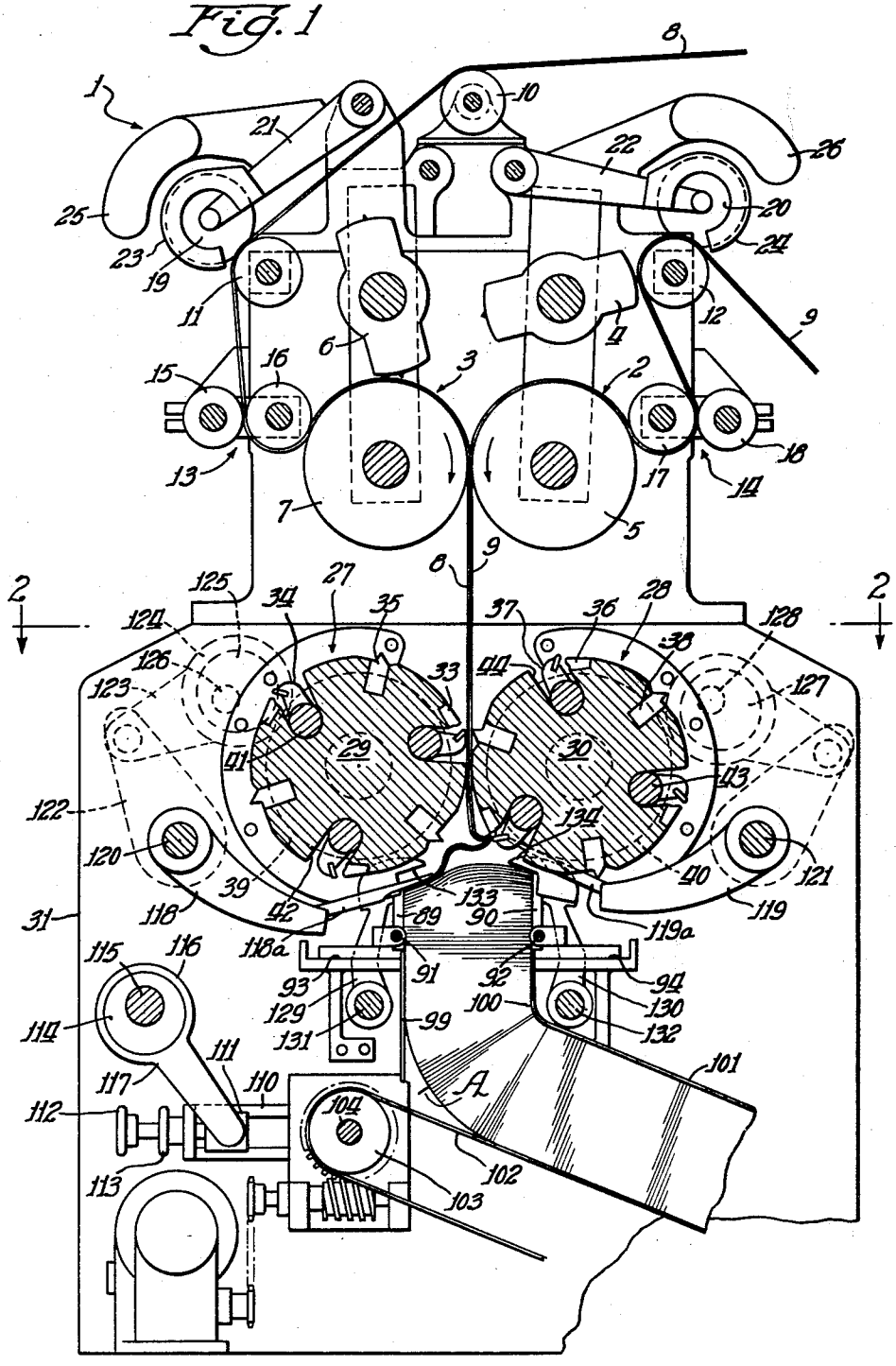
Dec. 29, 1964 P. G. FRANKE ETAL 3,163,413

CAM CONTROLLED FOLDING MEANS FOR PAPERMAKING MACHINE

Filed March 28, 1962 7 Sheets-Sheet 1

Fig. 1



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CAM CONTROLLED FOLDING MEANS FOR PAPERMAKING MACHINE

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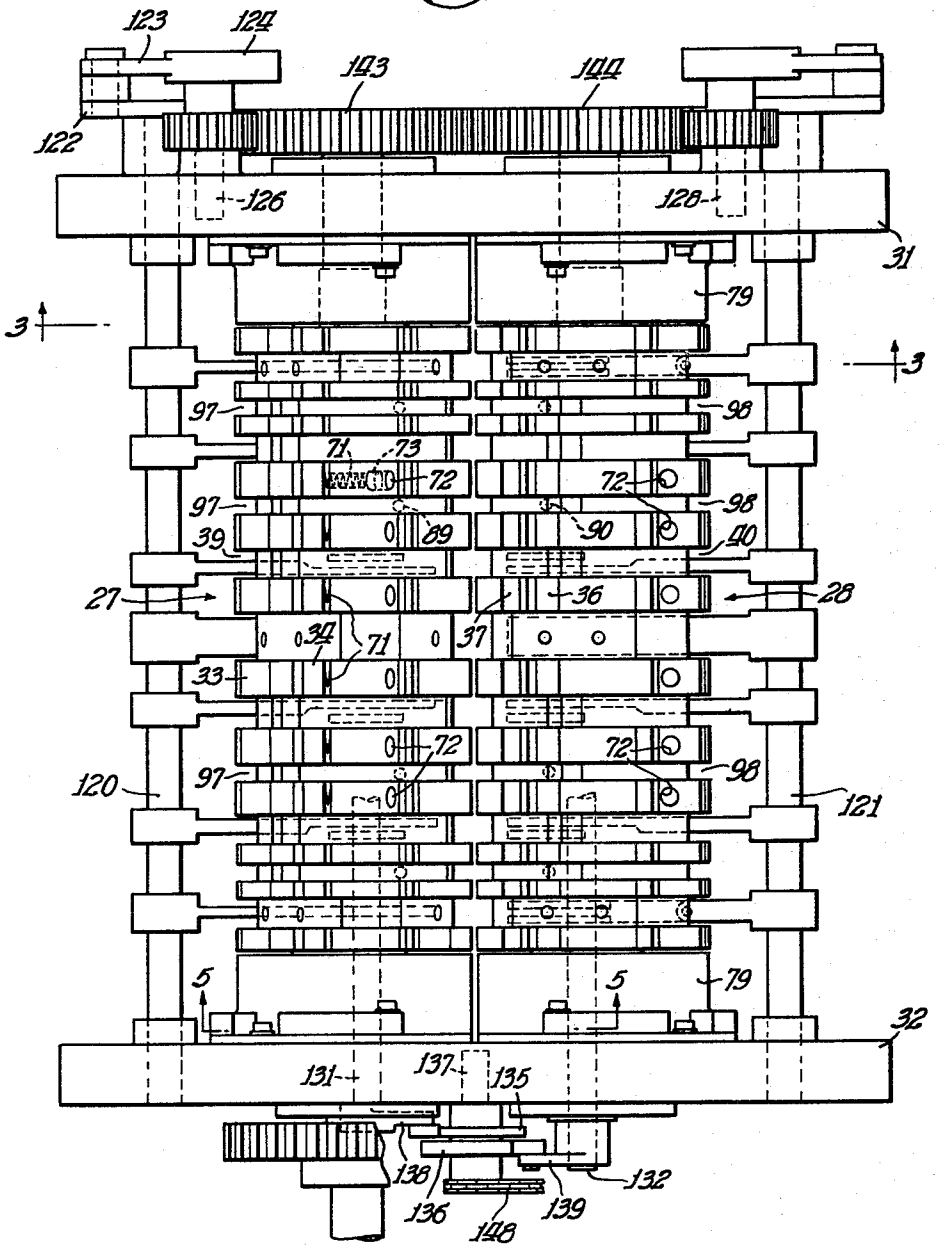
Fig. 2



