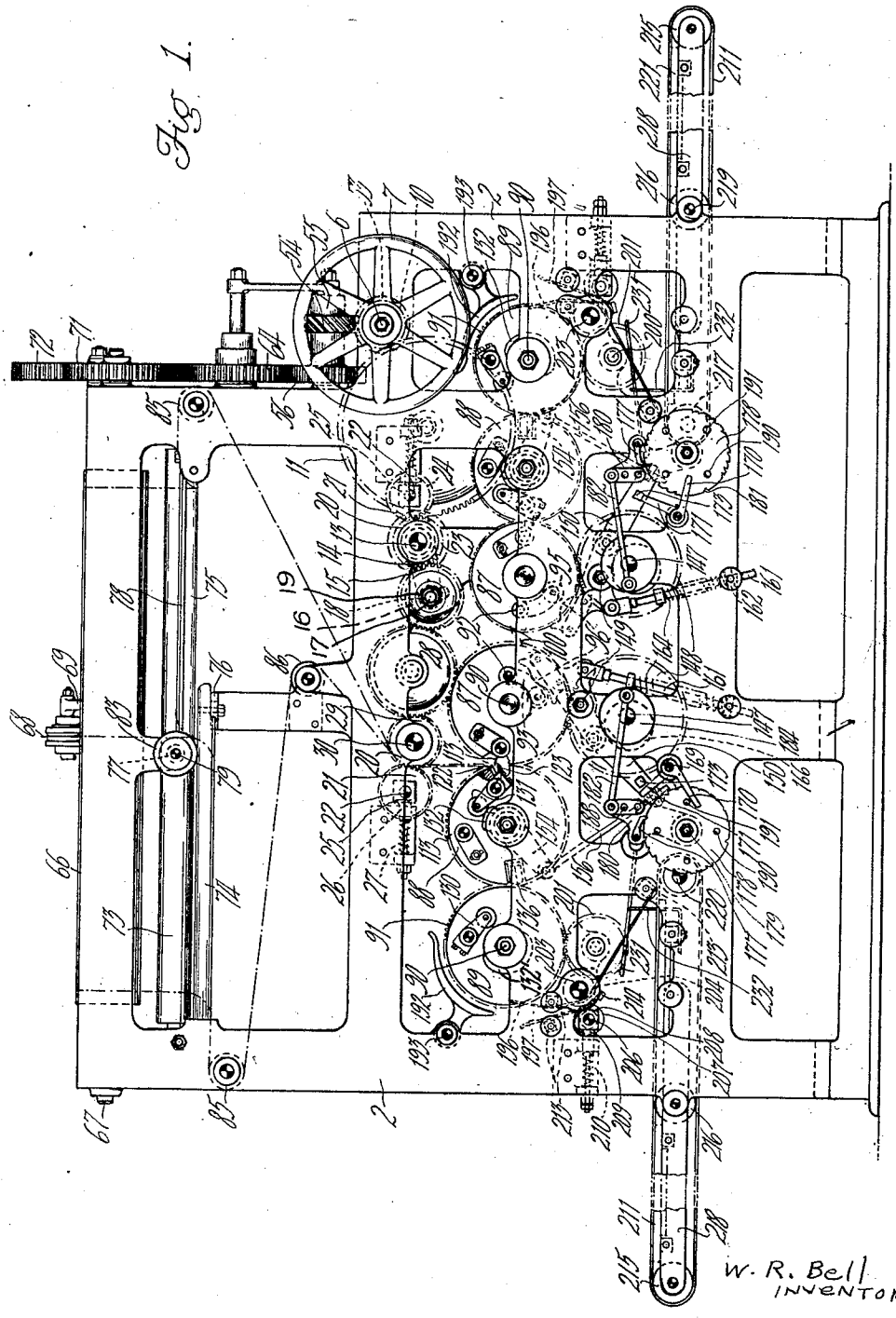
April 12, 1932. W. R. BELL 1,853,494

PAPER RULING, CUTTING, AND FOLDING MACHINE

Filed Aug. 20, 1930 5 Sheets-Sheet 1

Fig. 1.



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PAPER RULING, CUTTING, AND FOLDING MACHINE

Filed Aug. 20, 1930 5 Sheets-Sheet 2

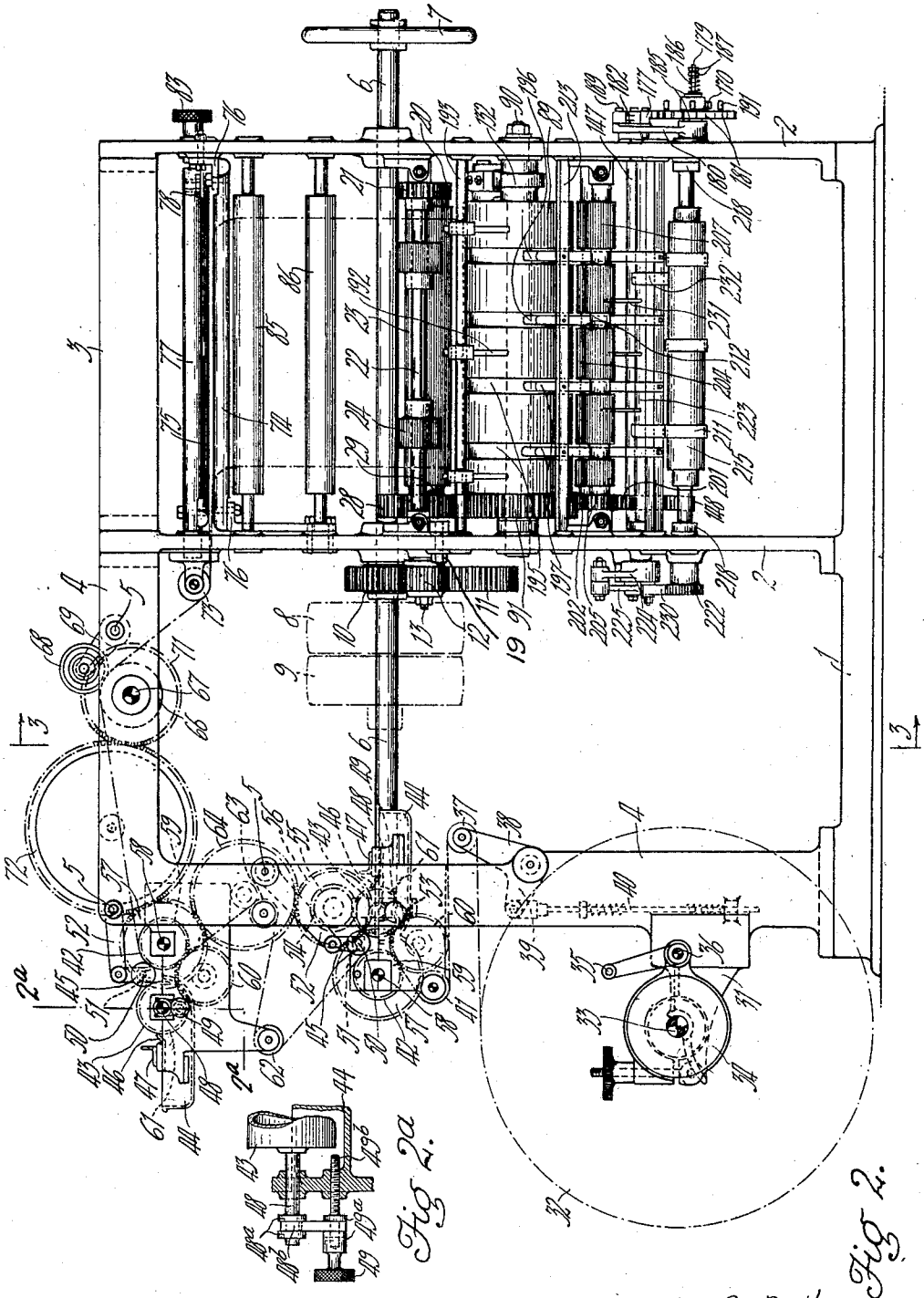

Fig 2a.

Fig 2.

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PAPER RULING, CUTTING, AND FOLDING MACHINE

