Nov. 22, 1938. T. J. MILLS ET AL 2,137,978

CUTTING, FOLDING, AND STAPLING MECHANISM FOR USE WITH PRINTING MACHINES

Filed March 26, 1936 2 Sheets-Sheet 1

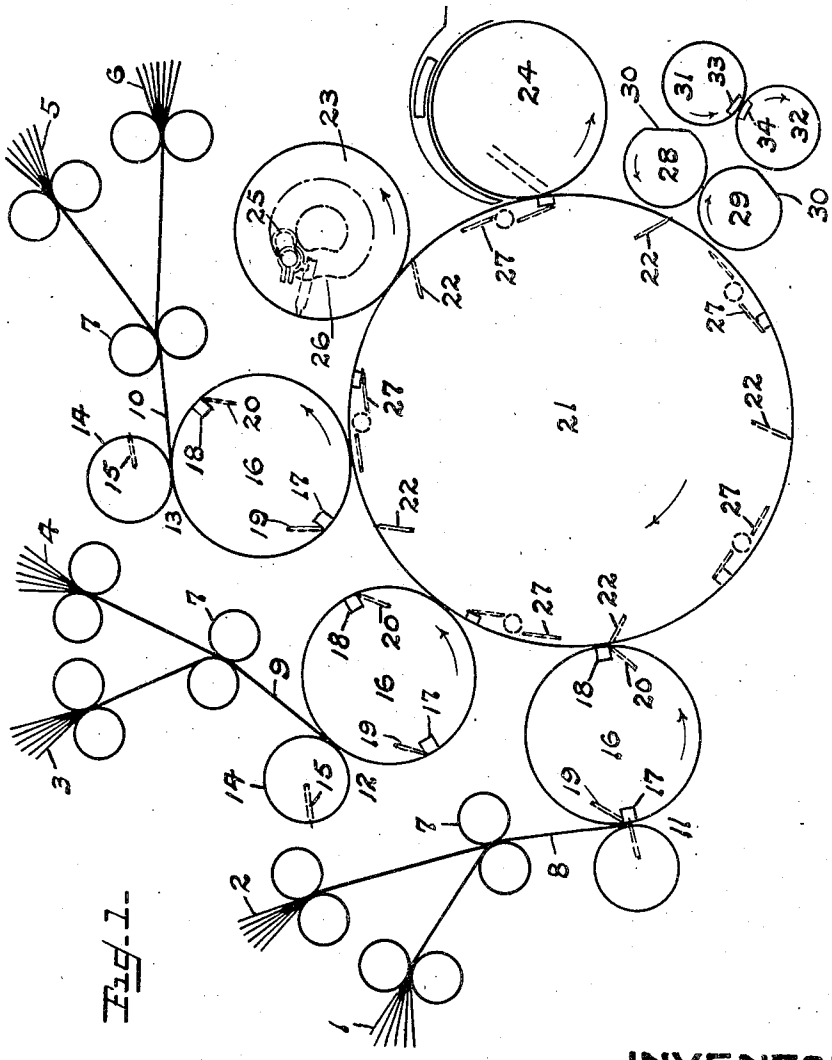


Fig. 1.

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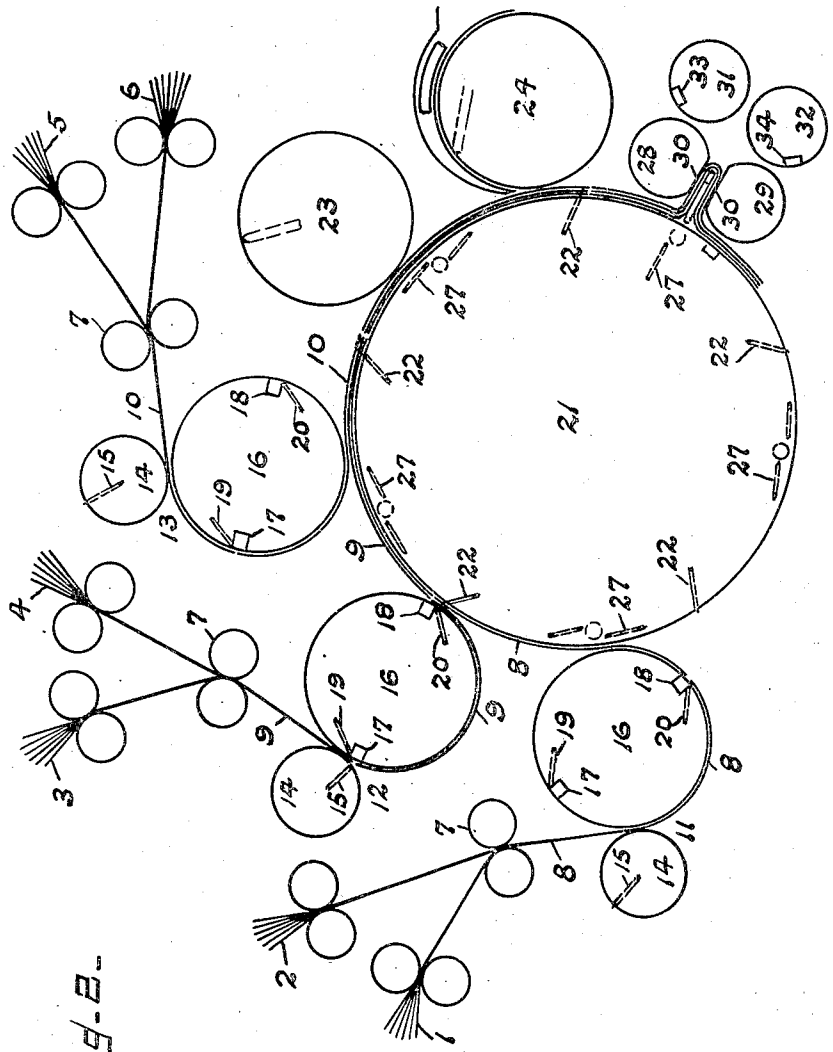