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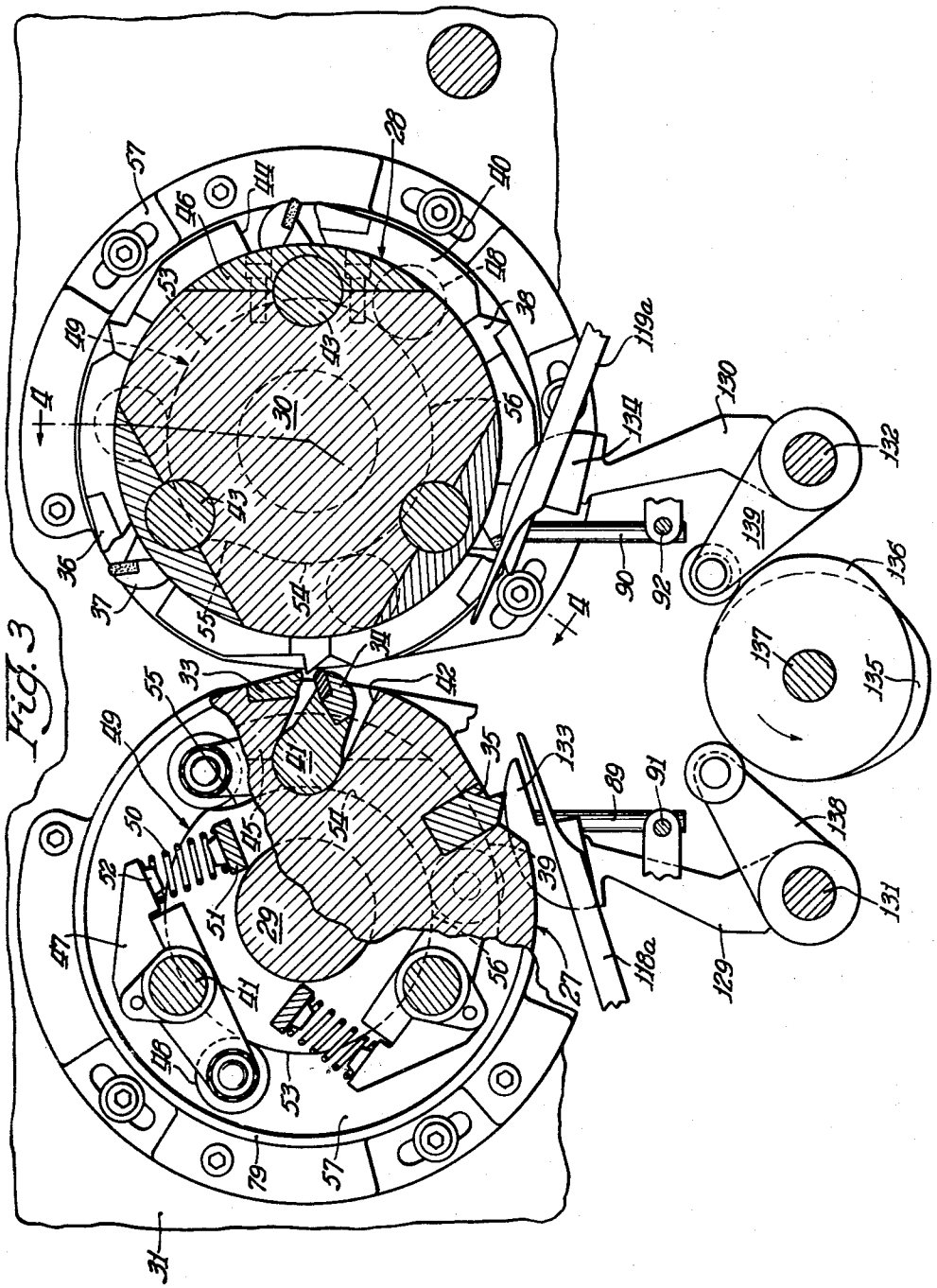
CAM CONTROLLED FOLDING MEANS FOR PAPERMAKING MACHINE

Filed March 28, 1962 7 Sheets-Sheet 3



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CAM CONTROLLED FOLDING MEANS FOR PAPERMAKING MACHINE

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Fig. 4

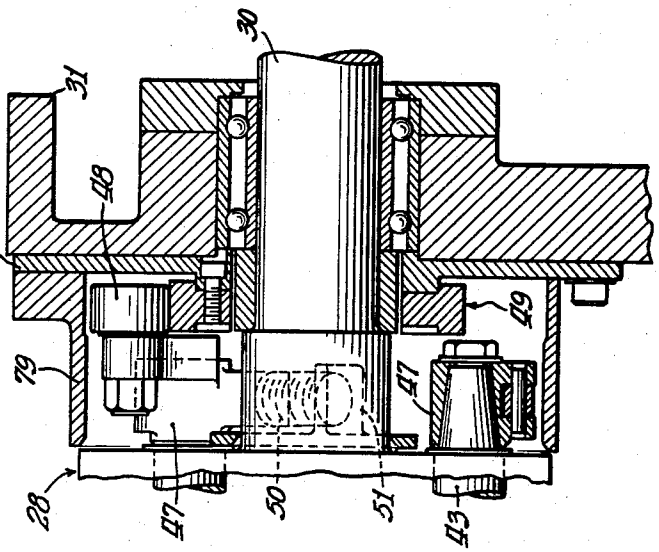


Fig. 10

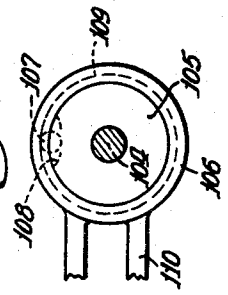
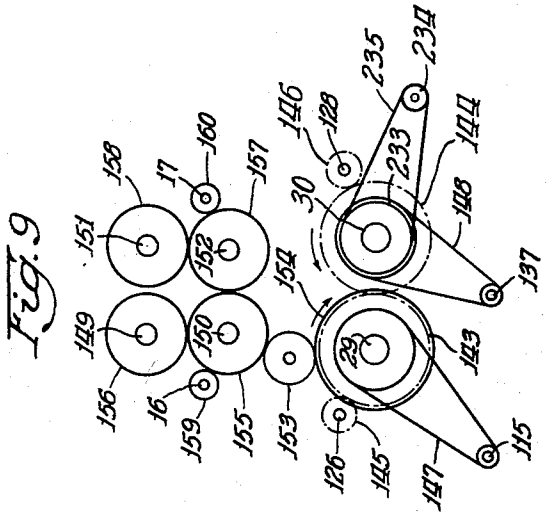