Filed Aug. 20, 1930 5 Sheets-Sheet 3

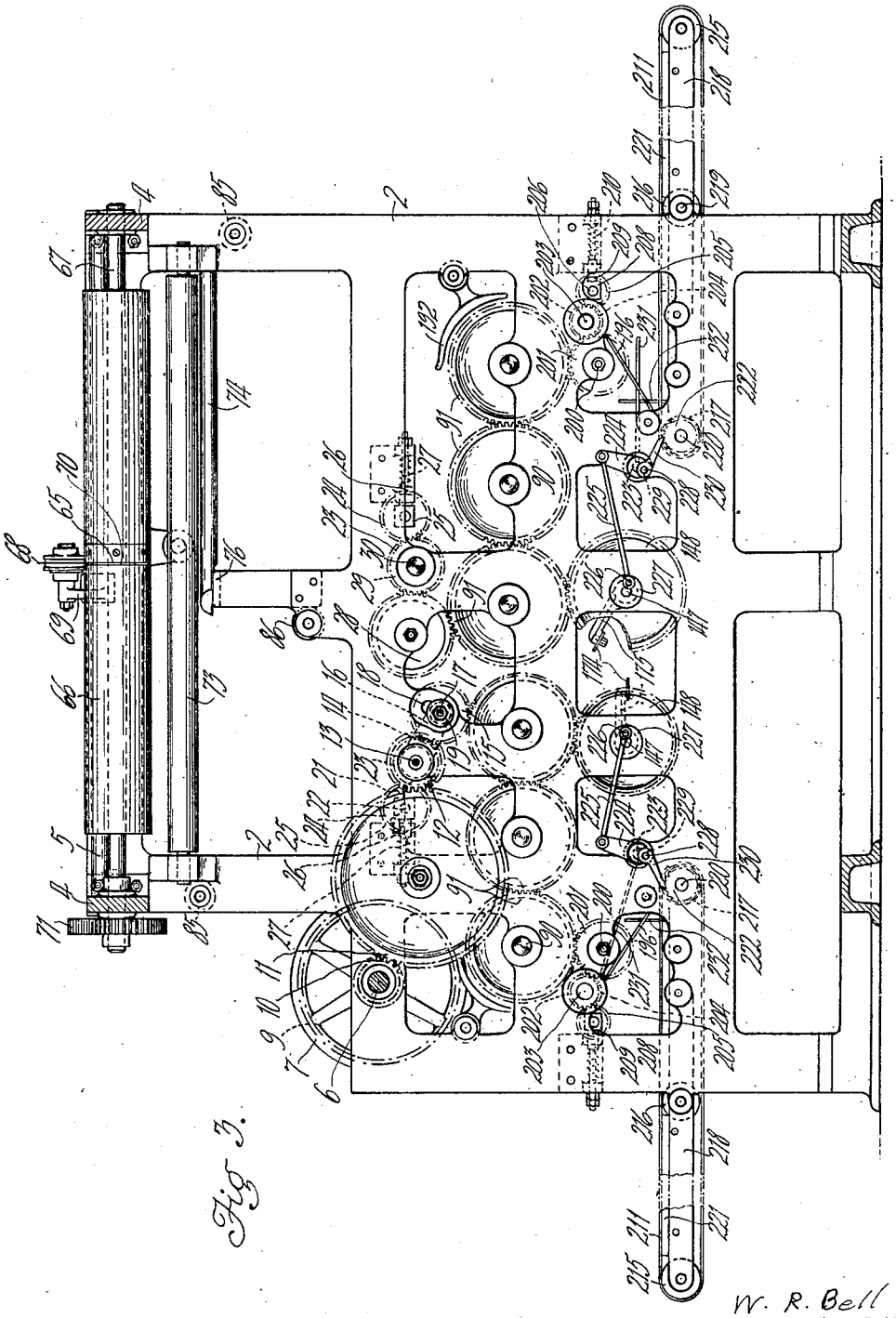

Fig. 3.

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PAPER RULING, CUTTING, AND FOLDING MACHINE

Filed Aug. 20, 1930 5 Sheets-Sheet 4

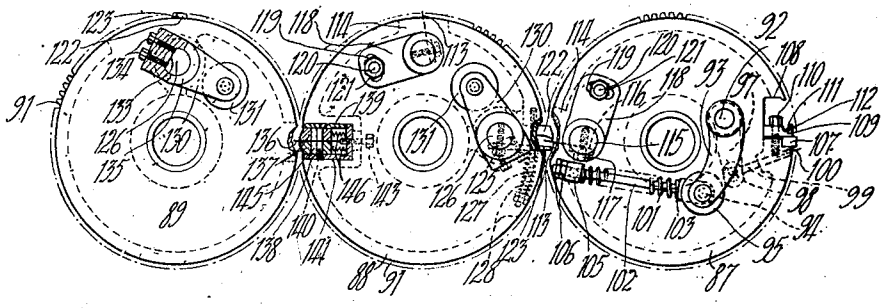

Fig 4.

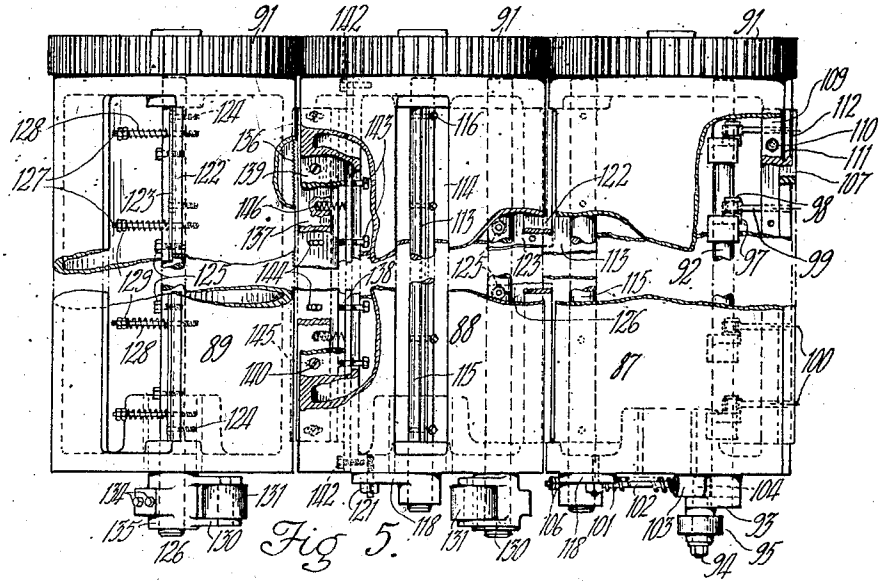

Fig 5.

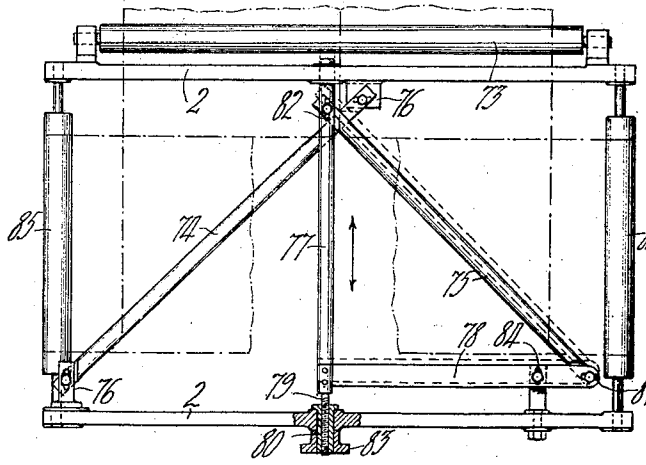

Fig 6.

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PAPER RULING, CUTTING, AND FOLDING MACHINE

Filed Aug. 20, 1930 5 Sheets-Sheet 5

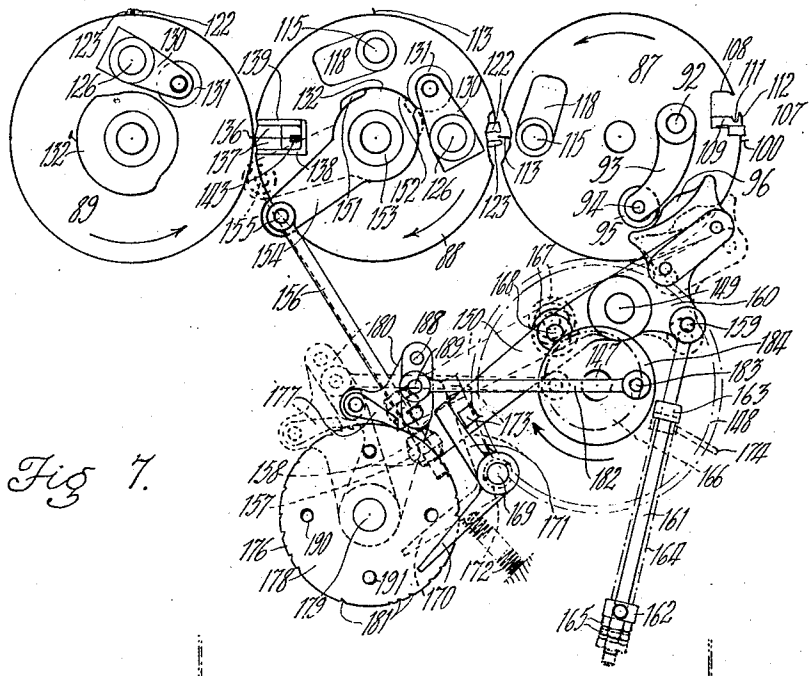

Fig 7.

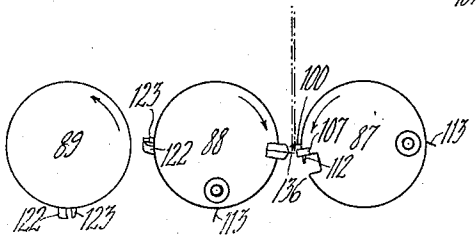

Fig 8.

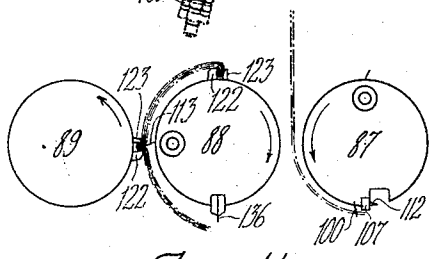

Fig 11.

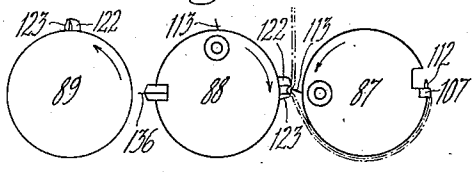

Fig 9.

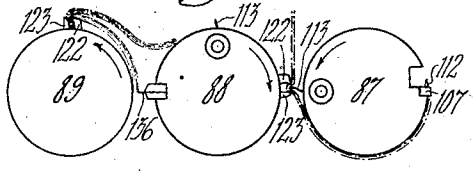

Fig 12.

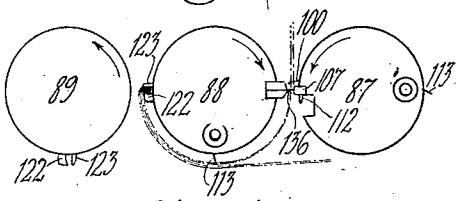

Fig 10.

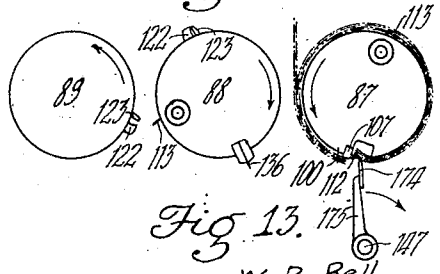

Fig 13.

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By: Marks & Clark Attys.

Patented Apr. 12, 1932 1,853,494

UNITED STATES PATENT OFFICE

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PAPER RULING, CUTTING, AND FOLDING MACHINE

Application filed August 20, 1930, Serial No. 476,685, and in Great Britain September 2, 1929.

