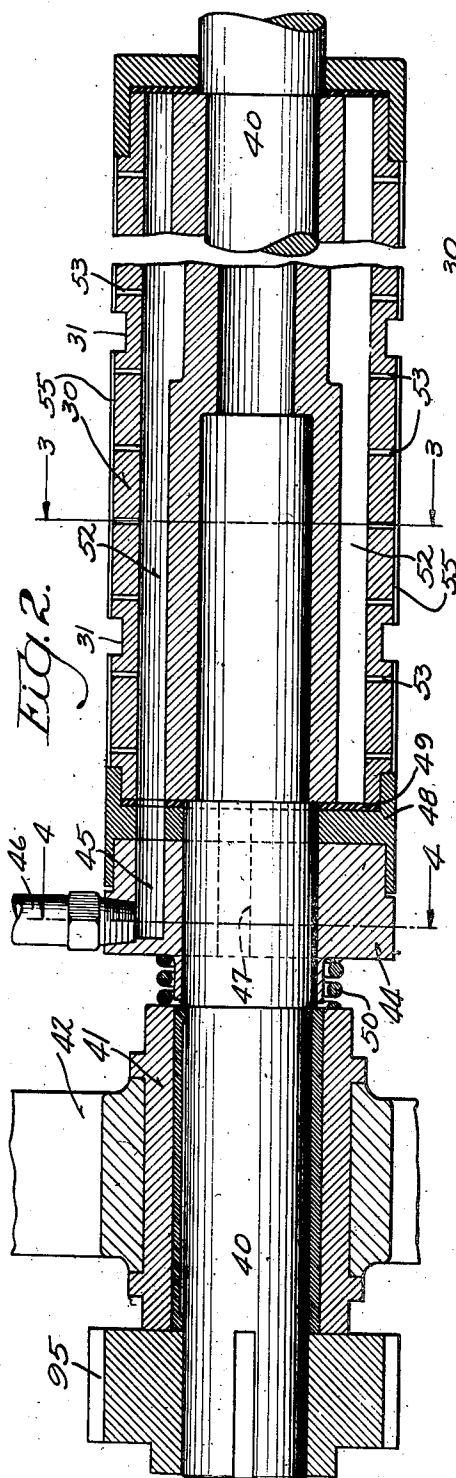
S. J. CAMPBELL

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PAPER INTERFOLDING MACHINE

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5 Sheets-Sheet 2



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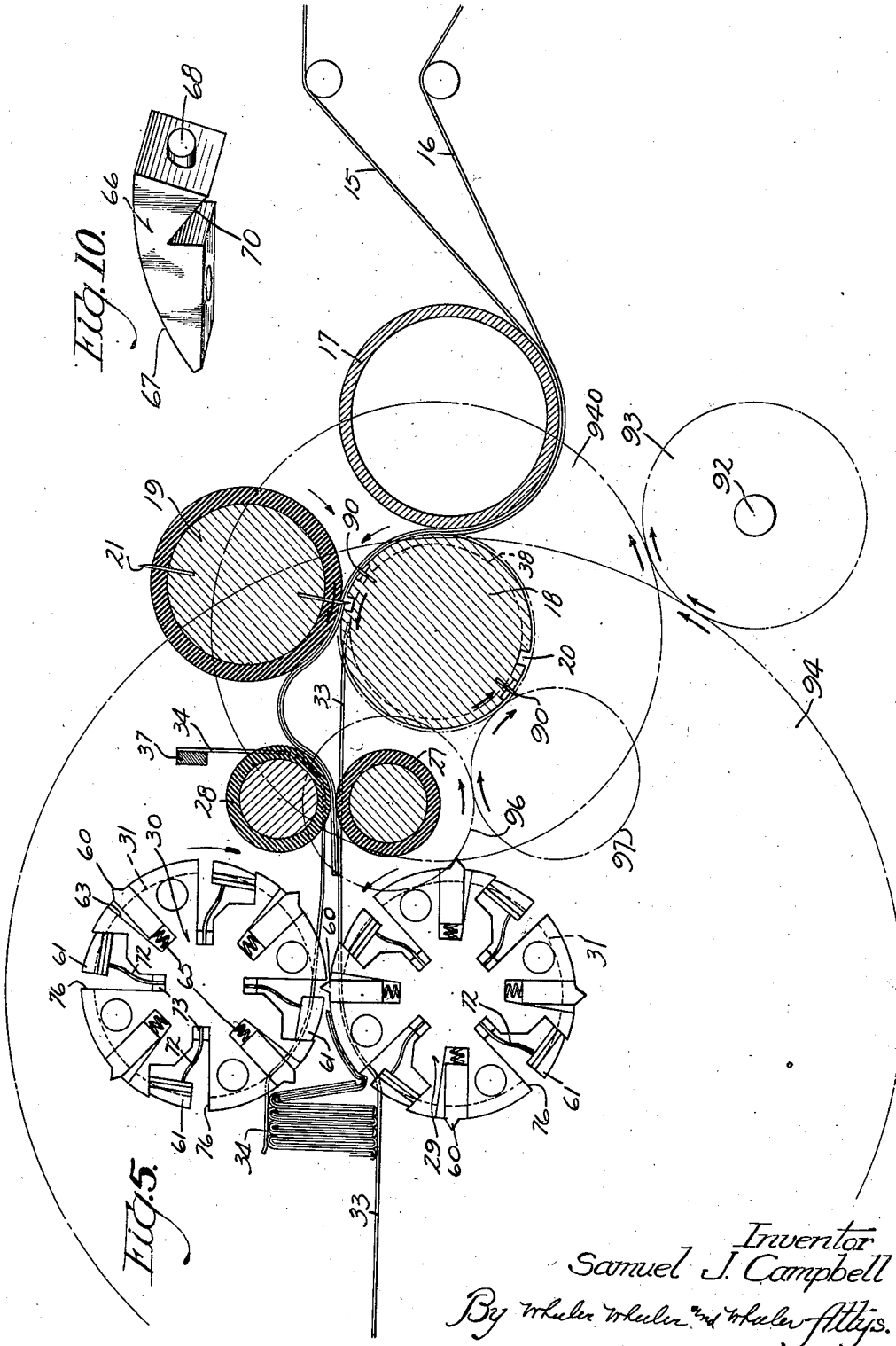
S. J. CAMPBELL