Fig. 9



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CAM CONTROLLED FOLDING MEANS FOR PAPERMAKING MACHINE

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Fig. 5

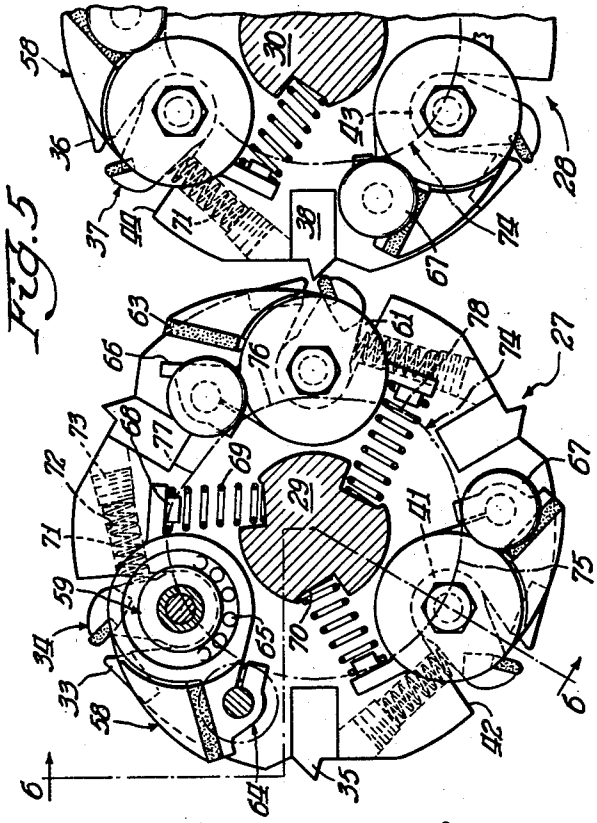

Fig. 7

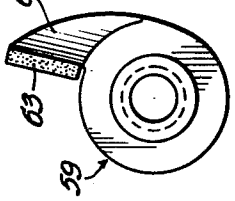

Fig. 8

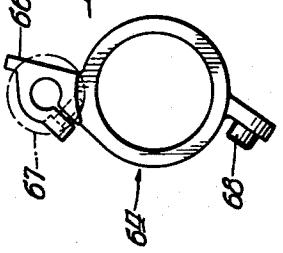

Fig. 6

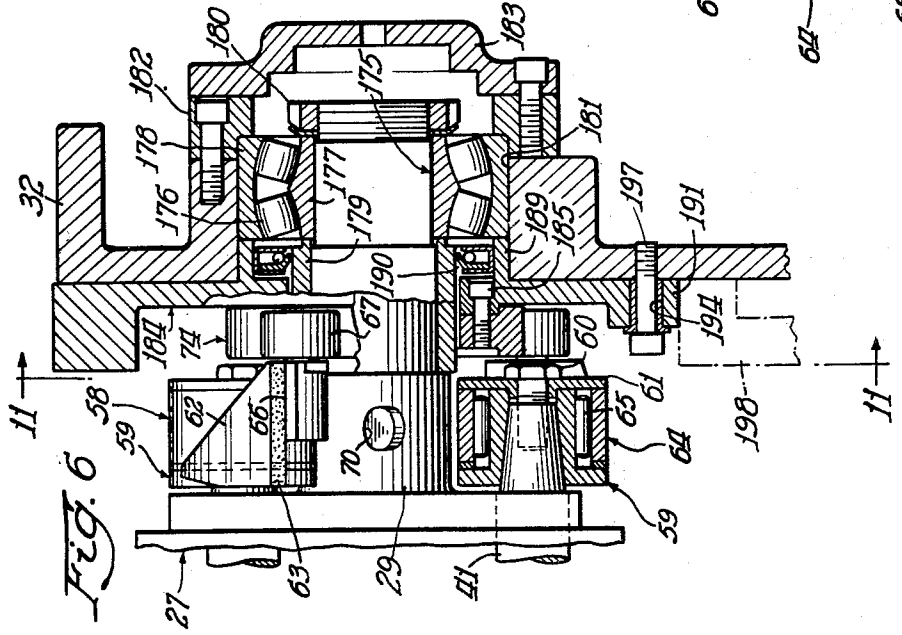

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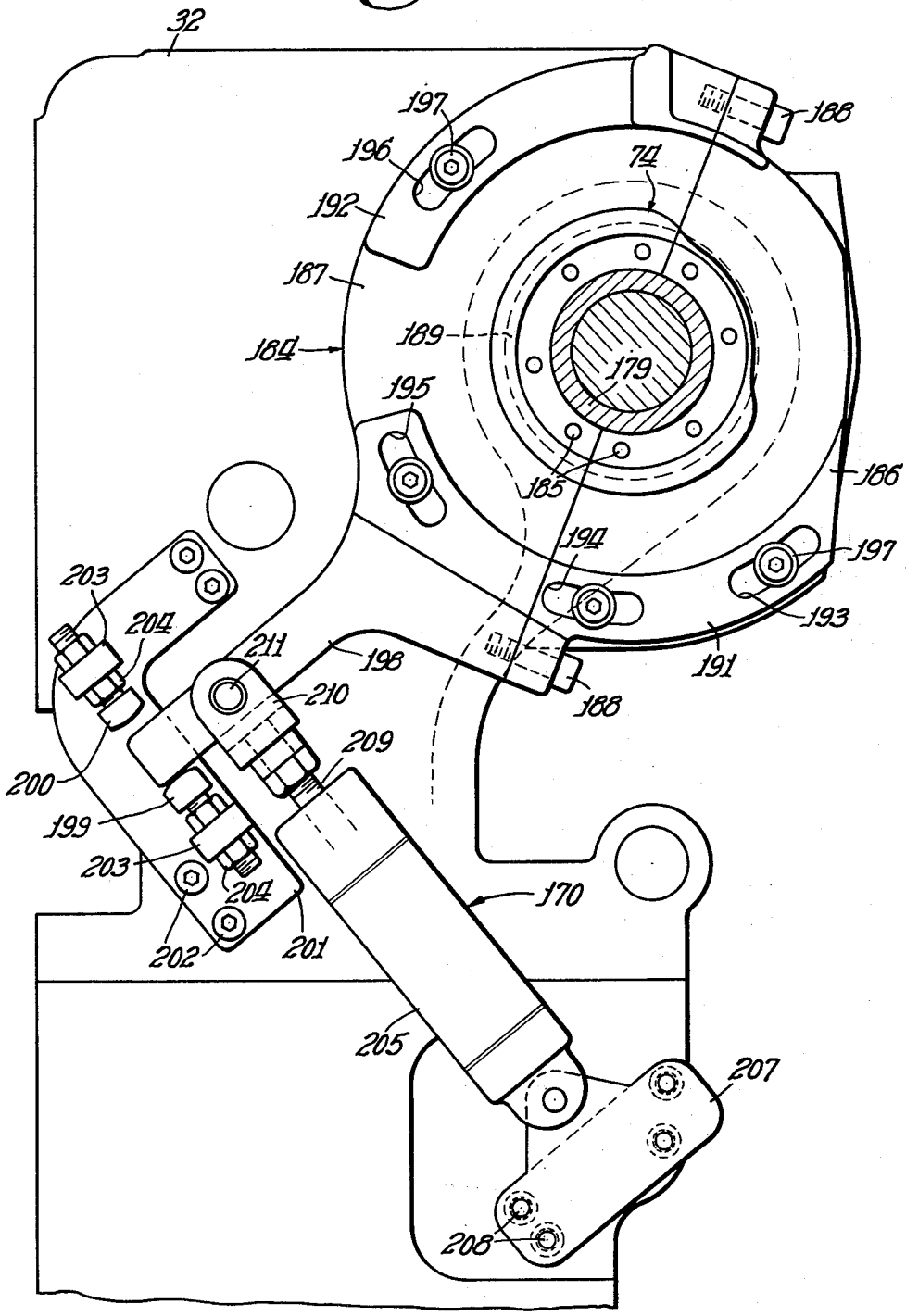
Fig. 11



CAM CONTROLLED FOLDING MEANS FOR PAPERMAKING MACHINE

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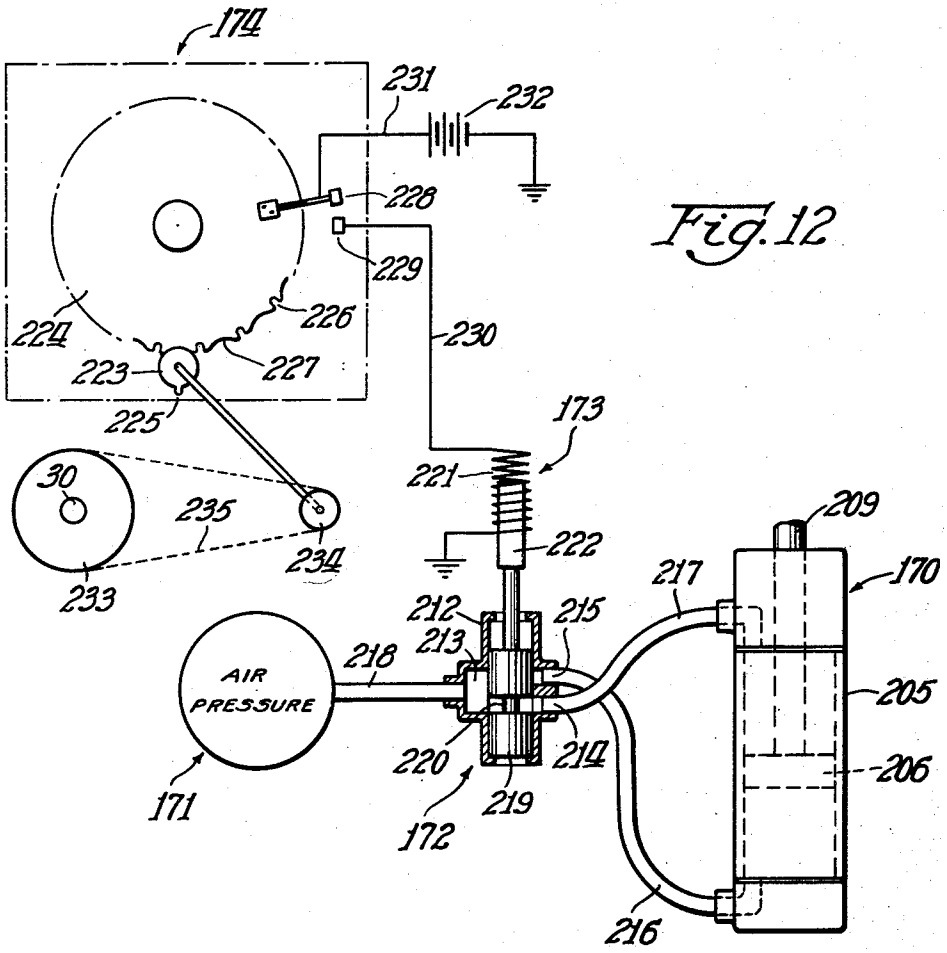
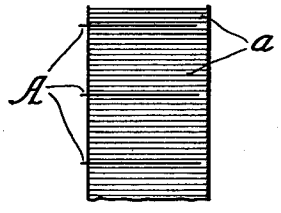