This invention relates to improvements in paper ruling, cutting, and folding machines and refers more particularly but is not restricted to the manufacture of exercise book sections, whereby the operations of ruling, cutting, and folding are automatically performed, in required sequence on a web of paper drawn from a reel or roll mounted on the machine or positioned adjacently thereto, to produce completed book sections having predetermined numbers of pages.

In the present invention the web of paper is drawn from the reel or roll by means of one or more co-acting pairs of inter-geared serrated drawing or traction rolls, and is firstly ruled on one or both sides. After being ruled, as required, the web of paper is cut or divided longitudinally into two strips or ribbons of equal width, each strip or ribbon being, accordingly, half the width of the reel or roll.

The separated ribbons or strips are next caused to move in opposite directions and at right angles to their original course, and after passing around suitable guiding members, approach each other and move into contact and finally become superposed one upon the other, and said strips or ribbons, with their correspondingly ruled lines accurately registered then travel in the same direction.

The superposed strips or ribbons are now fed to the cutting and folding mechanism comprising three inter-geared cylinders or rolls adapted to revolve at equal speeds and termed respectively, the collecting cylinder, the cutting cylinder, and the delivery cylinder.

The strips or ribbons pass between the collecting and cutting cylinders which rotate in opposite directions, and at or near their ends the said strips or ribbons become pierced by and caught upon a series or row of needles or spikes projecting from the periphery of the collecting cylinder.

The piercing needles carry the ends of the strips or ribbons a predetermined distance around the periphery of the collecting cylinder, whereupon the needles are withdrawn within the said periphery to release the ends of the paper strips.

At or about the time the needles release the paper strips, a tucking blade, carried by the collecting cylinder, enters between open gripping jaws, or shortly grippers, mounted on the cutting cylinder, and pushing laterally on the superposed paper strips impels the same into the said grippers which close over the tucking blade and the portion of said strips therein.

The relative movement of the collecting and cutting cylinders causes the tucking blade to slide outwardly from said grippers which closing firmly upon the paper strips fold the same.

The said cylinders have now revolved approximately through one half a revolution from the positions they occupied when the needles pierced the paper strips. Upon further rotation the grippers draw the folded paper strips around the periphery of the cutting cylinder and draw the released ends of the said strips backwardly from the collecting cylinder.

The folded portion of the paper strips or ribbons are still connected with the reel or roll, and said strips or ribbons continue to pass between the collecting and cutting cylinders and are maintained taut by the traction of the gripping jaws or grippers. However, at the completion of approximately a further half revolution and rather less than one revolution from the original point at which the needles penetrated the superposed paper strips, a cutting blade on the cutting cylinder coacts with a rubber pad on the collecting cylinder to sever the folded portions from the said paper strips.

The peripheral length of the cutting cylinder is made approximately four times the width of the required exercise book and accordingly at this stage a book section having four leaves of twice the required width is obtained. It, therefore, becomes necessary to fold the section again to make it of standard width.

For this purpose, and when the said grippers have carried the section a sufficient distance around the periphery of the cutting cylinder, a tucking blade thereon bears laterally on the section at approximately the

mid-width thereof and inserts the paper leaves between similar spring closed gripping jaws or grippers on the delivery cylinder and re-folds the section to approximately standard width in the manner above described. At or about the same time the grippers on the cutting cylinder open and release the previous or first fold of the section.

The section now held by the grippers of the delivery cylinder is carried away from the cutting cylinder and said jaws are opened to release the section when the same has been positioned under propelling rolls. The section is finally removed from the delivery cylinder by strippers and guided thereby to nipping or squeezing rolls which compress and fold it more tightly and deposit it on intermittently propelled delivery belts.

Immediately after the folded section is severed by the interaction of the said cutting blade and rubber pad, the needles again pierce the superposed paper strips and a further section is produced in the manner above described and so on continuously.

The successive sections are thrown forwardly by beaters on to the intermittently propelled delivery belts and the said sections are thereby delivered in overlapped fan formation.

Book sections, consisting of the two sheets of paper severed from the superposed strips or ribbons at each revolution of the cutting and collecting cylinders, and formed as above described, will, when ruled in accordance with the standard system of ruling, bind into exercise books having sixteen pages.

An important feature of the present invention resides in the provision of special counting and tripping mechanism whereby the needles carried by the collecting cylinder, instead of receding within the periphery of the said cylinder during each revolution thereof, are maintained in an operative position wherein they project from the periphery of the collecting cylinder for two, three, four or more revolutions. Moreover, by means of the said counting and tripping mechanism, the closing of the grippers on the cutting cylinder is simultaneously delayed, so that although the tucking blade exerts lateral pressure on the superposed paper strips and pushes the same into the open grippers at each revolution, no fold is made, since the grippers do not close and the paper strips or ribbons are merely diverted into and pass out of the same.

Meanwhile, the said counting and tripping mechanism does not affect the normal operation of the cutting blade on the cutting cylinder, and the rubber pad coacting therewith on the collecting cylinder; accordingly, the sheets or portions of the superposed paper strips or ribbons taken up by the needles and wound around the periphery of the collecting cylinder at each revolution are cut away from the said strips or ribbons, and are collected or piled upon the said cylinders. At the termination of a predetermined number of revolutions and when the paper sheets wound about the collecting cylinder have become sufficiently numerous to form a required book section, the said counting and tripping mechanism causes the needles to recede and release the ends of the sheets, and simultaneously permits the grippers on the cutting cylinder to close, and, in conjunction with the co-acting tucking blade on the collecting cylinder, fold the sheets.

The folded sheets are then transferred by the grippers to the delivery cylinder and, after being again folded in the manner above outlined, are deposited in overlapped fan formation on the delivery belts. In this manner, by allowing the needles to remain in their operative positions during two revolutions, four paper sheets will be wound upon the collecting cylinder, and said sheets when folded and delivered, as above mentioned, will form book sections having thirty-two pages. Similarly, by permitting paper sheets to mount upon the collecting cylinder for three revolutions, corresponding book sections having forty-eight pages will be produced, and so on, sixteen extra pages being formed in the book sections for each additional revolution of the collecting cylinder.

Another feature of the invention resides in the provision of means whereby the rear or trailing ends of each pair of sheets after the same have been cut from the superposed strips or ribbons, are impelled into a longitudinal gap in the collecting cylinder and maintained therein during subsequent revolutions of the collecting cylinder and until the needles thereon are withdrawn and the grippers on the cutting cylinder are closed by the action of the counting and tripping mechanism.

By this means the rear or trailing ends of the cut or severed sheets are maintained within the said gap in a position wherein they cannot be clipped or re-cut during the succeeding revolutions of the collecting and cutting cylinders, and they remain in this position until they are withdrawn from the collecting cylinder by the grippers on the cutting cylinder.

A further feature of the invention consists in the mounting on the machine of independently operated cutting and folding mechanism, adapted to manufacture two different standard sizes of exercise books. For this purpose two similar sets of intergeared collecting, cutting, and delivery cylinders are provided, the three cylinders of each set having approximately the same diameter, but the respective diameters of the cylinders of the two sets being unequal and suited to the sizes of the two different standard exercise books. Adjustable driving means are provided, whereby one or the other set of cylin-

ders may be operatively connected with the main shaft of the machine.

In the drawings illustrating the invention:

Figure 1 is a view in side elevation of a paper ruling, cutting and folding machine.

Figure 2 is a view in end elevation of the paper ruling, cutting and folding machine shewn in Figure 1.

Figure 2^a is a view in sectional elevation of a constructional detail taken on the dotted line 2^a—2^a of Figure 2.

Figure 3 is a view in longitudinal section on the line 3—3 of Figure 2.

Figure 4 is a view in end elevation of paper collecting cutting and delivery cylinders.

Figure 5 is a sectional plan of the cylinders shewn in Figure 4.

Figure 6 is a plan view of a detail of the invention. Figure 7 is a diagrammatical view of paper collecting, cutting and delivery cylinders, and mechanism governing the actions thereof.

Figures 8, 9, 10, 11 and 12 are diagrammatical views illustrating the sequence of operations, in the formation of a folded book section.

Figure 13 is a diagrammatical view illustrating the actions of the collecting cylinder in assembling paper sheets to be subsequently folded to form a book section.

In these drawings the numeral 1 designates a bed plate having fixed thereto upright frames 2, spaced apart, in parallel positions and secured and braced together by a required number of transverse members 3.

Fixed to one of the frames 2, and to the bed plate 1, are similar L-shaped members 4, which are likewise firmly secured in parallel positions by transverse braces or stays 5.

Mounted in suitable bearings in the frames 2 and on one of the L-shaped members 4 is a main shaft 6, which may be provided with a hand-wheel 7, and with fast and loose pulleys 8 and 9 or with other suitable driving means or gear.

On the main shaft 6 is a pinion 10 which meshes with an idler gear 11, engaging a gear 12 fixed securely on a shaft 3 extending transversely between the upright frames 2 and rotatively mounted in bearings therein.

Fixed adjacently to the gear 12, but on the inner side of the upright frame 2, is a pinion 14 which meshes with a gear 15 carried on an adjustable swinging arm 16 mounted concentrically with respect to the shaft 13.

The adjustable swinging arm 16 is provided with a bolt 17 which passes through an arcuate slot 18 in the upright frame 2, and the said arm may be secured in adjusted positions, for purposes which will presently appear, by tightening a nut 19 on the bolt 17.

On the end of the shaft 13 remote from the adjustable arm 16 is a gear 20 which meshes with an equal gear 21 carried on a shaft 22 positioned in parallel alignment with the shaft 13.

Fixed to the said shafts 13 and 22 respectively, are co-acting serrated drawing or traction rolls 23 and 24, which rotate in opposite directions, and by means of which paper is drawn from a reel or roll in the manner hereinafter described.

The shaft 22 is mounted in bearings 25, carried on slides or plungers 26, and springs 27 bearing on the slides or plungers 26 urge the shaft 22 towards the shaft 13, and accordingly cause the drawing roll 24 to resiliently bear upon the periphery of the drawing roll 23, and thereby firmly grip the paper passing between the said drawing rolls.