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PAPER INTERFOLDING MACHINE

Filed Nov. 26, 1934

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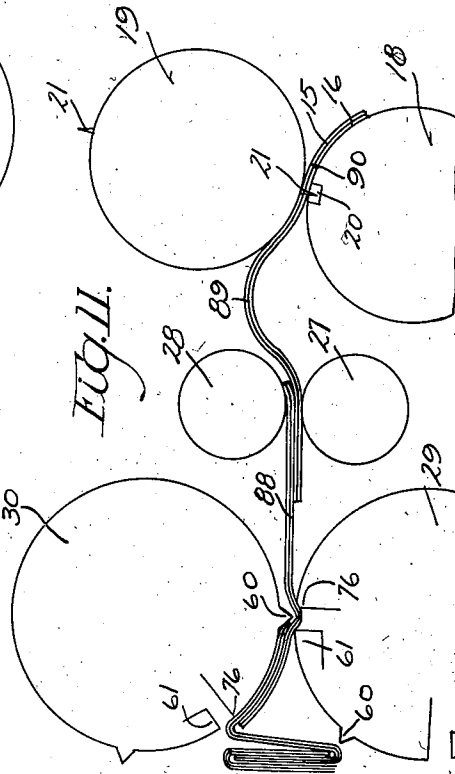
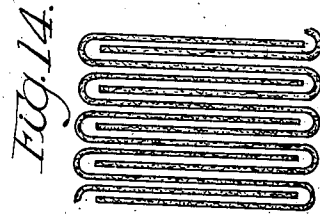
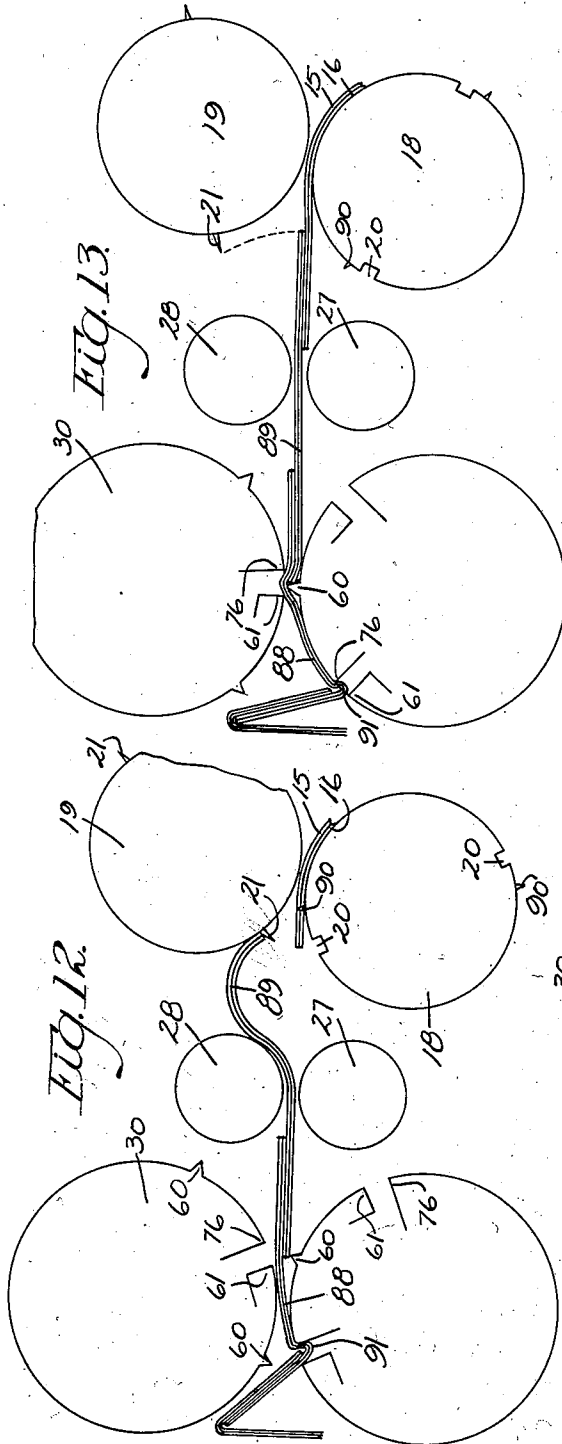
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PAPER INTERFOLDING MACHINE