Fig. 12

Fig. 13



United States Patent Office

3,163,413
Patented Dec. 29, 1964

3,163,413

CAM CONTROLLED FOLDING MEANS FOR PAPERMAKING MACHINE

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Filed Mar. 28, 1962, Ser. No. 183,124
4 Claims. (Cl. 270—73)

The invention relates to papermaking machines and, more particularly, to apparatus for interfolding tissues.

In one type of tissue interfolding machine, such as is disclosed in Patent 2,631,846, issued to R. N. Sabee on March 17, 1953, and in a patent application of Charles T. Banks, Serial No. 77,048, filed December 20, 1960, now Patent No. 3,044,766, on Papermaking Machine, two continuous webs of tissue paper are separately fed between cutting rolls which sever the webs transversely in such manner so as to leave a few very slight bonds connecting the web portions on opposite sides of the line of severance. Such webs are then fed into face to face relation, with the lines of severance of one web in staggered relation with the lines of severance in the other, after which the sheet areas between succeeding lines of severance are folded approximately midway between the lines of severance. Folding is effected in such a manner that the bonds connecting successive sheet areas of one web are enclosed between the folds of the other web and preferably at the fold line thereof.

Folding in this type of machine is accomplished by a pair of folding rolls or cylinders, each of which carries a plurality of tuckers fixed to the folding roll and each of which also carries pairs of tissue gripping jaws between which the tuckers insert the webs prior to closure of the jaws. The tuckers are operative to insert the tissues between the jaws slightly above a plane connecting the centers of the two rolls, and the jaws are closed as the rolls rotate so as to provide folds in the webs on opposite sides of the stack of the webs as folded. The jaws are opened as they approach the sides of the folded webs so as to deposit the webs as folded into the stack. Each of the jaw pairs includes a fixed jaw and a movable jaw, and the movable jaws on each of the rolls are opened by means of a cam and cam followers and are closed by another cam and other cam followers.

It is an object of the present invention to provide improved sheet marking or counting mechanism in a tissue interfolding machine of this type for counting out sheets or indicating parts of the finished stack of interfolded sheets having a common predetermined number of sheets in them, so that these parts may be separated one from the other in order to provide substacks of a predetermined number of folded sheets. More particularly, it is an object of the present invention to provide counting mechanism in connection with this type of interfolder operative to cause marking or indicating sheets to protrude from sides of the finished stack of interfolded sheets produced by the machine between which there are a predetermined number of folded sheets, so that the stack of sheets may be separated into substacks either by sight or feel, using the protruding sheets as markers or indicators.

Still more particularly, it is an object of the present

invention to provide counting mechanism effective on one of the cams for the movable jaws, particularly the jaw opening cam for the movable jaws of one of the folding rolls, so arranged to cause such marker or indicator sheets to protrude from a side of the finished stack.

The invention consists of the novel constructions, arrangements and devices to be hereinafter described and claimed for carrying out the above stated objects, and such other objects, as will be apparent from the following description of a preferred embodiment of the invention, illustrated with respect to the accompanying drawings, wherein:

FIG. 1 is a vertical sectional view through the working parts of a machine embodying the principles of the invention and including a pair of tissue folding rolls having jaw pairs which are opened and closed by means of cams and follower mechanism;

FIG. 2 is a sectional view taken on line 2—2 of FIG. 1;

FIG. 3 is a sectional view on an enlarged scale taken on line 3—3 of FIG. 2;

FIG. 4 is a sectional view taken on line 4—4 of FIG. 3;

FIG. 5 is a sectional view taken on line 5—5 of FIG. 2 and illustrating cams and cam follower arms for opening the jaws on the tissue folding rolls;

FIG. 6 is a view partially in elevation and partially in section taken on line 6—6 of FIG. 5;

FIGS. 7 and 8 are views of the follower arms shown in FIG. 5;

FIG. 9 is a more or less diagrammatic view illustrating an arrangement for driving the various operating parts of the machine;

FIG. 10 is a detailed view of a driving element, appearing also in FIG. 1, for operating one of the shafts of the machine;

FIG. 11 is a view of the jaw opening cam for one of the tissue folding rolls and associated parts, including a motor for oscillating the cam;

FIG. 12 is a schematic illustration of controlling mechanism for the cam oscillating motor; and

FIG. 13 is a fragmentary end view of a stack of folded tissues produced by the machine.

Like characters of reference designate like parts in the several views.

The illustrated machine embodies a unit of mechanism designated in its entirety by the reference numeral 1. The unit comprises cooperating cutter roll pairs 2 and 3, the roll pair 2 embodying a knife roll 4 and an anvil roll 5 and the roll pair 3 comprising similar knife and anvil rolls 6 and 7 respectively. Paper webs 8 and 9 are fed over suitable guide rolls 10 and 11 for the web 8 and a roll 12 for the web 9 to feed roll pairs 13 and 14 respectively. The feed roll pair 13 includes cooperating rolls 15 and 16, at least one of which is positively driven at a predetermined rate of speed to effect travel of the web 8 at the desired rate of travel. Similarly, the roll pair 14 comprises rolls 17 and 18 at least one of which is positively driven at a predetermined rate of speed to propel the web 9 at the required speed which is the same as the speed of travel of the web 8. The rolls of the feed roll pairs 13 and 14 are preferably adjustably mounted so as to facilitate control of the pressure with which the webs fed between them are gripped by the respective roll

pairs. The specific means for mounting these rolls forms no part of the present invention and is, therefore, not described in detail.

In the arrangement illustrated, the knife and anvil rolls of the cutting roll pair 3 are so set with respect to the knife and anvil rolls of the cutting roll pair 2 that the successive lines of severance formed in the web 8 will be located subsequently midway between successive lines of severance formed in the web 9 when the webs 8 and 9 are delivered in face to face relation from between the anvil rolls 5 and 7 as shown in FIG. 1.

Commercial forms of facial tissue are usually in the neighborhood of 10 inches in width. It is convenient to interfold a double width of tissue and to subsequently break the double width into separate sections of the required width. Accordingly, the apparatus is provided with slitters 19 and 20 carried on the free ends of the arms 21 and 22 respectively, which are suitably pivotally mounted through the agency of supporting shafts carried by the frames of the upper unit of mechanism.

The slitters 19 and 20 are preferably enclosed by suitable guards 23 and 24 which are carried by the arms 21 and 22, and weighted arms 25 and 26 associated with the respective slitter arms 21 and 22 serve to urge the slitters 19 and 20 toward the respective guide rolls 11 and 12 with sufficient force to slit webs 8 and 9 longitudinally intermediate their width. The slitting is not quite complete and does not actually separate the webs into two strips, sufficient but easily breakable bonding remaining to preserve continuity of the divided webs.