Mounted on the upright frame 2 is an idler gear 28 which engages a gear 29 on a transverse shaft 30 rotatively supported in the opposite frames 2.

The shaft 30 operates serrated drawing rolls 23 and 24 similar to those above described, of which the roll 23 is mounted upon the shaft 30, and the roll 24 is mounted on a shaft 22 parallel to the said shaft 30, and driven by the same gears 20 and 21.

The shaft 22 is mounted in bearings 25 carried on slides or plungers 26, which under the action of springs 27 cause the roll 24 to resiliently bear upon the roll 23 precisely as above described. The idler gear 28 is engaged with and driven by the gear 15 when the swinging arm 16 is fixed in its upper position as shewn in Figure 1, but is thrown out of action when the said arm is clamped by the nut 19 in its lower position as in Figure 3.

Mounted on brackets 31 fixed to the members 4 is a reel or roll of paper 32 of required width, from which the web of paper is drawn by one or other pair of serrated drawing rolls 23 and 24.

A spindle 33, whereon the reel of paper 32 is mounted is provided with an adjustable friction brake 34 of usual construction, having a handle 35 and screwed shaft 36 by means of which the friction brake 34 and spindle 33 may be adjusted in an endwise direction, to locate the reel 32 in required position.

The paper web on leaving the reel 32 passes around a guide roller 37 mounted on arms 38 of levers, the opposed arms 39 of which are connected to spring plungers 40.

The friction brake 34 may be adjusted to provide a required tension in the web of paper, and the resiliently mounted guide roller 37, functions as a yieldable resistance to absorb any sudden variations of tension or shocks in the paper web.

The web passes from the guide roller 37 to and around a guide roller 41 thence to primary ruling means having a rubber covered impression roller 42, rubbered duct roller 43 rotating in a trough 44 of ruling ink,

and ruling discs 45 revolving in contact with a duct roller 43.

The ruling discs 45 convey ink from the duct roller 43 to the paper web passing around the impression roller 42, and thereby rule lines as required on one side of the paper.

To prevent an excess of ink being taken up by the ruling discs 45, a rubber scraper or wiper 46 is provided which bears upon the periphery of the duct roller 43 and removes surplus ink and forms the ink adhering to the said duct roller into a uniform film. The scraper or wiper 46 is held in position by a slotted clamping plate 47 and by adjusting this plate and altering the inclination of the said wiper to the periphery of the duct roller 43, the thickness of the film of ink may be regulated, as required.

In order to prevent the formation of grooves in the duct roller 43 at the points of contact of the ruling discs 45 therewith, the spindle 48 of the said roller is adapted for endwise adjustment, and for this purpose may be provided with a pair of collars 48^a, Figure 2^a, engageable by a yoke 48^b carried between collars 49^a on a threaded shaft 49^b having a knurled head 49 by means of which it may be screwed into or out of a tapped hole in the framing.

The ruling discs 45 are mounted at required spaced intervals on a spindle 50 carried in bearings 51 in the framing of the ruling means, and the spindle 50 may be provided with a central bearing 51 carried on an adjustable arm 52 mounted on one of the stays 5.

The first or primary ruling means is driven by the main shaft 6, and for this purpose a skew gear 53 on said shaft meshes with a similar gear 54 on a counter shaft 55.

On the countershaft 55 is a gear wheel 56 which engages with a gear 57 mounted on the shaft 58 of the impression roller 42. A gear 59, fixed to the shaft 58 meshes with an idler 60, which in turn engages with and rotates a gear 61 mounted on the spindle 48 of the duct roller 43.

The web of paper upon being ruled on one side by the primary ruling means passes therefrom to a guide roller 62 mounted on the framing of secondary ruling means, thence around guide roller 63, and therefrom to the impression roller 42 of the said secondary ruling means.

The secondary ruling means is adapted to rule the other side of the web of paper and is constructed similarly to the primary ruling means, and is provided with an impression roller 42, duct roller 43, trough 44, ruling discs 45, wiper 46, means for endwise adjustment of the duct roller 43 operated by handle 49, and central bearing 51, carried by the adjustable arm 52 mounted on a stay 5.

The secondary ruling means is operated by an idler gear 64, which inter-connects the gear 56 on the countershaft 55 with the gear 57 on the impression roller shaft 58.

A gear 59 on the impression roller shaft 58 drives, by means of an idler 60, the gear 61 on the spindle 48 of the duct roller 43, in the same way as in the primary ruling means.

The web of paper, now ruled on one or both sides as required, passes from the impression roller 42 of the secondary ruling means, to slitting means accurately adjusted to sever or cut the said paper web longitudinally into two equal portions or halves, thereby forming two paper strips or ribbons of exactly the same width.

The said slitting means, comprises rotary shears, one cutting member thereof consisting of a periphery blade 65 positioned at or about the mid-length of a roller 66 carried on a shaft 67, rotatively mounted in the opposite members 4. The other cutting member comprises a circular blade 68 carried on an arm 69 mounted on one of the said stays 5.

The circular blade 68 enters a narrow peripheral slot 70 in the roller 66 and co-acting with the peripheral blade 65 divides the paper web into two portions of equal width as above mentioned.

In order to operate the said rotary shears a gear wheel 71 is mounted on the shaft 67 and is driven by the gear wheel 57 on the secondary ruling means by means of an intermeshing idler gear 72.

The two equal paper strips or ribbons pass from the rotary shears to a roller 73, which directs them to a pair of inclined turning bars 74 and 75 positioned accurately at right angles to each other and located on opposite sides of the central longitudinal slit in the paper and inclined at angles of 45° thereto.

The bar 74 is fixed at a lower elevation than the bar 75, and the upper edge of the former is positioned in a plane slightly below that of the lower edge of the latter, as clearly shewn in Figure 2.

The lower bar 74 as shewn in Figure 6, is bolted to slotted supports 76, and said bar accordingly can be adjusted angularly with respect to the line of division of the paper ribbons or strips and also to the bar 75.

The upper bar 75 forms one side of an adjustable triangular frame, the other sides of which consists of a cylindrical bar 77, and a flat bar 78.

The bar 77 is at one end slidably mounted in one of the upright frames 2, and is provided at its opposite end with a threaded extension 79 which passes through a correspondingly screwed sleeve 80 rotatively mounted in the frame 2. The sleeve 80 is fixed against end movement in the frame 2, so that when it is rotated the bar 77 will be moved in an endwise direction.

The bar 78 is fixed securely and at right angles to the bar 77 and the former bar is pro-

vided with a longitudinal slot 81 at or near its outer end.

One end of the upper turning bar 75 is adjustably bolted to the slotted end of the bar 78, whereas the opposite end of bar 75 is likewise adjustably secured to the bar 77 by a bolt passing through a slot 82 in the latter.

By means of the bolts and slots 81 and 82 the inclination of bar 75 to the line of division of the paper and to the bar 74 may be adjusted, as necessary.

The sleeve 80 is provided with a handwheel 83, by means of which it may be turned to move the bar 77, and accordingly adjust the position of the frame consisting of the three bars 75, 77 and 78.

A support 76 is fixed to the frame 2, near the end of the flat bar 78 which is provided with a transverse slot 84 through which a bolt passes into a hole in the support 76.

On adjustment of the frame, consisting of the bars 75, 77 and 78, by the sleeve 80, the said frame may be fixed in an adjusted position by tightening the bolt passing through the transverse slot 84.

One of the paper strips or ribbons passes over and partly around the lower turning bar 74, whereas the other strip or ribbon passes under and partly around the upper turning bar 75.

The inclined bars 74 and 75 turn the paper strips or ribbons at right angles to their original course and cause the same to travel in opposite direction towards the ends of the frames 2 to guide rollers 85 mounted thereon.

The paper strips or ribbons pass around the guide rollers 85 and return towards the central plane of the machine, the strip turned aside by the lower bar 74 passing over a guide roller 86, and becoming positioned above the strip diverted by the upper bar 75, as shewn in Figure 1.

By adjustment of the bar 75 by the hand wheel 83, the lower strip, Figure 1, may be positioned exactly over the upper strip, without any overlapping of the edges of the said strips, and the lines ruled on the respective strips may be brought into accurate registration.

The paper strips now accurately aligned and superposed one above the other approach and pass between either pair of drawing rolls 23 and 24, which have drawn them firstly, as a single web of paper from the reel or roll through the primary and secondary ruling means, and then to the said rotary shears 65 and 68, and thereafter, as two separate strips to the guide roller 73, and therefrom to and partly around the turning bars 74 and 75, and thence to and from the guide rollers 85.

After passing between the serrated drawing rolls 23 and 24, the paper strips now in contact with each other, are fed to the previously mentioned folding and cutting mechanism, which as hereinbefore stated primarily comprises a collecting cylinder 87, a cutting cylinder 88, and a delivery cylinder 89.

The cylinders 87, 88 and 89 shewn clearly apart from the machine in Figures 4 and 5, are of approximately the same diameter and are hollow in construction, and are freely mounted on shafts 90, which extend axially through them and are supported by and fixed securely in the said frames 2.

The shafts 90 of the three cylinders 87, 88 and 89 are parallel and lie in the same horizontal plane, and the said cylinders are interconnected by equal inter-meshing spur gears 91, that is spur gears having equal numbers of teeth, so that the said three cylinders are thereby constrained to rotate at equal speeds.

In order that book sections of two different sizes may be manufactured, as previously mentioned, two sets of cylinders 87, 88 and 89 are provided, although for some purposes machines may be made having a single set of said cylinders only.

The two sets of cylinders and the associated mechanism, hereinafter described, co-acting therewith or respectively governing the actions thereof, are similar in construction, arrangement, and operation, but the diameters of the cylinders of the respective sets are dimensioned to adapt their peripheries to the sizes of the two different book sections.

The machine accordingly may be provided with two sets of cylinders, 87, 88 and 89, one set being of considerably greater size than the other, as shewn in Figures 1 and 3.

Either set of cylinders may be operated; the larger set being driven when the adjustable swinging arm 16 is clamped by the nut 19 in the upper position, shewn in Figure 1. In this position the gear 15 is meshed with and rotates the gear 28 and the latter, which at all times engages the gear 91 of the collecting cylinder 87, drives the same and the cylinders 88 and 89 inter-geared therewith.