Fig. 2.

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UNITED STATES PATENT OFFICE

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CUTTING, FOLDING, AND STAPLING MECHANISM FOR USE WITH PRINTING MACHINES

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17 Claims. (Cl. 270—37)

This invention relates to cutting, folding and stapling mechanism for use with printing machines, and is concerned with mechanism for use ing producing products having a large number of pages.

According to one feature of the present invention, which has for its main object to avoid subjecting the cutting mechanism to undue load consequent upon the large number of sheets, the webs required to produce the product are led in groups each of which passes to a rotary cutting mechanism comprising a cutting cylinder and a co-operating gutter cylinder and these mechanisms are spaced around the periphery of a main or collating cylinder having sheet taking devices which operate as the collating cylinder rotates to collect a series of sheets from each cutting mechanism in turn so as finally to collect the total number required to produce the product.

The invention is also concerned, in accordance with a further feature, with stapling a product consisting of a large number of sheets by means of mechanism operating to insert a wire staple through the products, the legs of the staple penetrating the sheets being turned over by a die.

According to this feature, which has for its object to avoid difficulties consequent upon causing the legs to penetrate a large number of sheets, mechanism is provided for pre-perforating completely or partially through the sheets and before the sheets are presented to the stapling mechanism, the perforations being effected at points to which the legs of the staples will be presented. By reason of the pre-perforation the staple is not called upon to penetrate the entire thickness of the collected sheets and its passage through the combined thickness of the sheets is thus facilitated.

When this further feature is applied to mechanism in accordance with the first feature, there is provided peripherally of the collating cylinder a rotary pre-perforating member which operates to form apertures in the sheets while they are on the collating cylinder and there is also arranged at the periphery of the collating cylinder a rotary stapling mechanism up to which the pre-perforated sheets are carried by the collating cylinder and which operates to insert staples into the perforations formed wholly or partially through the collected sheets.

The invention, according to yet a further feature thereof, is concerned with folding mechanism of the kind comprising a rotary member which carries the sheets to be folded and a member which operates on the sheets at the fold line to project the sheets between the nip of folding rollers. In this type of mechanism the folded over edge, i. e. that edge which is presented to the folding-off rolls is not square but is rounded and bulges out of the planes representing the thickness of the folded product, the bulge being the greater, the larger the number of sheets. When a large number of sheets is required to form the product there would be a liability for the folding-off rollers of normal cylindrical form to drag the outermost sheet or sheets from the remaining sheets and thus produce an incorrect fold. To avoid or minimize this defect the folded edges of the products to be folded are, in accordance with this further feature of the invention, presented first to rollers formed with flat surfaces which register with one another at the time that the products are projected by the folding-off member and so provide a passage into and through which the rounded folded end of the product can pass and the normal or unflattened surface of the rollers operates to grip the product at the trailing side of the folded edge and also to feed the product forward to a second pair of rotary folding rollers which may be provided with local crushing members which are timed to operate to apply an impact to the folded over edge of the product and hence flatten out the said folded edge. As the first pair of rollers grips the product at the rear or on the trailing side of the folded edge, the outermost sheet or sheets is or are prevented from being dragged over the other sheets when the folded edge is presented to the crushing members.

This feature of the invention may also be incorporated in a mechanism having the first and second feature, and to effect this the collating cylinder would be provided with folding-off members.

The invention is illustrated in the accompanying drawings in which Figure 1 is a diagrammatic view and Figure 2 a view similar to Figure 1 showing a product in the various stages of its production.