The mechanism for Z folding and for interfolding the paper is supported by side frames immediately below the above described web feeding, slitting and severing mechanism. The webs 8 and 9 in face-to-face relation travel downwardly between a pair of folding rolls 27 and 28 which are carried respectively by shafts 29 and 30 which are suitably journalled in the side frames 31 and 32, respectively, of the mechanism (see FIG. 2). The rolls 27 and 28 are so mounted relative to each other that their surfaces are spaced apart a distance which will cause the rolls to guide the webs 8 and 9 downwardly between them without gripping or exerting any positive feeding effect. The rolls are continuously rotated in opposite directions, the roll 27 being rotated clockwise and the roll 28 counterclockwise as viewed in FIG. 1.

Each of the rolls 27 and 28 carries three sets of jaws and three tuckers, the tuckers being located intermediate the pair of jaws. In the present embodiment of the invention, three pairs of tuckers and three jaws are employed, but it is apparent that by using smaller or larger carrying rolls, or to adapt the apparatus to the interfolding of tissue sheets of shorter or longer length than those for which the present machine is designed, or for other reasons, the number of jaws and tuckers may be varied.

The roll 27 is provided with jaw pairs each embodying a fixed jaw element 33 and a movable rubber tipped jaw element 34. The tuckers provided in the roll 27 are indicated by the reference numeral 35, these tuckers being fixedly mounted in the roll. Similarly, the roll 28 has jaws comprising fixed jaws 36 and movable, rubber tipped, jaws 37 and fixed tuckers 38. The jaws and tuckers extend for the entire length of the respective rolls, but they are grooved transversely in conformity with the grooves provided in the rolls 27 and 28 for the reception of certain elements which will presently be described. Certain of such grooves are indicated at 39 and 40 in the rolls 27 and 28, respectively. The movable jaws 34 are formed with short shaft sections 41 intermediate the lengths of the jaws and at their ends. The jaws are rockably positioned in grooves 42 in the body of the roll 27. Similarly, the movable jaws 37 of the roll 28 are provided with intermediate and end shaft sections 43, and grooves 44 in the roll receive the jaws. The intermediate shaft sections 41 and 43 are located in alignment with the

grooves 39 and 40 in the respective rolls and are seated in bearing surfaces prepared for that purpose. Bearing caps 45 and 46 are bolted to the rolls 27 and 28 over the jaw shaft sections hold the jaws in place.

The end shaft sections 41 and 43 on the end of each of the movable jaws 34 and 37 adjacent the side frame 31 are provided with solid arms which carry rolls on their free ends for engagement with cams whereby the jaws may be closed in predetermined synchronism with cooperating elements of the mechanism. One of the solid jaw mechanisms is shown in FIG. 3 wherein the projecting end shaft 41 of the roll 27 is shown as being provided with a solid arm 47. Each arm 47 is provided on its free end with a roller 48 for engaging a cam 49 surrounding the shaft section 41 or 43. Each roller 48 is urged into engagement with the cam by means of a spring 50 compressed between spring seats 51 and 52, the spring seat 51 being fixedly mounted with respect to the roll 27 or 28 and the spring seat 52 being carried by the arm 47. Each of the cams 49 is an external type of cam and has a high dwell portion 53, a low dwell portion 54, an inwardly extending transition portion 55 and an outwardly extending transition portion 56. Each of the cams 49 is fixed with respect to the frame part 31 by means of a cam plate 57.

The end shaft sections 41 and 43, on the other side of the machine, adjacent the frame 32, are each provided with lost motion arm assemblies 58. Some of the lost motion arm assemblies are shown in FIGS. 5 and 6. Each of the end shaft sections 41 and 43 on these ends is tapered; and, as shown in FIG. 6, a movable jaw arm 59 has a corresponding internal tapered surface and fits on the end of the shaft section. The movable jaw arm is fixed with respect to the shaft section by a stud 60, which is screw threaded into the end of the shaft section, and a washer 61 held in place by the stud. The arm 59 is provided with an outwardly extending portion 62 to which is fixed a radially extending slab 63 of rubberlike material. A cam follower arm 64 is rotatably disposed on each jaw arm 59 by means of a bearing 65. The arm 64 is provided with a radially extending surface 66 adapted to contact the slab 63 of the jaw arm 59. Each cam follower arm 64 carries a roller 67 and is provided with a spring seat 68 in the form of a stud. A spring 69 is disposed on each seat 68 and extends into a corresponding flat bottomed depression or seat 70 provided in the shaft 29 or 30.

Springs 71 are provided for some of the movable jaws 34 and 37. Referring to FIG. 5, it will be observed that the springs 71 each extends through a cylindrical cavity 72 provided in the roll 27 or 28. A plug 73 is screw threaded in the end of each cavity 72 for holding the respective spring 71 in place.

A jaw opening cam 74 of the external type surrounds each of the shafts 29 and 30 adjacent the frame 32, and the rollers 67 contact the cams 74. The cams 74 are fixed with respect to the side frame 32 by means to be hereinafter described. Each of the cams 74 is provided with a high dwell portion 75, a low dwell portion 76, an inwardly extending transition portion 77 and an outwardly extending transition portion 78.

A cover 79 is preferably provided adjacent the side frames 31 and 32 for shielding the cams 74 and 49 and the rollers 67 and 48 running on the cams.

As shown in the drawings, the rolls 27 and 28 with their alternate jaw pairs and tuckers are so related to each other that each tucker of one roll cooperates with a pair of jaws of the other roll. The arrangement is such that each tucker tucks the webs 8 and 9 of tissue into the opposite or cooperating jaw pair while the jaws are open, the tucker being also fully withdrawn from between the jaws before they close and before the jaws actually grip the tucked in webs. At the time of first contact of a tucker and its cooperating jaw pair with the web to be folded (or the webs to be interfolded), the tucker 35 or 38 is

preferably located in registry with a radius extending upwardly at about an angle of 12 degrees from a horizontal radius of the roll.

As the rolls 27 and 28 continue their rotation from this point, the end of the tucker enters the space between the opposite jaws 33 and 34 or 36 and 37 and moves the web between the jaws. When the tucker point is in registry with the horizontal radius of its roll 27 or 28, the tucker has reached its position of greatest penetration between the opposite jaws, and the subsequent travel of the tucker results in withdrawal thereof from between the jaws. On further rotation of the rolls 27 and 28, the tucker point is withdrawn from between the opposite jaws, and complete withdrawal is reached when the tucker point has traveled so that it is on a radius of its roll extending downwardly at about an angle of six degrees from the horizontal radius. The opposite jaws at this point of travel of the rolls 27 and 28 are beginning to close on that part of the web that has been tucked between the jaws by the tucker, and the jaws continue their closing action as the rolls 27 and 28 rotate farther, so that when the point of the tucker registers with a radius of its roll extending downwardly at about an angle of ten degrees of the horizontal, the tucker is then completely withdrawn from between the jaws, but the movable jaw has not yet completely closed on the fixed jaw. As the rolls 27 and 28 continue their rotation for approximately another two degrees, the jaw 34 or 37 has been closed on the jaw 33 or 36, and the tucked in portions of the webs are effectively gripped between the jaws.

Pivotal closing movements of the movable jaws are thus effected by a relatively small travel distance, jaw pivoting beginning at about the time that a cooperating tucker and jaw pair are centered on a horizontal line extending between the axis of the rolls 27 and 28 and proceeding gradually so as to avoid any pinching of the webs against the faces of the tuckers, and the movable jaws are not closed to grip the web against the fixed jaws until the tuckers are completely withdrawn.

After the jaws are closed, they remain closed until the gripped web fold is just about over the edge of the stack in which the folded material is deposited. The pivoted jaw is then opened, with the opening being so timed that the web fold is discharged before the jaws reach their fully open position. According to the invention, one of the jaws 34 of the roll 27 is delayed in its opening after a predetermined number of revolutions of the roll 27 for the purpose of drawing the web fold gripped by the jaw out of line with the folded edges of the web as deposited during the preceding revolutions of the roll 27, so that the particular web fold serves as a marker to indicate the last fold of the web of a predetermined number of web folds.

Tautness of the web during the tucking operation is prevented by causing the web feed rolls to deliver the web or webs to the folding rolls 27 and 28 at a speed which is slightly greater than the normal surface speed of the folding rolls, so as to develop a slight amount of slack in the web length extending from the anvil rolls 5 and 7 to the folding rolls 27 and 28 and by so spacing the folding rolls 27 and 28 that the web is free to slip between them incident to the higher feed rate of the web as compared with the travel of the jaws and roll surfaces. By providing slack, both above and below the folding rolls 27 and 28, the tucks may easily be formed without drawing the webs tight over any of the jaw and tucker surfaces or edges. The provision of frictional material jaw tips aids in avoiding withdrawal of the tucks incident to withdrawal of the tuckers and also aids retention of each tuck for a short time after opening of the jaws is started.