Similarly, the cylinders 87, 88 and 89, of the smaller set will be operated, when the arm 16 is adjusted to mesh the gear 15 with the gear 91 of the collecting cylinder 87 of the said set, as shewn in Figure 3.

The three cylinders 87, 88 and 89 of each set are arranged in line, the cutting cylinder 88 of each set being positioned between the collecting cylinder 87 and the delivery cylinder 89 thereof, and the cylinders 87 and 89 rotate in the same direction and oppositely to the said cutting cylinder 88.

The peripheries of the adjoining cylinders 87 and 88, and 88 and 89, are spaced at short intervals apart, and, although the said adjoining cylinders rotate oppositely, their peripheries move past each other in the same direction, as will be readily understood.

The serrated drawing rolls 23 and 24 are positioned above the cylinders 87, 88 and 89,

and the paper strips descend from the said rolls between the collecting cylinder 87 and the cutting cylinder 88 of the said larger set as shewn in Figure 1.

When the set of smaller cylinders is in operation, the positions of the paper strips on entering the drawing rolls 23 and 24 are reversed, the strip turned aside by the bar 74 is then led directly to the drawing rolls, whereas the strip diverted by the bar 75 is passed around the guide roller 86 on its way to the said drawing rolls.

The following description is equally applicable to either set of cylinders 87, 88 and 89, for, as above mentioned, both sets and the mechanism associated therewith are similar in construction and operate in the same way.

Attention being directed more particularly to Figures 4 and 5, the collecting cylinder 87 is provided with a shaft 92, hereinafter termed the needle shaft, which is journaled in bearings at opposite ends of the said cylinder and is parallel to the supporting shaft 90 thereof, and the shaft 92 rotates with the cylinder and moves in a circular orbit about the shaft 90.

The needle shaft 92 projects from one end of the cylinder 87 and is provided with an arm 93 having rotatively mounted upon a pin 94 at its outer end a runner or roller 95 adapted to contact with a cam 96 carried by controlling mechanism hereinafter described.

Fixed to the needle shaft 92 within the cylinder 87, is a row of aligned arms 97, the ends of which are connected by pins 98 to plungers 99, each of which carries a needle or spike 100, and is slidably fitted in a hole in the wall of the said cylinder.

The needles or spikes 100 are normally extended in a row outwardly from the periphery of the collecting cylinder 87 by a spring 101 carried on a guide rod 102 and bearing upon a shoulder 103 thereon. The guide rod 102 is attached conveniently to an extension 104 of the pin 94 and is slidably fitted in a guide 105 fixed to the end of the said cylinder.

Adjustable check nuts 106 screwed upon the guide rod 102 provide means for adjusting the positions of the arm 93, and cam roller 95 carried thereby, and also permit the extent to which the needles 100 project from the cylinder 87 to be adjusted as required.

The roller 95 contacts with the cam 96 at a certain point in each revolution of the cylinder 87 and the said cam impels the roller 95 and arm 93 towards the axis of the cylinder, and thereby partly rotates the shaft 92 and draws the needles 100 within the periphery of the said cylinder.

In this way the needles 100 may be withdrawn once and maintained beneath the periphery of the cylinder 87, for a portion of each revolution depending upon the peripheral extent of the cam 96. However, for purposes hereinafter described, the cam 96 may be removed from the path of the roller 95, for one or more revolutions of the cylinder 87, so that the needles 100 continue to project from the periphery of the said cylinder, until such time as the cam 96 is restored to its operative position.

The collecting cylinder 87 also carries a rubber pad 107 which projects somewhat from the periphery of the cylinder and extends across the face thereof, and is positioned adjacently to the row of needles 100, but is fixed in advance thereof in the direction of rotation of the said cylinder.

A longitudinal opening or gap 108 is made in the periphery of the collecting cylinder 87 in advance of the rubber pad 107, and in the said opening or gap 108 is positioned a clamping plate 109, which by set screws 110, or the like, firmly secures the rubber pad 107 in position.

The clamping plate 109 is provided with a longitudinal groove 111, and is thereby furnished with a flange or lip 112, the purpose of which will hereinafter appear.

Positioned diametrically opposite to the rubber pad 107 is a fixed tucking blade or plate 113 which extends through another longitudinal opening 114 made in the cylinder 87, and projects from the periphery of the said cylinder at all times.

Rotatively mounted in opposite ends of the cylinder 87 and extending therethrough, is a shaft 115 having a chordal surface, or flat 116 upon which the tucking blade 113 is firmly secured by screws 117 which pass through the same and into tapped holes in the shaft 115.

The tucking blade 113 may be adjusted to project to a greater or less distance from the periphery of the cylinder 87 by rotary adjustment of the shaft 115.

The shaft 115 projects from the end of the cylinder 87 and is provided with a plate 118 having therein an arcuate slot 119 through which extends a bolt or stud 120, fixed in the end of the cylinder. The arcuate slot 119 permits the shaft 115 to be rotated to a limited extent to adjust the tucking blade 113 and the said shaft and blade may be secured in an adjusted position by tightening a nut 121 on the bolt or stud 120.

The cutting cylinder 88 is likewise provided with a tucking blade 113 similar in all respects to that above described and mounted on the collecting cylinder 87.

The cutting cylinder 88 and the delivery cylinder 89 are provided with grippers of similar construction, having a fixed jaw 122 and a movable jaw 123.

The fixed jaw 122 comprises a plate fixed by screws 124 to the side of a longitudinal opening or gap formed in the periphery of each of the cylinders 88 and 89, and the movable jaw 123 likewise consists of a plate fixed

by screws 125 to a flat on a shaft 126 journaled in the ends of the said cylinders.

Rods 127, passing through holes in the plates comprising the said fixed and movable jaws, are screwed into the side of the said opening or gap, and springs 128 carried on the rods 127 are interposed between the movable jaw 123 and nuts 129 on the outer ends of the said rods.

The nuts 129 form abutments for the springs 128, and the latter bear upon the movable jaw or plate 123 and normally hold the same in contact with the fixed jaw 122, thereby maintaining the said jaws in closed position.

The ends of each of the shafts 126 project from the cylinders 88 and 89, and carry arms 130 having at their outer ends rotatable rollers 131, which impinge upon and ride over cams 132 and 132′ respectively, Figures 1 and 7, once during each revolution of the said cylinders. The cam 132′ hereinafter more fully described, is of fixed peripheral length in the case of the cylinder 89, but the cam 132 in the case of the cylinders 88 is capable of peripheral extension.

Impact of the roller 131 upon the cam 132, deflects the arm 130 outwardly, and thereby rotates the shaft 126 to move the jaw 123 away from the jaw 122, and the said jaws are maintained in an open position during the passage of the roller 131 over the cam 132.

The points of impact and departure of the roller or runner 131 with and from the cam 132 and accordingly the time and extent of the opening of the said grippers, may be varied by peripherally adjusting the position on the shaft 126 of the arm 130.

For this purpose, the shaft 126, is provided with a flat or chordal surface 133 at or near the opposite ends of which set screws 134 contact or bear. The set screws 134 are passed through tapped holes in the boss 135 of the arm 130, and by adjusting these set screws the arm 130 may be turned upon the shaft 126 into a required position wherein it will be firmly secured by the said set screws.

In this way the roller 131 may be set more or less closely to the cam 132, so that the arc of movement of the arm 130 on impact with the said cam, may be increased or decreased to vary the extent of movement or opening of the movable jaw 123.

The cylinder 88 is provided with a serrated or saw tooth blade 136, which is positioned diametrically opposite the gripping jaws 122 and 123 and projects at all times a preadjusted distance from the periphery of the said cylinder.

The blade 136 is mounted between abutment blocks or chicken woods 137, and the said blade and abutment blocks are mounted in a holder comprising an angle plate 138 having unequal sides, and a flat plate 139, secured to the angle plate 138 by a row of screws 140.

The holder consisting of the angle plate 138 and flat plate 139, is detachably fitted in a longitudinal recess 141 in the periphery of the cutting cylinder 88, and is secured in place by screws 142 passing through the angle plate 138 into the ends of the said cylinder.

The blade 136 is radially adjustable by means of a series of screws 143, fitted in tapped holes in the angle plate 138, and in order to permit of the radial adjustment of the said blade, the same is provided with slots 144 through which the screws 140 extend.

The abutment blocks or chicken woods 137, are likewise provided with slots 145 through which the screws 140 pass, and the slots 145 permit the abutment blocks to be displaced in an inward radial direction in opposition to a series of springs 146, which normally maintain the said blocks in position wherein they project slightly from the periphery of the cylinder 88.

The operations and interactions of the collecting cylinder 87, cutting cylinder 88, and delivery cylinder 89, in the production from the two contiguous paper strips or ribbons, of book sections having sixteen pages will now be described, reference being had more particularly to Figures 7 to 12 inclusively of the drawings.

In Figures 8 to 13 inclusive the cylinders are shown in widely spaced positions, in order that their actions may be readily observed, whereas in the machine itself the adjoining peripheries are separated from each other by narrow gaps or intervals.

The two contiguous paper strips, indicated by dot and dash lines, enter between the collecting cylinder 87 and the cutting cylinder 88 as shown in Figure 8, and the ends of the said strips become pierced by and caught upon the row of projecting needles 100, and are carried thereby around the periphery of the cylinder 87 for approximately half a revolution to the position indicated in Figure 9.

At or about this time the needles 100 are drawn inwardly below the periphery of the cylinder 87 to release the paper strips, this movement of the needles 100 being effected by contact of the roller 95 with the cam 96, as previously described.

Synchronously with the withdrawal of the needles 100 from the paper strips, the tucking blade 113 on the cylinder 87 enters between the gripping jaws 122 and 123 of the cylinder 88, which at this time are maintained in an open position by the movement of the roller 131 over the cam 132 as above described.

On entering the open gripping jaws 122 and 123, the tucking blade 113 pushes laterally on the paper strips interposed between

the cylinder 87 and 88, and forces them into the said open jaws to make the primary or first fold in the said strips as shewn in Figure 9.