In the drawings there is illustrated a machine for producing a product consisting of one hundred and forty-four pages and a cover. The product is formed from webs which are associated, as indicated at 1–6 into six sets five of which consist of six webs and the set 6 of seven webs. These six sets are at associating rollers 7, associated into three groups of two sets of webs each, 8, 9 of which includes twelve

webs and the third 10 includes thirteen webs, the groups of webs 8, 9 and 10 being denoted in their passage through the machine by single lines.

For each group of webs 8, 9 and 10 there is provided a rotary cutting mechanism denoted generally by the references 11, 12, 13 and each consisting of a cutting cylinder 14 carrying a single cutting knife 15 and a gutter cylinder 16 each carrying two gutters 17, 18 which alternately co-operate with the knife 15 to sever the respective groups of webs into product lengths, it being understood that the circumferential length of the cutting cylinders 14 is equal to one product length and the circumferential length of the gutter cylinders 16 is equal to twice the length of a product. It will be understood that by the term "length of product" is meant the distance from one edge to the other when the product is straightened out or in other words twice the width of a page of the product.

Each gutter cylinder also carries two sets of sheet taking pins 19, 20 arranged on the trailing side of the gutters 17, 18, so as to penetrate the webs at points which become (when the webs are severed into product lengths) the leading ends of the severed web lengths.

The cutting mechanisms 11, 12 and 13 are spaced apart around a portion of the periphery of a main or collating cylinder 21. The circumferential length of the collating cylinder is equal to five times the length of the product to be produced and this cylinder is provided with five sets of sheet taking pins, indicated at 22 and spaced apart through a distance equal to one product length.

With the mechanism so far described the various groups 8, 9 and 10 of webs are taken at their leading ends by one or other set of pins 19 or 20 on the various gutter cylinders 16, are carried by the pins around with the cylinders, and are then transferred to the pins 22 on the collating cylinder 21. At the moment of transfer the cutting knives 15 on the cutting cylinders operate to sever the webs and the fresh leading ends of which are taken by the second set of pins 19 or 20 on the gutter cylinders 16.

Thus, considering the operation of any one set of pins 22 of the collating cylinder 21 it will be seen that they will operate to take a number of sheets from the gutter cylinder 16 of the cutting mechanism 11 at the moment that these sheets are severed from one group 8 of webs. These pins 22 will then pass around and take a second set of sheets from the gutter cylinder 16 of the second mechanism 12 at the moment that this second set of sheets is severed from the next group 9 of webs, whereafter this set of pins 22 will pass to the next gutter cylinder and will similarly operate to take a further set of sheets severed from the group 10 of webs. Thus each set of pins 22 finally collects a number of sheets equal to the total number of webs delivered to the various cutting mechanisms.

It will be seen that each cutting mechanism is required to cut only a part of the total number of webs required to form the product. In the particular case described two of the mechanisms cut only twelve webs and one only thirteen webs and such a number of webs is readily accommodated by the cutting knives of rotary cutting mechanism.

It will also be seen that as the cutting cylinders 14 operate to sever sheet lengths from the webs at the same time the sheets are transferred to the pins on the collating cylinder 21 there is little or no drag imposed on the sheets and hence there is little liability to cause the pins on the collating cylinder to tear the sheets and produce a large aperture. Furthermore, the arrangement avoids the difficulties which are normally experienced in simultaneously taking, by a cylinder, a large number of sheets which are of course fed at the same linear speed but the outermost ones of which have to travel at a greater speed than the inner ones by reason of their greater distance from the centre of the cylinder. This condition normally results in the sheet taking pins, which are of course rotated with the cylinder, making an enlarged aperture or tear in the outermost webs whereas the arrangement according to this invention avoids this defect. Moreover, by reason of the employment of a main cylinder of large dimensions the degree of curvature to which the products are subjected in passing around with the cylinder is reduced and considerably flatter.

The sheets taken and collected by the pins 22 of the collating cylinder 21 are carried around to a further cylinder 23 which is provided with a series of punches which are operated to penetrate all, or a portion of the collected sheets at points corresponding to points at which the legs of staples formed by a rotary stapling cylinder 24 will be presented to the sheets, the punches being operated through a roller 25 actuated by a cam 26. The perforated and unperforated sheets are carried by the collating cylinder 21 to the stapling cylinder 24 which feeds the legs of staples into the perforations formed by the punches and then forces them through the unperforated sheets, the collating cylinder having die members which turn over the legs of the staples. The number of sheets which are left unperforated can be a small portion of the total number of collected sheets and hence the staple is subjected to little bending strain, despite the comparatively large number of collected sheets to be stapled. If desired the punches may be arranged to completely penetrate all of the collected sheets although it is preferred that only a portion of the sheets be perforated.