The closing of the jaws 34 and 37 is controlled by the rollers 48 carried by the arms 47 following about the cams 49. As the rollers travel from the high dwell cam portions 53 onto the low dwell portions 54 inwardly along the transition portions 55, the springs 50 and the springs 71 move the jaws 34 and 37 to close with the respective fixed jaws 33 and 36.

The opening of the jaws is controlled by the cams 74. As each roller 67 carried by an arm 64 on an end shaft section 41 or 43 travels from a low dwell portion 76 onto a high dwell portion 75 across a transition portion 78, the respective cam follower arm 64 is rotated on a bearing 65. After a predetermined amount of rotation, the radial surface 66 on the arm 64 contacts the adjacent resilient slab 63 of the respective jaw arm 59 and rotates the arm 59 and the jaw 34 or 37 connected thereto. The rotation of the arm 64 is against the action of the associated spring 69, and the jaw opening movement is against the action of the springs 71 acting on the particular jaw. The surface 66 and the resilient slab 63 are separated from each other on the initial rotation of the cam follower arm 64; and, after predetermined rotation of the arm 64, contact is made with the associated slab 63. There thus exists a lost motion connection between the cam follower arm 64 and the movable jaw arm 59. Each of the rollers 67 thus rides on its cam 74 for 360 degrees of movement of the associated roll 27 or 28. The cam 74 for the roll 27 is rotated slightly by automatic mechanism to be hereinafter described after a predetermined number of revolutions of the roll 27 for the purpose of causing one of the jaws 34 to remain closed longer than normal, so that the web fold carried by the jaw is out of line with the other web folds produced by the roll 27 for the purposes above mentioned. Since there is no corresponding lost motion in the arms 47 which control the closing of the movable jaws 34 and 37, the rollers 48 separate from the low dwell portions 54 of the cams 49 as the rolls 27 and 28 rotate.

The interfolded webs are delivered to a stack located immediately below the rolls 27 and 28, such stack being formed between guide posts or fingers 89 and 90 which are supported at their lower ends on transverse rods 91 and 92. The rods 91 and 92 are carried by bracket members such as 93 and 94 which are fastened to the side frames of the machine. The stack guide members 89 and 90 respectively extend upwardly into suitable grooves 97 and 98 in the rolls 27 and 28, there being a sufficient number of these guide members 89 and 90 spaced across the lengths of the rolls to adequately support the tissue stack as shown in FIG. 1. The guides 89 and 90 are, in effect, extended downwardly by tissue channel-forming plates 99 and 100, which are also supported by attachment to the said brackets 93 and 94. The plate 100 is extended forwardly at an angle as indicated at 101 to form the top wall of a horizontally and downwardly extending chute or channel, the bottom wall of which is formed by the upper reach of a conveyor belt 102. The guide plate 99 terminates a short distance above the conveyor belt 102 as shown. The belt 102 is normally driven at a very slow rate of speed approximately corresponding to the rate of travel of the stack of tissues resulting from the addition of folded sheet after sheet to the top of the stack and downward feeding of the stack top by stripping and hold-down devices presently to be described.

The belt 102 is driven from a pulley 103 (FIG. 1) carried by a shaft 104 which is suitably journalled in the frame structure of the machine. At a suitable point in the length of the shaft 104 it has secured to it a clutch disc 105 (see FIG. 10) which is surrounded by a clutch ring 106. The clutch ring 106 is rocked and has an operative connection to the clutch disc 105 of such character that when the ring 106 moves in one direction, the disc 105 and shaft 104 will be advanced while movement of the ring 106 in the opposite direction will be independent of any movement of the disc 105 and shaft 104. Any suitable one-way clutch may be employed, and in this instance, it is represented as constituting a ball type of clutch embodying one or more balls or rollers 107 housed in recesses such as 108 in the disc 105 and grooves such a 109 in

the ring 106. The bottom of the recesses 108 are so related to the circumference of the disc that when the ring 106 turns in on direction, the balls will become wedged between the bottoms of the grooves 109 and the bottoms of the recesses 108 so as to effect unitary movement of the ring 106, the clutch disc 105 and shaft 104. Movement of the ring in the other direction serves, of course, to release the clutch balls or rollers so that reverse movement of the ring 106 is not imparted to the disc and shaft 104.

The ring 106 is provided with an arm 110 (see FIG. 1) which is slotted to adjustably receive a pivot block 111. The position of the pivot block 111 in the slotted arm may be adjusted and fixed by any suitable means such as an adjusting screw 112 and a lock nut 113 to thereby facilitate adjustment of the amount of travel imparted to the belt by each operative movement of the clutch ring. Rocking motion is imparted to the arm 111 by means of an eccentric 114 carried by a shaft 115 suitably journalled in the machine frame. An eccentric ring 116 surrounds the eccentric 114 and is connected to the clutch arm 110 by means of an arm 117 formed integrally with the ring and pivoted to the block 111. The shaft 115 is continuously rotated by a suitable driving connection which will hereinafter be explained.

The jaws 33 and 34 of the roll 27 and the jaws 36 and 37 of the roll 28 serve to alternately deposite web folds at the opposite sides of the stack. To insure stripping of the folds from the jaws which are automatically opened as they approach the vertical planes of the front and rear sides of the stack, there are provided a plurality of stripper arms 118 and 119 respectively associated with the rolls 27 and 28; and the grooves 39 and 40, previously referred to, serve to receive such strippers in their elevated positions. The strippers 118 and 119 are carried respectively by shafts 120 and 121 which are suitably journalled in the side frames of the machine, and these shafts together with their strippers are rocked in properly timed relation to the travel of the jaws of the respective rolls so that the end or finger portions 118*a* and 119*a* of the respective strippers will be operative to strip the folded webs from the jaws of the respective rolls and pack the folded web down on top of the stack of folded tissues.

The shaft 120 is rocked by means of an arm 122 which is carried by the shaft 120 and connected by means of a pin and slot connection to an arm 123 which has an eccentric ring 124 surrounding an eccentric disc 125 carried by a driven shaft 126. The shaft 121 is rocked by similar operating connections to an eccentric 127 carried by a driven shaft 128. The pin and slot connections in the arms serve to permit adjustment of the throw of the stripper fingers 118*a* and 119*a* and their timing may be adjusted by adjustment of the eccentric discs 125 and 127 about the shafts 126 and 128. In addition, the arm 122 on the shaft 120 and its counterpart on the shaft 121 may be adjustably connected to the shaft to permit adjustment of the position of the respective stripper fingers.

When one of the stripper fingers 118*a* of 119*a* is in a down position (in which the stripper 118*a* is illustrated in FIG. 1) the other stripper is in an elevated position. Also, the stripper fingers have an intermediate position in which they are both located about midway between their upper and lower positions. In order to hold the top of the stack against upward displacement when the stripper fingers 118*a* and 119*a* are in elevated relation to the normal top level of the stack, there are provided holding arms or hooks 129 and 130 respectively carried by shafts 131 and 132 which are rockably mounted in the frame sides of the machine. The arms 129 and 130 are provided at their upper ends with heads 133 and 134 respectively which move from a position overlying the respective margins of the stack to retracted positions clear of the top area of the stack. In their retracted positions the heads of the hold-down arms are received in the aforementioned grooves 39 and 40 at the sides of the respective stripper fingers 118*a* and 119*a* as indicated in FIG. 2. The hold-down arms 129 and 130 are secured to the shafts 131 and 132 which are rocked in such synchronism with the movement of the stripper fingers that the hold-down members are brought into operative engagement with the top of the stack before the associated stripper finger leaves the top of the stack. Therefore, the top of the stack is at all times restrained against upward movement beyond a desired level.

The shafts 131 and 132 may be rocked in the required timed relation to the operation of the strippers by any suitable means, such as typified by cams 135 and 136, carried by a frame carried stub shaft represented at 137. The cams are rotated by a suitable connection to one of the other rotating parts of the machine whereby the proper timed relationship will be maintained. The cams 135 and 136 respectively act against rollers carried at the free ends of arms 138 and 139 which are respectively secured to the rock shafts 131 and 132.