During the formation of this fold the gripping jaw 123 is closing, as at this time the roller 131 is moving down the sloping end of the cam 132, and just as the fold is made the roller 131 moves away from the said cam, and thereby permits the springs 128 to close the jaw 123 and the blade 113, and firmly grip the fold within the said jaws, further movement of the cylinders subsequently withdrawing the tucking blade 113 from the fold.

The closed grippers or jaws 122 and 123, now firmly grasping the fold in the paper strips carry the same around the periphery of the cylinder 88, and at the same time draw the ends of the strips released by the needles 100 backwardly from the cylinder 87.

At the end of another half revolution, the grippers on the cutting cylinder 88 arrive at the position shewn in Figure 10, the folded paper strips now comprising four contiguous sheets, the two inner sheets being still connected with the paper strips entering between the cylinders 87 and 88.

However, at this time the rotation of the cylinders 87 and 88, has brought the saw tooth cutting blade 136 in contiguity with the rubber pad 107, whereupon the two paper strips are gripped between the spring operated abutment blocks or chicken woods 137 and the rubber pad 107, and are cut away from the entering strips of paper by the co-action of the blade 136 and the said pad.

Immediately thereafter the needles 100 again pierce the ends of the entering paper strips.

The folded edges of the now severed sheets, comprising four contiguous strips, are carried around the cylinder 88 for a further quarter of a revolution, at which time the cylinders 87, 88 and 89 occupy the position shewn in Figure 11.

In this position the gripping jaws 122 and 123 of the cylinder 88 have been opened by contact of the roller 131 with the cam 132, thereby releasing the first or primary fold of the book section.

Shortly before the grippers or jaws 122 and 123 on the cylinder 88 release the primary fold, the tucking blade 113 on the said cylinder inserts the sheets laterally into the grippers or jaws 122 and 123 on the delivery cylinder 89 the latter grippers or jaws being held open at this time, as the roller 131 is then positioned on the cam 132 governing the actions thereof. Immediately thereafter, the roller 131 recedes from the cam 132 and thereby permits the grippers on the cylinder 89 to close upon the paper sheets and the tucking blade 113 of the cylinder 88 to make the second fold in the said sheets.

The opening of the grippers on the cylinder 88 synchronizes with the closing of the grippers on the cylinder 89 to make the second fold in the sheets, and at or about the instant the fold is made, the grippers on the cylinder 88 release the primary or previously made fold, and the now doubly folded sheets are carried around the periphery of the cylinder 89.

In Figure 12 the positions of the cylinders 87, 88 and 89 at the termination of another quarter revolution is shewn, wherein the primary fold has been drawn backwardly from the cylinder 88, and the second fold of the back section is firmly held between the jaws 122 and 123 of the grippers on the cylinder 89.

In this position, moreover, the tucking blade 113 of the cylinder 87 is co-acting with the grippers of the cylinder 88 to make the primary fold of the succeeding book section the ends of which have just been released by the retraction of the needles 100.

In each revolution of the cylinders 87 and 88, two sheets approximately equal in length to the periphery of the cylinder 87 are folded and cut away from the paper strips entering between the said cylinders. However, book sections consisting of such pairs of sheets, formed with double folds as above described, are only suitable for the production of books having 16 pages.

In order that books having greater numbers of pages may be produced, it is necessary for the collecting cylinder 87 to take up the required number of sheets before the first fold is made, as above described and as shewn in Figure 9. Accordingly, if the said cylinder takes up four sheets before the first fold is made, books having thirty two pages will be made, and if six sheets are collected prior to the formation of the primary fold, books having 48 pages will be made, sixteen pages being added to the books for each revolution of the cylinder 87.

For the purpose of making books having multiples of sixteen pages, counting and tripping mechanism, is provided, and will now be described in detail.

Mounted in co-axially aligned bearings in the frames 2 is a transverse shaft 147, termed the cam shaft, to which is secured a spur gear 148 similar to those inter-connecting the said three cylinders 87, 88 and 89. The spur gear 148 is conveniently meshed with the spur gear 91 of the collecting cylinder 87, so that the cam shaft 147 rotates at the same speed as the said three cylinders 87, 88 and 89, and revolves oppositely to the collecting cylinder 87.

Pivoted on a pin 149 fixed in one of the frames 2 is a lever 150, hereinafter termed the tripping lever, one end of which has secured to it the cam 96, previously referred to, which operates the roller 95 on the arm 93, to draw

the needles 100 within the periphery of the cylinder 87 as above described.

As previously mentioned the cam 132 operating the gripping jaw 123 of the grippers of the cutting cylinder 88, is peripherally extensible, and for this purpose the said cam is made in two relatively adjustable parts.

One part 151 of the said cam is mounted in fixed position on the shaft 90, whereas the other part 152 is movable or angularly adjustable about the said shaft, and is mounted on a lateral extension or boss 153 of the fixed part 151 of the cam.

The peripheries of the said fixed and movable parts 151 and 152 are of equal radius, and in effect the said parts form a single cam 132, the arc of contact of which with the roller or runner 131 may be increased or diminished by angular adjustment of the movable part 152.

The point of impact of the roller 131 with the two-part cam 132 is invariable, as the said roller approaches and contacts with the fixed part 151 thereof. However, the point of departure of the roller 131 from the said cam can be varied by adjustment of the movable part 152 thereof, and it may be made earlier or later as required.

It will, accordingly, be understood that by means of the two part cam 132 the movable jaw 123 of the grippers of the cylinder 88 is opened in a constant position of the said cylinder, but the closing of the said jaw may be delayed by angular adjustment of the movable part 152 of the said cam.

The movable part 152 is provided with an arm 154, to a pin 155 in the outer end of which is attached a link 156. The opposite end of the link 156 is extended through a swivelling lug 157 mounted at the end of the tripping lever 150, and the link 156 is adjustably secured by nuts 158 to the said lug.

Attached to a pin 159 in a lug 160 on the tripping lever 150 is a rod 161, the opposite end of which passes through a swivelling lug 162 mounted in the frame 2.

On the rod 161 is an adjustable collar 163, and also on the rod 161 and interposed between the collar 163 and the lug 162 is a spring 164.

The lug 162 forms an abutment for the spring 164 and the latter applies pressure to the collar 163 to normally maintain the tripping lever 150 in the position shewn by full lines, in Figure 7. In this normal position, which may be regulated by adjustment of lock nuts 165 threaded upon the rod 161, the cam 96 is maintained in the path of the roller 95 to withdraw the needles 100, and the movable part 152 of the cam 132, is held in its normal position, wherein it permits the jaw 123 to close to make the primary fold, as above described.

Fixed to the cam shaft 147 is a tripping cam or eccentric 166, adapted to contact with a roller or follower 167 mounted on a pin 168 in the tripping lever 150, and displace the same against the resistance of the spring 164 into the position shewn by broken lines in Figure 7.

The tripping lever 150, when thus displaced by the tripping cam 166, is moved into a position wherein it holds the needle actuating cam 96 clear of the roller 95, so that the needles 100 are not withdrawn during the revolution of the cylinder 87. Moreover, in the position of the tripping lever 150, shewn by broken lines, the link 156 has displaced the arm 154, and the movable part 152 of the two part cam 132 has been thereby moved into a retarded position, likewise indicated by broken lines.

In this retarded position of the movable part 152 of the said two part cam the closing of the gripping jaw 123 of the cylinder 88 is delayed and does not occur until the said jaws 122 and 123 have moved away from the tucking blade 113 of the cylinder 87. Accordingly the primary fold of the paper strips would not be made.

Extending through the frame 2 and rotatable therein is a shaft 169, one end of which carries a trigger arm or trigger 170, whereas the opposite end has fixed to it a tripping arm 171. The tripping arm 171 under the action of a spring 172, preferably arranged as a torsion spring upon the said shaft is adapted to become positioned under an abutment block or tripping piece 173 formed on the tripping lever 150 or fixed thereto, when the lever 150 is elevated by contact of the tripping cam 166 with the roller 167.

The tripping arm 171, when its end is positioned under the tripping piece 173 maintains the tripping lever 150, in the idle position shewn by broken lines in Figure 7, wherein as above described, the needle actuating cam 96 occupies an idle position, and the movable part 152 of the said two-part cam is moved into a retarded position wherein it delays the closing of the grippers on the cylinder 88.

This condition will be maintained until such time as the tripping arm 171 is removed from the tripping piece 173 and so long as the tripping lever 150 is held in the idle position, the needles 100 will continue in their operative positions projecting from the cylinder 87, and will pierce and take up pairs of sheets from the paper strips at each revolution, the said sheets becoming collected and piled around the periphery of the collecting cylinder 87, as shewn in Figure 13.

As each pair of sheets is collected on the cylinder 87, they are cut away from the entering paper strips by the coaction of the blade 136 and the rubber pad 107, and the rear or trailing ends of the sheets are impelled into the longitudinal opening 108, wherein they become caught beneath the lip

or flange 112 on the plate 109, as illustrated in Figure 13.

The trailing ends of the sheets collected on the cylinder 87 are thrust below the lip 112 by a tail beater 174 mounted on arms 175 fixed to the cam shaft 147.

The beater 174 is adapted to enter the opening or gap 108, as the former and the latter move past each other during the rotation of the cam shaft 147 and the cylinder 87, and the cut or trailing ends of the collected sheets are in this way forced below the lip 112 into a position, wherein they connot be re-cut or clipped during subsequent revolutions of the cylinders 87 and 88.

When the tripping lever 150 is held in its idle position by engagement of the tripping arm 171 with the tripping piece 173, the grippers of the cylinder 88 do not close as they move past the tucking blade 113 on the cylinder 87, so that no fold is made in the sheets during their collection by the cylinder 87, the said sheets being merely pushed into the open jaws 122 and 123 by the tucking blade 113, as the said jaws and blade approach each other, and being withdrawn from the jaws as the same and the tucking blade 113 recede from each other.