2,092,952

Filed Nov. 26, 1934

5 Sheets-Sheet 5



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UNITED STATES PATENT OFFICE

2,092,952

PAPER INTERFOLDING MACHINE

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Application November 26, 1934, Serial No. 754,798

22 Claims. (Cl. 270—39)

This invention relates to improvements in paper interfolding machines.

It is the primary object of the invention to provide an interfolding machine which will operate accurately and uniformly to cut sheets from a web or pair of superposed webs, overlap the end of the web with the end of the sheet last cut therefrom, and interfold successive sheets with perfect registration.

More particularly stated, it is one of the objects of the invention to provide a machine in which uniformity of registration is assured by the relation of the cutting rolls and feed rolls through which the paper passes on its way to the interfolder.

Another object of the invention is to provide improved suction type and jaw type interfolding mechanisms that will more clearly appear from the following disclosure.

In the drawings:

Figure 1 is a diagrammatic view, partially in longitudinal section and partially in side elevation, of apparatus embodying the invention.

Figure 2 is a detail view in longitudinal section showing one of the folding rolls and associated valve mechanism.

Figure 3 is a transverse section of a suction type folding roll, taken on line 3—3 of Figure 2.

Figure 4 is a transverse section of the valve mechanism, taken on the line 4—4 of Figure 2.

Figure 5 is a diagrammatic view similar to Figure 1 showing the modified embodiment of the invention, in which tucker blades and clamping jaws are substituted for the vacuum type interfolder shown in Figures 1 to 4, inclusive.

Figure 6 is an enlarged detail view of one of the folding rolls in fragmentary end elevation.

Figure 7 is a fragmentary view of the surface of the folding roll.

Figure 8 is a fragmentary detail in plan of the end of one of the vice rolls showing the cam means for actuating the moving vice jaw.

Figure 9 is a detail view in end elevation of the cam mechanism shown in Figure 8.

Figure 10 is a detail view in perspective showing the retaining clamp for a tucker blade.

Figures 11, 12, and 13 are detail views illustrating diagrammatically in side elevation the relative positions of the parts in successive operations.

Figure 14 is a fragmentary detail on an enlarged scale showing the interfolded relation of the paper ultimately produced by the operations of the machine herein disclosed.

Figure 15 is a fragmentary detail on an en-

larged scale showing the lower portion of roll 30 in section to illustrate the means for holding to the roll the otherwise free leading end of a severed sheet.