One arrangement of driving connections for the various parts of the machine is illustrated in FIG. 9. For driving purposes, one of the shafts 29 or 30 may be driven by a suitable chain drive connection to an electric motor, this primary drive being not shown. The shafts 29 and 30 are geared together by gears represented at 143 and 144 secured to the respective shafts 29 and 30. The shafts 126 and 128 may be driven in properly timed relation to the drive of the interfolding rolls by means of gears represented at 145 and 146 carried by the respective shafts 126 and 128 and meshing with the gears 143 and 144 respectively. For driving the shaft 115 from which the normal feed of the tissue stack is obtained, there may be provided a chain drive represented at 147 from a suitable sprocket mounted on the roll shaft 29 to engage a suitable sprocket mounted on the eccentric shaft 115. The hold-down actuating cams which are carried by the shaft 137 may also be driven by a chain 148 which engages suitable sprockets carried by the respective shafts 30 and 137.

The shafts 149 and 150 of the cutter roll pair 3 and the shafts 151 and 152 of the cutter roll pair 2 may be driven by means of an idler gear 153 which meshes with a gear 154 on the interfolder roll shaft 29 and a gear 155 on the cutter roll shaft 150. The gear 155 meshes with another gear 156 on the knife roll shaft 149 and with a gear 157 on the cutter roll shaft 152, said gear 157 also meshing with a gear 158 on the cutter roll shaft 151. The innermost rolls of the web feed roll pairs 13 and 14 may be driven from the respectively adjacent gears 155 and 157 of the anvil rolls through the agency of gears 159 and 160 secured to the respective feed roll shafts and meshing with the respectively adjacent anvil roll gears 155 and 157. The outer rolls 15 and 18 of the tissue feed roll pairs may be frictionally driven from the inner rolls, said outer rolls being arranged to gravitate toward the driven inner rolls or provided with spring means urging them toward said inner rolls. The gears and sprockets for the chain drives are, of course, properly selected as to their pitch diameters and number of teeth to produce the required rotation of the various driven parts.

The mechanism for causing the protrusion of certain sheets of the stack of interfolded webs moving downwardly between the guide posts 89 and 90 and along the belt 102 comprises basically (see FIG. 11) an air motor 170 for at times oscillating the cam 74 on the end of the shaft 29 through a small angle, a source of air pressure 171 connected to the motor 170 by means of a valve 172, an electric solenoid 173 for actuating the valve 172 and a counting mechanism 174 for energizing the solenoid 173.

Referring to FIG. 6, the shaft 29 may be rotatably mounted with respect to the side frame 32 by a bearing of any suitable type; however, for the purposes of example, a roller type bearing 175 is illustrated. This bearing comprises rollers 176, which have external rolling surfaces that decrease in diameter toward the ends of the rollers and which are disposed between inner and outer

races 177 and 178. The inner race 177 together with a bushing 179 are fixed on the end of the shaft 29 by means of a nut 180. The outer race 178 fits within an opening 181 in the side frame 32, and the race 178 is held in this position by means of an annular retainer 182 fixed to the side frame 32. A cap 183 is fixed to the annular retainer 182 for shielding the bearing 175.

A cam plate 184 is disposed on the side frame 32, and the cam 74 on the shaft 29 is suitably fixed to the plate 184, such as by studs 185. The cam plate 184 is made up of a pair of parts 186 and 187 which are fixed together by means of studs 188 (see FIG. 11) and which together form a hub portion 189 fitting within the opening 181, so that the cam plate 184 may rotate with respect to the side frame 32 about the center of the shaft 29. A seal 190 of any suitable construction is preferably provided within the hub portion 189 and is effective on the external surface of the bushing 179.

The cam plate 184 is provided with flange portions 191 and 192. Slots 193, 194 and 195 are provided in the flange portion 191, and a slot 196 is provided within the flange portion 192. The sides of each of these slots is circular, having centers on the center of the shaft 29. A stud 197 extends through each of these slots and is screwed into the side frame member 32.

The cam plate 184 is provided with an arm 198, and a pair of stops 199 and 200 are provided on opposite sides of the arm 198 for limiting rotation of the cam plate 184 to a limited arc. The stops 199 and 200 are fixed on an L shaped mounting arm 201 that is in turn fixed with respect to the side frame member 32 by means of studs 202. Each of the stops 199 and 200 extends through a mounting ear 203 of the mounting arm 201, and the stops 199 and 200 are fixed with respect to the ears 203 by means of nuts 204.

The motor 170 comprises a cylindrical casing portion 205 having a piston 206 slidably disposed therein (see FIG. 12). The casing portion 205 has its lower end fixed with respect to the side frame 32 by means of a bracket 207 (see FIG. 11) that is fixed to the side frame 32 by means of studs 208. A piston rod 209 at one end is connected to the piston 206 and at its other end has a clevis 210 fixed to it, the ends of which embrace the arm 198 and are connected to the arm 198 by means of a pin 211.

The valve 172 comprises a casing 212 having an elongated port 213 on one side and a pair of spaced ports 214 and 215 on the other side. The port 215 is connected by means of a conduit 216 with one end of the casing 205, and the port 214 is connected by means of a conduit 217 with the other end of the casing 205. The elongated port 213 is connected by means of a conduit 218 with the source of air pressure 171. The valve 172 comprises also a valve piston 219 slidable within the casing 212 and having an annular groove 220 formed in it.

The solenoid 173 comprises an electric winding 221 and an armature 222 within the winding which is connected with the piston 219. One end of the winding 221 is grounded, as shown.

The counting mechanism 174 may be of any suitable type, obtainable commercially, functioning to provide an electric potential on the solenoid 173 after a predetermined number of revolutions of either of the shafts 29 or 30. The counting mechanism 174, in the form illustrated, comprises a Geneva mechanism having a small gear 223 and a large gear 224. The small gear 223 has a single tooth 225 and is otherwise cylindrical on its periphery. The large gear 224 has a number of recesses 226 for receiving the tooth 225, and the recesses 226 are spaced by cylindrical peripheral surfaces 227 adapted to fit the periphery of the gear 223 to prevent any rotation of the gear 224 except that due to a mating of the tooth 225 with the recesses 226.

The gear 224 carries a contact 228 adapted to slide over and thereby engage a fixed contact 229 to complete an electrical circuit. The contact 229 is connected by means of a lead 230 with one end of the winding 221; and the contact 228 is suitably connected, as by a lead 231, with one terminal of a battery 232, the other terminal of the battery being grounded.

The gear 223 is preferably driven at that number, which is equal to the number of jaw pairs on each of the rolls 27 and 28, times the speed of the shaft 29 or the shaft 30 in revolutions per minute. Each of the rolls 27 and 28 has three pairs of web gripping jaws in the illustrated interfolder, and the gear 223 is thus driven at three times the speed of the shafts 29 and 30. The gear 223 may be driven from the shaft 30 by means of a sprocket 233 fixed on the shaft 30, a sprocket 234 connected to drive the gear 223, and a chain 235 extending around the sprockets 234 and 233.

The counting mechanism 174 is operative to actuate the solenoid 173, which in turn actuates the cam 74 on the shaft 29 through the cam plate 184, the motor 170 and the valve 172, so as to turn the cam 74 slightly to delay the opening of one of the movable jaws 34 on the roll 27 with respect to the respective fixed jaw 33 after a predetermined number of web folds have been deposited onto the stack of folded webs beneath the rolls 27 and 28. With the single toothed gear 223 being driven from the shaft 30 through the sprockets 233 and 234 at three times the speed of the shafts 29 and 30 in the counterclockwise direction as seen in FIG. 12, the gear 224 rotates in steps in the clockwise direction to move the contact 228 in corresponding steps as the rolls 27 and 28 rotate. Each step corresponds to a movement of one of the movable jaws 34 past a central plane through the centers of the two shafts 29 and 30 and is caused by the tooth 225 of the small gear 223 entering one of the recesses 226 to thus move the gear 224 through a small arc corresponding to the distance between two of the recesses 226. On such continued rotation of the shaft 30 and gear 223, assuming that the gear 224 starts at a position in which the contact 228 is just beyond the fixed contact 229 in the clockwise direction, the gear 224 finally is rotated through a complete revolution in a crosswise direction to a position in which the contact 228 engages the contact 229. The number of steps required for this rotation corresponds to the number of recesses 227 in the periphery of the gear 224 and to the same number of times a jaw pair on roll 27 has passed through the plane between the centers of the shafts 29 and 30 and thus to the same number of folded edges and folds in the stack of folded webs that have been deposited during this movement of the gear 224. Engagement of the contact 228 with the contact 229, as will be described, results in the web fold, which is produced by the folding roll 27 while the contacts 228 and 229 are in contact, protruding outwardly from the stack a slight distance, such as 3/16 inch, so that there is a protruding web fold A in the stack of folded webs *a* as the stack is illustrated in FIGS. 1 and 13. For each subsequent revolution of the large gear 224, a web fold A will protrude from the stack of folded webs *a* so that, as will be more fully described hereinafter, the web stack *a* may be separated into parts or substacks having a predetermined number of folded webs in each substack.