When a required number of sheets have been piled upon the cylinder 87, the trigger 170 is actuated as later described, to rotate the shaft 169 and thereby release the tripping arm 171 from the tripping piece 173, whereupon the spring 164 at once returns the tripping lever 150 to its normal position. The cam 96 thereupon withdraws the needles 100 from the collected sheets, and the movable part 152 of the two part cam is returned to its normal position, wherein it permits the grippers of the cylinder 88 to close upon the paper sheets and the tucking blade 113 of the cylinder 87 to make the primary fold in the said collected sheets, as previously described.

The said sheets are then carried away by the closed gripping jaws 122 and 123 and are thereafter transferred to the delivery cylinder 89, and refolded precisely in the manner above described.

In order that the collecting cylinder 87 may make a sufficient number of revolutions to collect a required quantity of pairs of sheets before the trigger 170 is actuated to release the tripping arm 171 from the tripping piece 173, a counting ratchet 176, and operating pawl 177 are provided.

The ratchet 176 comprises a disc 178, rotatively mounted on a stub shaft 179 fixed in the frame 2, and the pawl 177 is carried on a swinging arm 180 pivotally supported on the stub shaft 179 and is adapted to engage in notches 181 in the periphery of the ratchet disc 178.

The swinging arm 180 is connected by a link or pitman 182 to a crank pin 183 mounted in a disc 184 fixed to the end of the cam shaft 147, and during each revolution of the said shaft the swinging arm 180 will be oscillated to and fro, and the pawl 177 thereon will engage the notches 181 in succession and intermittently rotate the ratchet disc 180 more or less.

To ensure that the momentum of the ratchet disc 178, when rotated by the pawl 177, will not move the former to a distance in excess of the movement of the latter, the said disc is mounted between washers 185 of fibre or like material, and a spring 186 on the shaft 179 is interposed between adjustable lock nuts 187 and the outer washer 185. The spring 186 applies resilient pressure to the outer washer 185 and thereby presses the ratchet disc 178 against the inner washer 185. Accordingly, the spring 186 sets up frictional resistance or braking action opposing the movement of ratchet disc 178, so that the same will cease to move immediately the pawl 177 starts upon its idle stroke, and said disc will remain stationary until the said pawl engages the succeeding notch.

In order that the extent of the oscillation or angular movement of the arm 180 may be varied, holes 188 are made therein at different radial distances from the pivotal axis thereof, and the link or pitman 182 may be connected to one or other of the holes 188 by a pin 189. In this way the throw of the swinging arm 180 may be increased or diminished and the stroke of the pawl 177 correspondingly varied to rotate the ratchet disc 178 through a greater or less distance.

To release the trigger 170 and accordingly the tripping arm 171 from the tripping lever 150, when the cylinder 87 has taken up a required number of sheets, four holes 190 are made in the ratchet disc 178 at ninety degree intervals, in which tripping pins 191 may be secured.

The trigger 170 is mounted adjacently to the ratchet disc 178, and when the tripping arm 171 is engaged with the tripping piece 173, the trigger 170 is positioned in the path of the tripping pins 191, and when struck by one or other of the same is moved to release the tripping arm 171 from the said tripping piece.

Tripping pins 191 may be inserted into two diametrically opposed holes 190, or into all four of the same, and in the latter case for a given stroke of the swinging arm 180, the trigger 170 will be operated twice as many times in each revolution of the ratchet disc 178 as in the former case.

Assuming two oppositely disposed pins 191 to have been fixed in the ratchet disc 178, the pin 189 connecting the pitman 182 to the swinging arm 180 may be inserted into one or other of the holes 188, so that the arc of movement of the swinging arm 180 may be adjusted to rotate the ratchet disc 178 through half a revolution in four, five or six

turns of the cam shaft 147, and accordingly in a corresponding number of revolutions of the cylinder 87 geared therewith, since as previously stated the cam shaft 147 and cylinders 87, 88 and 89 rotate at the same speed.

By making the holes 190 in the ratchet disc 178 in required positions with respect to the notches 181 in the periphery thereof, the impact of the pins 191 on the trigger 170 may be synchronized with the release of the needles 100 from the paper strips, and the closing on the same of the grippers on the cylinder 88.

Accordingly, after the cylinder 87 has rotated through a sufficient number of revolutions to take up a required number of paper sheets, one of the pins 191 strikes upon the trigger 170, and thereby releases the tripping arm 171, in this way permitting the tripping lever 150 to place the cam 96 in its operative position to withdraw the needles 100, and the movable part 152 of the cam 132 in its normal position, wherein it allows the grippers of the cylinder 88 to close upon the tucking blade 113 of the cylinder 87 to fold the collected sheets and carry them around the cylinder 88, as previously described.

Immediately after the tripping lever 150 has, in this way, caused the release and folding of the collected paper sheets, it is returned by the tripping cam 166 to its former inoperative position wherein it is locked by the re-engagement of the tripping arm 171 with the tripping piece 173 until the following pin 191 strikes upon the trigger 170 and releases the tripping arm 171.

If all four pins 191 are used in the ratchet disc 178, the trigger 170 will be operated at regular intervals more frequently, and by appropriate connection of the pitman 182 to one of the holes 188 of the swinging arm 180, the trigger 170 may be actuated to release the tripping lever 150 after two, three, or four revolutions of the cam shaft 147 and collecting cylinder 87, and accordingly after four, six or eight sheets have been accumulated on the said cylinder.

The ratchet disc 178 may, for example, have sixty equally spaced notches 181 formed in its periphery and adapted for engagement with the pawl 177 and if the pawl 177 is adapted by suitable connection of the pitman 182 to the swinging arm 180, to move freely over ten notches 181 it will at the commencement of its return movement engage the tenth notch 181 to rotate the said disc. When so adjusted, the pawl 177 will completely rotate the ratchet disc once in every six revolutions of the cam shaft 147 and cylinder 87 geared therewith.

Similarly, by adjusting the throw of the pawl 177 to engage every twelfth notch 181, the ratchet disc 178 will be rotated once in every five revolutions of the cam shaft 147 and collecting cylinder 87. Again, if the pawl 177 is arranged to engage every fifteenth notch 181, the ratchet disc 178 will be rotated once in every four revolutions of the said cam and cylinder.

Accordingly, it will be understood, that by using the appropriate number of pins 191 in the ratchet disc 178 to release the trigger 170, and suitably adjusting the connection of the pitman 182 to the holes 188 of the swinging arm 180, four, six, eight or more sheets may be collected by the cylinder 87 before the trigger 170 is operated by one or other of the pins 191 to release the tripping arm 171, and thereby permit the collected sheets to be folded by the co-action of the tucking blade 113 on the cylinder 87 and the grippers on the cylinder 88, and to be taken by the said grippers away from the former cylinder.

In order to prevent any possibility of creeping of the ratchet disc 178, and consequent derangement of the timing or synchronization of the actions of the tripping mechanism and the said needles 100 and grippers, only such notches 181, as are required for engagement by the pawl 177, are cut in the periphery of the ratchet disc 178, thus in the example above given, only every tenth, twelfth and fifteenth notch 181 is cut, the intervening portion of the periphery of the ratchet disc 178 being blank and providing sufficient space for the pawl 177 to overrun any notch 181 with which it is to engage on its return movement. The pawl 177 is accordingly bound to engage only the correct notches 181, and the said pawl will engage with certainty the index notch once in each revolution, thereby rendering the timing automatic.

The doubly folded book sections are carried by the closed gripping jaws 122 and 123 of the delivery cylinder 89 beneath a row of guides 192 concentrically disposed about the said cylinder and mounted on a transverse bar 193 extending between and fixed in the frames 2. The guides 192 prevent spreading of the folded book sections while the same are being carried around the cylinder 89 by the grippers thereon. For the same purpose an adjustable brush may be located concentrically with respect to the cylinder 88.

The periphery of the delivery cylinder 89 is provided with a series of grooves 195 into each of which extends a stripper blade 196 as shewn in Figure 3. The ends of the stripper blades 196 are located within the periphery of the delivery cylinder 89.

The stripper blades 196 remove each folded book section from the delivery cylinder 89, the second fold of the said section at or about the same time being released by the opening of the gripping jaw 123 by impact of the roller 131 on the cam 132.

The stripper blades 196 co-operate with guide strips 197 to form a tapered conduit to receive the book sections from the cylinder

89 and the said sections are directed into the conduit so formed, by propelling rollers which are pressed by springs upon the periphery of the cylinder 89.

Mounted on a stub shaft 200 fixed in the frame 2 adjacently to the gear 91 of the delivery cylinder 89 is an idler gear 201 which meshes with the said gear 91.

The idler gear 201 engages and drives a gear 202 fixed to a shaft 203 extending between and rotatable in the frames 2, and on the said shaft is mounted a serrated nipping or squeezing roller 204.

The gear 202 engages and operates a gear 205 on a shaft 206 having thereon and securely fixed thereto a serrated nipping or squeezing roller 207 adapted to co-act with the roller 204.

The shaft 206 is mounted in slidable bearings 208 carried on slides or plungers 209, and springs 210 bearing on the slides or plungers 209 urge the shaft 206 towards the shaft 203, and accordingly cause the nipping roller 207 to resiliently bear upon the periphery of the nipping roller 204.

The folded book sections are directed by the conduit, comprising the stripper blades 196 and guide strips 197, to the co-acting nipping rollers 204 and 207, and becoming gripped thereby the said sections are carried therebetween and compressed and folded more closely, and are then deposited on delivery belts 211.

Peripheral grooves 212 are formed in the nipping rollers 204 and 207, and the stripper blades 196 and the guide strips 197 extend through the grooves 112 as shewn in Figure 1.

The stripper blades 196 are extended backwardly from the nipping roller 204 and said blades are secured to cross bars or stays 213 extending between the frames 2. The guide strips 197 are likewise secured to a cross stay 213 and to a cross bar 214, as shown in Figure 1.

The delivery belts 211 are supported on rollers 215, 216 and 217, the roller 215 being supported on bars 218 fixed to and projecting from the frames 2, and the rollers 216 and 217 being mounted on shafts 219 and 220, supported by the said frames.

The delivery belts 211 move over the upper surface of a platform or table 221, supported by the projecting bars 218.