Like parts are identified by the same reference characters throughout the several views.

It is broadly immaterial whether the machine be operated with one web of paper or more. Two separate webs are shown at 15 and 16 in progress to the feed roll 17 about which the webs are passed in face contact.

The rolls 18 and 19 are cutting rolls between which the web is passed to be severed into sheets. The roll 18 serves as a matrix, being channelled at 20 to receive the knives 21 which project beyond the rubber cover 22 of roll 19. Sockets are provided at 24 in the matrix roll 18 for the perforating punches 25 carried by the knife roll 19, the function of which will hereinafter be described. It is to be noted that a line drawn between the axes of rolls 18 and 19 is at an oblique angle with reference to a line drawn between the bite of these rolls and the bite of the rubber covered feed rolls 27 and 28. This position of the cutting rolls with reference to the direction of feed of the web and the severed sheet is calculated to deliver the end of each successively cut sheet in an upward direction, as is clearly shown in Figure 12. The peripheral speed of the cutting rolls 18 and 19 and feed roll 17 is one-third again as great as the peripheral speed of feed rolls 27 and 28 so that following a severing of each sheet the trailing end thereof will be bulged upwardly to enable the leading end of the more rapidly moving web to advance therebeneath, as clearly appears from Figures 12 and 13.

Beyond the feed rolls 27 and 28 are the folding rolls which will be generically designated by reference characters 29 and 30 irrespective of their detailed construction. The folding rolls 29 and 30 are peripherally grooved at 31 to receive the skimmers or stripping fingers 33 and 34 which are spaced beyond the rolls to provide a guide or chamber at 35 to receive the interfolded paper 36. These fingers extend through the grooves 31 and therebeyond. Finger 34 extends about 90 degrees around the feed roll 28 in a peripheral groove therein and is anchored to a frame member 37. Skinner 33 extends through a peripheral groove in feed roll 28 into a peripheral groove at 38 in roll 18, where it ends, as shown in Figure 1.

If the folding rolls are provided with suction means for engaging the paper they are constructed as shown in Figures 2, 3, and 4 on Sheet

2. The roll 30 therein disclosed is mounted on shaft sections 40 carried in suitably bushed journals 41 in the frame member 42. Mounted on shaft 40 at the end of the roll is a stationary valve member 44 having an axially open port 45 communicating with a vacuum pipe 46. Approximately 90 degrees removed from the port 45 is a hole 47 open to the atmosphere. A correspondingly ported valve 48 has a sleeve fitting over the valve member to comprise an extension thereof. The valve is provided with a bushing 49 which is also correspondingly ported and engages the end of the roll under the pressure of a compression spring 50 confined between the bushing 41 and the valve 44.

The roll has a series of longitudinally extending bores 52 communicating with ducts 53 which lead radially therefrom to longitudinal grooves 55 along the periphery of the roll. The arrangement is such that as each successive bore 52 registers with a port 45 the vacuum in said port will be communicated through the bore 52 and ducts 53 to the longitudinal grooves 55 to draw the paper web into the grooves for folding purposes. The machine is so timed that concurrently the tucker blades 57 of the opposing roll will thrust the paper into the grooves. After the required degree of rotation, which is only about 45 degrees, the opening 52 within the roll will communicate with the atmosphere through port 47 to release the vacuum and permit the folded sheet to leave the roll. The rolls 29 and 30 have alternate grooves 53 and blades 57 which are angularly staggered so that the folding operation will first be conducted upon one roll and then upon another.

As indicated in the drawings, the timing of the machine is such that each fold will be made adjacent the end of one of the sheets or pairs of sheets so that such end will be interfolded into the other sheet in the customary manner.

If the folding rolls generically designated by reference characters 29 and 30 have mechanical folding means they may be constructed as shown in Figs. 5 to 10 on Sheets 3 and 4 of the drawings.