When the contact 228 engages the contact 229, an electric circuit is thereby completed from the battery 232, through the lead 231, the contacts 228 and 229, and the solenoid 173. The solenoid 173 is thereby energized, drawing the armature 222 upwardly into the winding 221. The piston 219 is connected to the armature 222, and the piston is thereby moved upwardly into its position in which its groove 220 is in alignment with the port 215. Air pressure is thus supplied through the conduit 218, the port 213, the groove 220, the port 215 and the conduit 216 to the lower end of the casing 205 of the motor 170, and the piston 206 is thereby moved up-

wardly. The motor **170** thus is operative to move the arm **198** of the plate **184** against the stop **200**, and the cam **74** on the shaft **29** is moved through the same small arc as that through which the plate **184** and arm **198** move from the position of the arm in contact with the stop **199** to the position in contact with the stop **200**. This small movement of the cam **74** about the shaft **29** causes one of the movable jaws **34** to remain in engagement with the respective fixed jaw **33** for a small additional distance and for a small additional arc of rotation of the roll **27** than otherwise, so that the web fold gripped by the jaws is carried outwardly farther with respect to the stack of folded webs. The web fold carried by this delayed opening jaw may, for example, be carried about 3/16 inch farther than the other web folds gripped by this and the other jaws of the roll **27** before such actuation of the motor **170**, and such a web fold, designated as fold A in FIG. 13, projects outwardly with respect to the other web folds of the finished stack *a* as is illustrated in this figure.

After such activation of the motor **170**, the subsequent revolution of the small gear **223** moves the large gear **224** one step farther in a clockwise direction, so as to open the contacts **228** and **229**. The solenoid **173** is de-energized with opening of the contacts **228** and **229**, and the valve piston **219** moves downwardly to bring its port **220** into register with the port **214**. Air pressure is then again supplied through the conduits **218** and **217** and through the ports **213** and **214** to the upper end of the casing **205** to return the piston to its lowermost position and to rotate the plate **184** and the cam **74** connected to it back into their original positions with the arm **198** in contact with the stop **199**. The cam **74** on the shaft **29** is then again operative, as the next movable jaw **34** of the roll **27** and the succeeding jaws **34** of this roll pass through the plane between the centers of the shafts **29** and **30**, to deposit the web folds carried by these jaws in their normal positions on the left edge of the stack as illustrated in FIG. 13. The web folds carried by the movable jaws of the roll **27** continue to be so disposed in their normal positions until the contacts **228** and **229** again engage after a plurality of web folds, subsequent to a web fold A, have been deposited on the stack which are determined in number by the counting mechanism **174** and, for the particular form of counting mechanism disclosed, amount to one less than the number of recesses **226** in the gear **224**.

The stack of folded webs on the conveyor **102** may be separated either by sight or feel into substacks of predetermined height, using the protruding web folds A as markers, since there are a predetermined number of folded webs between each of the protruding web folds A. The substacks may be removed as units from the finished continuous stack proceeding along the conveyor **102**, and the two halves of each substack may be separated simply by pulling them apart, breaking them along the slit provided by the slitters **19** and **20** so as to provide tissue stacks in commercial sizes.

It will be apparent that the motor **170** in conjunction with the oscillatably disposed cam **74** on the shaft **29** and with the counting mechanism **174** advantageously provide a satisfactory, relatively economical, arrangement for counting the folded sheets produced by the interfolder of the type disclosed.

We wish it to be understood that the invention is not to be limited to the specific constructions and arrangements shown and described, except only insofar as the claims may be so limited, as it will be apparent to those skilled in the art that changes may be made without departing from the principles of the invention.

We claim:

1. In a rotary folding machine, the combination of a pair of folding rolls mounted for rotation in opposite directions, means for feeding a web to be folded to said folding rolls, a pair of jaws and a tucker carried by each of said rolls, means for driving said rolls in such timed rotation that the tucker of each roll enters between the jaws of the other roll and is withdrawn therefrom as an incident to the rotation of the rolls, cam mechanism operative as an incident to the rotation of the rolls for causing the closing of the jaws of each of said rolls as the tucker of the other roll is withdrawn from between the jaws so that the jaws grip the web between them to form a web fold and for causing the opening of the jaws on a predetermined further rotation through a certain angle of the roll so as to release the web fold, power operable means effective to move said cam mechanism for one of said rolls so that said angle for the roll may be changed while the machine is in operation, and means for selectively actuating and deactuating said power operable means.

2. In a rotary folding machine, the combination of a pair of folding rolls mounted for rotation in opposite directions, means for feeding a web to be folded to said folding rolls, a pair of jaws and a tucker carried by each of said rolls, means for driving said rolls in such timed rotation that the tucker of each roll enters between the jaws of the other roll and is withdrawn therefrom as an incident to the rotation of the rolls, cam mechanism for causing the closing of the jaws of each of said rolls as the tucker of the other roll is drawn from between the jaws so that the jaws grip the web and form a fold in the web, cam mechanism for causing the opening of the jaws of each of said rolls after the roll rotates through a predetermined angle from its position at which the jaws close so that the jaws release the web fold and the two rolls form a stack of folded webs between them, power operable means for moving said jaw opening cam mechanism for one of said rolls so as to increase said angle for the roll and to draw the web gripped by said jaws of the roll outwardly from the web folds produced by prior operation of said jaws to provide a protruding web fold on a side of the stack of web folds produced by the folding machine, and means operable as an incident to the operation of the folding machine for consecutively actuating and deactuating said power operable means during operation of the machine.

3. In a rotary folding machine, the combination of a pair of folding rolls mounted for rotation in opposite directions, means for feeding a web to be folded to said folding rolls, a pair of jaws and a tucker carried by each of said rolls, means for driving said rolls in such timed rotation that the tucker of each roll enters between the jaws of the other roll and is withdrawn therefrom as an incident to the rotation of the rolls, cam mechanism operative as an incident to the rotation of the rolls for causing the closing of the jaws of each of said rolls as the tucker of the other roll is withdrawn from between the jaws so that the jaws grip the web between them to form a web fold and for causing the opening of the jaws on a predetermined further rotation through a certain angle of the roll so as to release the web fold, power operable means effective to move said cam mechanism for one of said rolls so as to change said angle of the roll, and means operative during operation of the folding machine for consecutively actuating and deactuating said power operable means to repeatedly change said angle.

4. In a rotary folding machine, the combination of a pair of folding rolls mounted for rotation in opposite directions, means for feeding a web to be folded to said folding rolls, a pair of jaws and a tucker carried by each of said rolls, means for driving said rolls in such timed rotation that the tucker of each roll enters between the jaws of the other roll and is withdrawn therefrom as an incident to the rotation of the rolls, cam mechanism for causing the closing of the jaws of each of said rolls as the tucker of the other roll is withdrawn from between the jaws so that the jaws grip the web between them to

form a web fold, cam mechanism for causing the opening of the jaws of each of said rolls as the roll rotates through a certain further angle after the closing of the jaws so as to release said web fold, means selectively operable on the said jaw opening cam mechanism for one of said rolls for changing said angle, and a counting mechanism driven in timed relationship with one of said rolls and operative on said selectively operable means so as to cause the latter to be operative after a predetermined number of revolutions of said last named roll.

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