The shaft 220 is journaled in the frames 2, and one end thereof extends through one of the frames 2 and has fixed to it a ratchet disc 222, shewn clearly in Figure 3.

Rotatively mounted in and transversely to the frames 2 and having one end extended in proximity to the ratchet disc 222 is a shaft 223, having fixed to its projecting end an arm 224 which is connected by a pitman 225 to a crank pin 226 fixed in a disc 227 securely mounted on the outwardly extended end of the cam shaft 147.

Mounted on a pin 228 fixed in an opposite extension 229 of the arm 224 is a pawl 230 adapted to engage the teeth of the ratchet disc 222 to rotate the same.

As the cam shaft 147 rotates, the crank pin 226 and pitman 225 oscillate the arm 224 and the shaft 223, to and fro, and the pawl 230 accordingly engages successively the teeth of the ratchet disc 222 and intermittently rotates the same and the shaft 220.

In this way the delivery belts 211 are caused to travel intermittently and carry the finished book sections along the table or platform 221 and outwardly from the machine.

As each book section is deposited upon the delivery belts 211, it is thrown downwardly upon the sections previously placed thereon by oscillating beaters 231, secured to the shaft 223, and in order to prevent the book sections moving backwardly into the machine a series of upright stop bars 232 are provided.

I claim:

1. In machines for the manufacture of folded book sections having interacting collecting, cutting and folding cylinders provided with paper piercing, tucking and gripping and cutting mechanism, means for determining the number of sheets of paper collected to form a book section at each operation comprising a rotatively mounted member, means associated with the cylinders for angularly displacing the rotatively mounted member a predetermined distance upon each rotation of the said cylinders, and means associated with the cylinders and with the rotatively mounted member for actuating the piercing mechanism and the gripping mechanism whereby a predetermined number of sheets will be collected and folded upon a predetermined angular displacement of the said rotary member.

2. In machines for manufacturing folded book sections according to claim 1, ratchet teeth associated with the rotary member, an oscillatable member having a pawl engaging the ratchet teeth, means for imparting movement to the oscillatable member upon each rotation of the cylinders, retractable needles disposed longitudinally of the collecting cylinder, mechanism for imparting a retractive movement to the said needles, means for retaining the needle retractive mechanism in an operative position, grippers disposed longitudinally of the folding cylinder, mechanism for periodically actuating the grippers, means for retaining the mechanism controlling the needles and grippers in inoperative positions during a predetermined number of revolutions of the cylinders and tripping mechanism associated with the rotary member for permitting the withdrawal of the

needles into their inoperative positions and for closing the grippers.

3. An improved machine for the manufacture of folded book sections having slitting members to cut a moving web of paper into two strips of equal width, guiding means to direct the paper strips to become aligned and contiguous one against the other, traction means to draw the paper web from a reel or roll past the slitting members and to draw the equal strips to and around the said guiding means, collecting, cutting and folding mechanism to receive the paper strips from the traction means and to cut from the said strips a pair or a plurality of pairs of paper sheets and to doubly fold the same to form book sections, counting mechanism to govern the number of pairs of sheets comprising the book sections, and means for delivering the same.

4. An improved machine for the manufacture of folded book sections as claimed in claim 3 having two independent sets of the said collecting, cutting and folding mechanism to cut from the said contiguous paper strips sheets differing in length and to fold the same to form dissimilar book sections, two groups of traction means, counting mechanism and means for delivering the same, one of the said groups being operatively connected and co-acting with one set of the said collecting cutting and folding mechanism and the second group being similarly associated with the other set of the said mechanism, and driving means adjustably engageable with either of the said sets to actuate the same and the corresponding group connected therewith.

5. A machine for the manufacture of folded book sections as claimed in claim 3, having two independent sets of collecting, cutting, folding and counting mechanisms, a gear train to operate the said sets of cutting and folding mechanism and associated groups of counting mechanism, a swinging arm in the gear train, a gear on the swinging arm engageable by adjustment of the said arm with either a gear operating one of the said sets and groups or an idler actuating the other set and group, and means for fixing the said arm in adjusted positions.

6. A machine for the manufacture of book sections, having means for cutting a pair of sheets from the contiguous paper strips and for doubly folding the same, comprising a row of interacting slidable needles on the first cylinder of a series of three intergeared and interacting cylinders, equal intermeshing gears on the three cylinders operatively connecting the same, a spring extending the needles from the periphery of the said cylinder to pierce the ends of the paper strips, a shaft mounted in the said cylinder and operatively connected with the needles, an arm fixed to the shaft, a roller on the shaft, a cam positioned in the path of the said roller to deflect the same and the said arm to withdraw the needles within the periphery of the cylinder to release the ends of the paper strips, a tucking blade on the first cylinder, grippers on the second cylinder of the said series coacting with the tucking blade on the first cylinder to form the first fold in the paper sheets, a peripherally extensible or expansible cam controlling the opening and closing of the said grippers, a rubber pad on the first cylinder, a cutting blade on the second cylinder co-acting with the rubber pad to sever the pair of sheets from the said contiguous strips, a tucking blade on the second cylinder, grippers on the third cylinder co-operating with the tucking blade on the second cylinder to make the second fold in the pair of sheets, and a cam controlling the opening and closing of the grippers on the said third cylinder.

7. In a machine for the manufacture of ruled book sections, according to claim 6, means for displacing the needle withdrawing cam from the path of the said roller, whereby the needles remain in extended position for one or more revolutions of the said first cylinder and become collected upon the same, a peripherally extensible or expansible cam having a fixed portion and an adjustable portion capable of angular movement to increase the circumferential length of the said cam to delay the closing of the grippers on the second cylinder to prevent the making of the first fold in the pairs of sheets until a predetermined number of the same have been collected by the first cylinder, an arm fixed to the said adjustable portion, and counting means to control the return of the needle withdrawing cam to its operative position and the adjustable portion of the expansible cam to its normal position when the predetermined number of pairs of sheets have been collected by the said first cylinder.

8. In a machine for the manufacture of ruled book sections, as claimed in claim 6, a pivoted tripping lever having the needle withdrawing cam on one end, a link connecting the opposite end of the said lever to the arm on the adjustable portion of the expansible cam, a spring maintaining the tripping lever in its active position wherein the needle withdrawing cam is located in the path of the said roller and the adjustable portion of the said expansible cam is held in its normal position, a cam shaft in parallel alignment with the said cylinders, a gear mounted on the cam shaft and equal to and engaging one of the intermeshing gears on the said cylinders, a cam on the cam shaft, a roller on the tripping lever engageable by the cam on the cam shaft to displace the said lever and remove the needle withdrawing cam from its operative position and angularly move the adjustable portion of the said expansible cam,

a tripping piece on the tripping lever, a spring actuated tripping arm to engage the tripping piece to maintain the tripping lever in its idle position, and counting means to release the tripping arm from the tripping piece when the cam shaft and cylinders have made a predetermined number of revolutions.

9. In a machine for the manufacture of folded book sections, as claimed in claim 1, counting means comprising a tripping lever associated with the collecting mechanism, a tripping piece on the tripping lever, a tripping arm to engage the tripping piece, a shaft adjacent to the tripping lever, a ratchet disc on the shaft, notches in the periphery of the ratchet disc, an oscillatable arm pivotally supported on the shaft, a crank disc on a cam shaft, a crank pin in the crank disc, a pitman connecting the oscillatable arm to the crank pin, a pawl on the oscillatable arm engageable with the notches in the ratchet disc to intermittently rotate the same, braking means opposing the movement of the ratchet disc, a shaft supporting the said tripping arm, a trigger on the said shaft, holes in the ratchet disc, and detachable tripping pins in the said holes to engage the trigger to release the tripping arm from the said tripping piece.

10. In a machine for the manufacture of folded book sections as claimed in claim 1, counting means comprising a tripping lever, associated with the collecting mechanism, a tripping piece on the tripping lever, a tripping arm to engage the tripping piece, a shaft adjacent to the tripping lever, a ratchet disc on the shaft, notches in the periphery of the ratchet disc, an oscillatable arm pivotally supported on the shaft, a crank disc on a cam shaft, a crank pin in the crank disc, a pitman connecting the oscillatable arm to the crank pin, a pawl on the oscillatable arm engageable with the notches in the ratchet disc to intermittently rotate the same, braking means opposing the movement of the ratchet disc, a shaft supporting the said tripping arm, a trigger on the said shaft, holes in the ratchet disc, detachable tripping pins in the said holes to engage the trigger to release the tripping arm from the said tripping piece, four holes disposed at intervals of ninety degrees apart and at equal radial distances from the axis of the said ratchet disc to accommodate the said detachable tripping pins.

11. In a machine for the manufacture of folded book sections, as claimed in claim 1, counting means comprising a tripping lever associated with the collecting mechanism, a tripping piece on the tripping lever, a tripping arm to engage the tripping piece, a shaft adjacent to the tripping lever, a ratchet disc on the shaft, notches in the periphery of the ratchet disc, an oscillatable arm pivotally supported on the shaft, a crank disc on a cam shaft, a crank pin in the crank disc, a pitman connecting the oscillatable arm to the crank pin, a pawl on the oscillatable arm engageable with the notches in the ratchet disc to intermittently rotate the same, braking means opposing the movement of the ratchet disc a shaft supporting the said tripping arm, a trigger on the said shaft, holes in the ratchet disc, detachable tripping pins in the said holes to engage the trigger to release the tripping arm from the said tripping piece, holes in the said oscillatable arm at different radial distances from the pivotal axis thereof, a pin to connect the said pitman to one or other of the said holes to vary the extent of the arc of oscillation of the said arm and the travel of the pawl, notches in the periphery of the said disc engageable with the pawl and corresponding to the different arcs of movement of the said pawl, and blank spaces in the periphery of the disc between the adjoining notches.

12. In a machine for the manufacture of book sections according to claim 1, means for preventing re-cutting or clipping of the severed sheets carried by a cylinder embodied in the collecting mechanism, comprising a longitudinal opening in the collecting cylinder, a lip extending along the said opening, and a tail beater to force the cut ends of the sheets into the opening and behind the said lip.

In witness whereof I hereunto affix my signature.

WILLIAM RUSSELL BELL.