Each of the rolls 29 and 30 provides alternating tucker blades 60 and movable vise jaws 61. The tucking blades 60 are mounted on longitudinal bars 62 intersected by the grooves 31 for the stripper fingers. These bars 62 are both oscillatable and slidable in slots 63 which extend longitudinally of the respective rolls and have radially divergent faces, as is clearly shown in Figs. 5 and 6. Holes bored diametrically through the rolls at 64 receive the compression springs 65 which press outwardly the bars 62 on opposite sides of the roll. The outward movement of the bars is limited by a clamp of the peculiar form shown at 66 in Fig. 10. Externally the clamp 66 has a cylindrical surface 67 corresponding to that of the roll. At its end it has a dowel pin 68. It is held to the roll by a screw 69 and at an intermediate point it has a notch which provides an inclined cam surface 70 which is complementary to a correspondingly beveled surface on the bar 62.

It will be obvious that the outward pressure of the compression spring 65 on the bar 62 will not only hold the tucker blade 60 in a normal projecting position as shown in Figs. 5 and 6, but will also hold the bar toward the top face of the slot 63 as viewed in Fig. 6.

The bevel of the surface 70 of the retaining clamp member 66 is such, however, that any force acting on the tucker blade 60 in a direction

clockwise of the roll as viewed in Fig. 6, will oscillate the bar 62 in a wide portion of the slot 63 while at the same time forcing the bar down into the slot on account of the angle of the cam surface 70. This action occurs when the movable jaw of the clamping device engages the paper to crease it. The initial movement of the clamping jaw oscillates the bar and this oscillation causes the bar automatically to retract itself whereby to withdraw the tucker blade 60 from the bite of the clamping jaws.

The clamping jaws 61 are neither pivoted on a fulcrum pin nor slidable in ways in the usual manner. Instead they are supported for bodily and pivotal movement upon leaf springs 72, the inner ends of which are engaged in mounting blocks 73 anchored in the bottom of the recesses 74 by set screws 75. The leaf springs tend to close the movable jaws 61 from the retracted position shown in full lines in Fig. 6, toward the face 76 of the roll which constitutes the fixed jaw. The advanced position of the movable jaw is shown in dotted lines in Fig. 6.

The movement of the successive jaws 61 is conveniently provided for by a cam operated mechanism individual to each jaw. At the end of each roll having the mechanically operated folding means is a cam track 78 having a drop at 79 axially from the roll. The cam follower 80 is provided with a roller 81 riding on the cam track, and is mounted on a guide plunger 82 normally held extruded by compression spring 83 socketed in the roll, as best shown in Fig. 8. The end of each one of the movable clamping jaws 61 is grooved at 84 and the cam follower 80 has a tongue at 85 engaged in the groove, the engaged surfaces being at such an angle that the axial movement of the cam follower 80 will wedge the movable jaws 61 open. The tongue and groove 85 and 84 constitute an additional means for guiding the cam follower 80 in its reciprocation.

It is broadly immaterial whether the movable jaw be normally held open by the spring 72, or whether it be closed by said spring as shown in the drawings. In the former case the creasing action would be very positive, being mechanically induced. In the device as disclosed the cam action positively opens the jaws and they close under pressure of their mounting spring 72. Where the stock fed to the jaws may have considerable variation in thickness this construction may be preferred, since the closing of the jaw under the pressure of the spring is impossible and uniform regardless of the thickness of paper engaged in the bite of the jaw.

In this construction, as in the suction operated device, the paper is folded first upon one roll and then the other, the co-acting jaws and tucker blade of the respective rolls being staggered and alternated for this purpose.

In any event the jaw approaching the line of bite between rolls 29 and 30 is open to receive the webs which are thrust therein by the registering tucker blades 60 of the other roll. Immediately the cam mechanism operates to close the jaw by relieving the wedging action which normally overcomes the pressure of the mounting spring 72. The movable jaw 61 moves toward the fixed jaw 76 to engage the fold of paper therebetween. Since this entire movement takes place in one of the jaws it will be necessary to arrange for a corresponding movement of the tucker blade 60 which was originally centered between the open jaws. The mov-

able jaw 61 oscillates the tucker blade 60 and, as above explained, the oscillation of the bar 62 carrying the tucker blade causes an interaction of said bar with the inclined surface of clamp member 66 to force the bar into the roll and thereby to retract the tucker blade from the fold. This causes materially less abrasion of the paper web or webs than would be the case if the squeezing of the jaws had to be relied upon to expel the tucker blade. It is to be noted particularly that the mounting of the tucker blade is such that it is always free to yield centrally of the roll in the event that the machine becomes clogged with paper at any time. This prevents damage which might otherwise be occasioned to the apparatus.

Figs. 11, 12 and 13 diagrammatically show the principle upon which the interfolding proceeds irrespective of the particular construction of the folding rolls 29 and 30. In Fig. 11 the tucker blade 60 is just introducing a portion of a previously severed sheet 88 between a pair of folding jaws of roll 29. The trailing end of the sheet 88 is still engaged between the feed rolls 27 and 28 in superimposed relation over the leading portion of the next succeeding sheet 89, which is just being severed by the cutting knife 21 of the roll 19. The leading end of the unsevered portion of the web or webs 15-16 is impaled on the points 90 of roll 18 to ensure its feed between said rolls in proper registration.

Fig. 12 shows how the fold in sheet 88 has been creased at 91 about the end of the next preceding sheet. The trailing end of sheet 89 is being propelled in an upward direction by the knife 21 due, in part, to the oblique angle at which these rolls are mounted, as previously explained, and due also to the fact that the rolls 18 and 19 are operating one third faster than rolls 27 and 28. The leading edge of the unsevered web or webs 15-16, because of its rapid movement, is already being fed beneath the trailing end of the sheet 89.

In Fig. 13 the creased portion 91 of sheet 88 is being released and sheet 88 is now being folded by pressure of a tucker blade 60 of roll 29 which is forcing it into the folding jaws of roll 30. The leading end of sheet 89 will be engaged in this fold and the trailing end of sheet 89 has been released by the cutting knife 21 and has dropped into overlapping relation on to the leading end of the unsevered web or webs 15-16. The continued rapid movement of incoming web will force its unsevered portion to bulge upwardly toward the position shown in Fig. 11 in preparation for the next cutting operation which will sever a new sheet therefrom. The fingers 33 shown in Fig. 1 make it impossible for the sheet to go downwardly.

The product of the apparatus is shown in Fig. 14 the single web being illustrated by way of example.

While the gearing for driving the mechanism is broadly immaterial, I have shown one possible set of driving connections in Fig. 1. A drive shaft 92 operates a pinion 93 which is sufficiently elongated to mesh both with gear 94 and gear 940. Gear 94 is mounted on the shaft which carries roll 29. The shafts for rolls 29 and 30 have intermeshing gears, one of which is shown at 95 in Fig. 2. The rolls 27 and 28 are also preferably intergeared, (the gearing not being shown). The shaft of roll 27 is driven by a gear represented by circle 96 in Fig. 1.

Gear 96 meshes with an idler gear 97 which,

in turn, meshes with a gear (not shown) on the shaft of roll 18, this being the same shaft on which gear 940 is mounted. The said gear on the shaft of roll 18 also meshes with a similar gear on the shaft of roll 19 to drive the latter. The particular driving connections form no part of the present invention except that they be so designed as to operate the rolls 17, 18 and 19 at a peripheral speed one third in excess of the peripheral speeds of the rolls 27, 28, 29 and 30. It is also important in this connection that the distance from the line of bite of the rolls 27 and 28 to the cut-off point between rolls 18 and 19 is less than the length of a single severed sheet. This positively eliminates uneven registration, which has offered much difficulty in connection with previous designs of interfolding machines.

Reference has already been made to the punches 25 shown in Fig. 1 in connection with the disclosure of the suction type interfolding rolls. It will be noted that in the interfolding operation the leading end of each successive sheet must be carried upwardly about roll 30 to the position clearly illustrated in Fig. 1. This presents some problem since the trailing end of the next preceding sheet is interposed between suction grooves of roll 30 and the leading end which must be elevated.

It is a function of the punches 25 to perforate small holes through the trailing end of each sheet so that when such sheet is held by suction to the folding rolls the vacuum developed on the surface of the folding rolls will be able to penetrate through the perforations of the sheet adjacent the roll to act on the leading end of the next successive sheet. Fig. 15 shows a detail of roll 30 and the sheets being folded thereon, the enlarged scale permitting illustration of the perforations at 99 in the sheet 100 communicating with the peripheral groove 101 in face of roll 30 which leads to that internal duct 52 of the roll which happens to be subject to vacuum at the time. Thus air is removed from the outer face of the sheet or composite sheet 100 so that atmospheric pressure holds sheet or composite sheet 102 to the roll. Where duplicates or composite sheets are used static electricity will ordinarily hold the outer sheet in place so that it is only necessary to transmit the vacuum to the inner member of the composite sheet.

I claim:

1. In an interfolding machine, the combination with grooved interfolding rolls respectively provided with alternating folding and tucking means, in mutually staggered relation, said rolls being peripherally grooved, of feed rolls having corresponding peripheral grooves, the matrix roll having corresponding peripheral grooves, a die roll having knife means co-acting with said matrix roll to sever a web, and stripping fingers spaced to provide a receptacle for interfolded sheets and converging in the grooves of said interfolding rolls and extending therebeyond as a guide for sheets passing from said feed rolls to said interfolding rolls, the stripping finger extending about one of said feed rolls being anchored there-adjacent, and the stripping finger extending through the groove of the other feed roll being carried on into the groove of the matrix roll.

2. An interfolding device comprising the combination with interfolding rolls having alternating folding and tucking means, of feed rolls, means for guiding the paper sheets from the feed rolls to the interfolding rolls, web feeding means

having a peripheral speed approximately one third in excess of the peripheral speed of the feed rolls and including die and matrix rolls having means for severing sheets from said web, said die and matrix rolls having the plane of their axes offset from parallelism with the plane of the axes of the feed rolls, and the distance from said die and matrix rolls to said feed rolls being less than the distance between successive severing means, whereby the advancing end of the unsevered portion of the web will underlap the trailing end of each severed sheet in the feed rolls before being severed to provide a new sheet.

3. An interfolder comprising the combination with a longitudinally slotted folding roll having one face adjacent the slot comprising a fixed jaw, of a movable jaw reciprocable peripherally in the slot of the roll, and a flexible member supporting the movable jaw from the roll for pivotal movement to and from the fixed jaw.

4. An interfolder comprising the combination with a longitudinally slotted folding roll having one face adjacent the slot comprising a fixed jaw, of a movable jaw reciprocable peripherally in the slot of the roll, and a flexible member supporting the movable jaw from the roll for pivotal movement to and from the fixed jaw, said flexible member comprising a spring urging said movable jaw to one extreme of its movement.

5. A device of the character described comprising the combination with a folding roll longitudinally slotted and provided with a fixed jaw face at one side of the slot, of a movable jaw mounted in the slot, and spring means carrying said movable jaw from the roll and urging said movable jaw toward said fixed jaw.

6. A device of the character described comprising the combination with a folding roll longitudinally slotted and provided with a fixed jaw face at one side of the slot, of a movable jaw mounted in the slot, and spring means carrying said movable jaw from the roll and urging said movable jaw toward said fixed jaw, together with means mechanically maintaining said movable jaw spaced from said fixed jaw and periodically releasable to permit said movable jaw to be moved by said spring toward said fixed jaw.

7. In a device of the character described, the combination with a folding roll having a longitudinal recess and a first jaw, of a second jaw movable in said recess to and from said first jaw, flexible members supporting said movable jaw from said roll, and cam means provided with connections for operating said movable jaw in one direction and for controlling its movement in the opposite direction.

8. In a device of the character described, the combination with a folding roll having a longitudinal recess and a first jaw, of a second jaw movable in said recess to and from said first jaw, flexible members supporting said movable jaw from said roll, and cam means provided with connections for operating said movable jaw in one direction and for controlling its movement in the opposite direction, said flexible members comprising springs urging said movable jaw in said opposite direction.

9. The combination with a longitudinally slotted folding roll, of a spring anchor seated in the bottom of the slot, means for retaining said anchor therein, springs projecting in a general radial direction from said anchor, and a movable jaw mounted on said springs and co-acting with the portion of said roll adjacent said slot.

10. A device of the character described comprising the combination with a roll having a fixed jaw, a movable jaw, and a set of springs constituting means for supporting and guiding said movable jaw for movement with respect to said roll.

11. A device of the character described comprising the combination with a roll having a fixed jaw, a movable jaw, a set of springs supporting said movable jaw from said roll, a cam track adjacent said roll, and cam means carried by said roll and co-acting with the end of the movable jaw for the peripheral movement of the movable jaw respecting the fixed jaw.

12. A device of the character described comprising the combination with a roll having a fixed jaw, a movable jaw, a set of springs supporting said movable jaw from said roll, a cam track adjacent said roll, and cam means carried by said roll and co-acting with the end of the movable jaw for the peripheral movement of the movable jaw respecting the fixed jaw, said springs acting on the movable jaw in a direction to press it toward the fixed jaw and said cam means acting on said movable jaw in opposition to said spring means.

13. In a folding machine, the combination with a fixed jaw, of a spring supported movable jaw provided with a beveled end, a cam member provided with guide means controlling its axial movement respecting said roll, a cam track with which said member co-acts in the rotation of said roll, and a cam surface on said member engaging the beveled end of the movable jaw.

14. In a folding machine, the combination with a fixed jaw, of a spring supported movable jaw provided with a beveled end, a cam member provided with guide means controlling its axial movement respecting said roll, a cam track with which said member co-acts in the rotation of said roll, and a cam surface on said member engaging the beveled end of the movable jaw, said cam surface and beveled end having a tongue and groove connection for the further guidance of said member.

15. A device of the character described comprising a roll having a longitudinally extending slot with radially divergent walls, tucking means mounted in said slot for radial reciprocation and for oscillation in the outer portion of said slot, and means resiliently supporting said tucking means.

16. In a device of the character described, the combination with a roll and a tucking blade, of means supporting said tucking blade for radial yielding movement toward the center of the roll and for oscillation in a direction peripheral with respect to said roll, and means for causing the retraction of said tucking blade upon the oscillation thereof.

17. In a device of the character described, the combination with web creasing means having relatively movable jaws, of tucking means adapted to thrust a web between said jaws, and means for mechanically forcing the retraction of said tucking means upon the closing of said jaw.

18. In a device of the character described, the combination with a folding roll having a fixed jaw and a movable jaw, of means providing for the closing movement of the movable jaw toward the fixed jaw in a given position of said roll, a complementary roll having a radially yieldable and normally projecting tucker blade positioned to enter between said jaws in the rotation of said rolls, and means controlled by the closing move-

ment of the movable jaw for causing the radial retraction of said tucker blade.

19. In a device of the character described, the combination with a folding roll having a fixed jaw and a movable jaw, of means providing for the closing movement of the movable jaw toward the fixed jaw in a given position of said roll, a complementary roll having a radially yieldable and normally projecting tucker blade positioned to enter between said jaws in the rotation of said rolls, means controlled by the closing movement of the movable jaw for causing the radial retraction of said tucker blade, said tucker blade being mounted for oscillation as well as for retracting movement, and means providing a cam guide against which said blade moves when oscillated by pressure of the movable jaw, said guide being formed to force said blade toward its retracted position when said blade is oscillated.

20. The combination with a folding roll having a slot with divergent sides, of a tucker blade mounted in said slot for reciprocation and oscillation, a spring pressing said blade outwardly in said slot, and a cam-shaped retainer engaging said blade and provided with a surface maintaining said blade against one side of said slot in its outer position and forcing said blade inwardly into the slot when oscillated from said side.

21. An interfolding device comprising the combination with sheet feeding rolls, of web feeding means having driving connections for the actuation of said means approximately one third in excess of the peripheral speed of the sheet feeding rolls, said web feeding means including die and matrix rolls having means for severing sheets from said web and having the plane of their axes offset from parallelism with the plane of the axes of the sheet feeding rolls, the distance from said

die and matrix rolls to the sheet feeding rolls being less than the distance between successive severing means, whereby the advancing end of the unsevered portion of the web will underlap the trailing end of each severed sheet in the sheet feeding rolls before being severed to provide a new sheet, together with interfolding rolls having alternating folding and tucking means, the folding means comprising a fixed jaw, a movable jaw, and leaf spring means constituting the sole connection of the movable jaws with the rolls.

22. An interfolding device comprising the combination with sheet feeding rolls, of web feeding means having driving connections for the actuation of said means approximately one third in excess of the peripheral speed of the sheet feeding rolls, said web feeding means including die and matrix rolls having means for severing sheets from said web and having the plane of their axes offset from parallelism with the plane of the axes of the sheet feeding rolls, the distance from said die and matrix rolls to the sheet feeding rolls being less than the distance between successive severing means, whereby the advancing end of the unsevered portion of the web will underlap the trailing end of each severed sheet in the sheet feeding rolls before being severed to provide a new sheet, together with interfolding rolls having complementary alternately arranged vacuum grooves and tucking blades upon their respective peripheries, and means for subjecting the respective grooves to vacuum during at least a portion of the rotation of the rolls in synchronism with the presentation of the tucking blades of an opposing roll to such grooves, whereby to hold in the grooves the paper tucked therein by said blades.

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