The collected sheets having now been stapled, are subjected to a folding operation which is effected by folding-off members 27 carried by the collating cylinder 21 and equal in number to the number of sets of sheet taking pins 22 on this cylinder. These folding-off members are arranged to be projected beyond the periphery of of the collating cylinder and to engage the collected sheets in the region of the intended fold line and to project the sheets along the fold line towards and finally between two rollers 28, 29, the sheet taking pins on the collating cylinder being operated to release the sheets thus projected. Each roller is formed on its periphery with a flat surface 30 and these two surfaces are arranged to come into parallel adjacent relation at the time that the folded edge of the sheets is projected by the folding-off members 27. These flats provide (as is shown in Figure 2) conjointly a passage for the reception of the curved folded edge of the sheets and permit this edge readily to pass between the rollers whereafter the unflattened portion of the rollers moves into engagement with the folded over product, just behind (i. e. on the trailing side of) the folded edge and propel the product towards a second pair of rollers 31, 32 in close proximity to the first rollers 28, 29. Each of the rollers 31, 32 is provided

with an inset crushing member 33, 34 respecticely, the two crushing members 33, 34 being disposed to register with one another at a time when the folded edge of the product is presented between them by the propulsion of the first rollers. The crushing insets 33, 34 thus operate to impose a crushing pressure upon the folded over edge of the products and hence this edge is considerably flattened, the product finally passing to any convenient delivery mechanism. It will be apparent that as the folded sheets are gripped behind their folded edge by the first rollers 28, 29, the tendency for the outermost sheets to be dragged over the remainder by presenting the curved folded edge to the nip between two rotating surfaces is avoided or at least minimized, and thus a difficulty experienced when folding products consisting of a large number of sheets is avoided.

It will be understood that the particular number of cutting mechanisms employed will depend upon the maximum size of product for which the machine is designed.

It may here be observed that the cutting mechanisms 11, 12 and 13, the stapling mechanism 24, the sheet taking pins 19, 20 and 22 and their means of operation, and the folding-off blades 27 and their means of operation, may be of any of the forms already well known in the art and it is therefore believed to be unnecessary for an understanding of the present invention for details of these well known mechanisms to be shown and described. Thus it will be understood that the cylinders 14, 16 and 21 will be rotated at the speed with which the webs are fed to the cutting mechanisms and that the rollers 28, 29 and 31, 32 will be rotated to draw the products forward and to feed them to any usual delivery mechanism.

It will be understood that the term "cylinder" is employed in the sense in which the term is understood in the printing machine art as meaning a rotary member.

It will be understood that the invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof, and it is therefore desired that the present embodiment be considered in all respects as illustrative and not restrictive, and it will be further understood that each and every novel feature and combination present in or possessed by the mechanism herein disclosed forms a part of the invention included in this application.

What we claim is:—

1. In a mechanism to cut a plurality of sheets from a plurality of webs and staple them together, cutting cylinders each arranged to cut a determined number of webs into sheets, means to collect all of the sheets cut by said cutting cylinders, a stapling mechanism for stapling together the plurality of sheets collected, and a device operating to perforate at least some of the sheets in the stapling zone before the sheets are operated on by the stapling mechanism, and means to fold the sheets after they are stapled.

2. In a mechanism to cut a plurality of sheets from a plurality of webs and staple them together, cutting cylinders each arranged to cut a determined number of webs into sheets, means to collect all of the sheets cut by said cutting cylinders, a stapling mechanism, including a perforating device, and means conveying a plurality of sheets to be stapled first past the perforating device which operates to perforate at least some of the sheets in the intended stapling zone and then past the stapling device which operates to insert staples through the pre-perforations in the sheets, and means to fold the sheets after they are stapled.

3. In a mechanism to cut a plurality of sheets from a plurality of webs and staple them together, cutting cylinders each arranged to cut a determined number of webs into sheets, means to collect all of the sheets cut by said cutting cylinders, a rotary stapling mechanism, including a first cylinder, a punch member carried by the cylinder, a second rotatable cylinder, means on the second cylinder to take a plurality of sheets, the said second cylinder being rotated to present the sheets first to the first cylinder and then to the stapling mechanism, and means operating the punch member to perforate at least some of the sheets in the zone in which the stapling mechanism is intended to insert a staple.

4. In a mechanism to cut a plurality of sheets from a plurality of webs and staple them together, a plurality of rotary cutting mechanisms, means feeding a plurality of webs to each cutting mechanism, a rotary collating cylinder, sheet taking devices carried by the cylinder, a second rotatable cylinder, a punch member carried by the second cylinder, a rotary stapling mechanism, the sheet taking devices on the collating cylinder operating to take in succession product lengths from each of the cutting mechanisms, and then to present the product length to the second cylinder and then to the rotary stapling mechanism, and means operating the punch member to perforate at least some of the product lengths in the zone in which the stapling mechanism is to insert a staple.

5. In a mechanism to cut a plurality of sheets from a plurality of webs and staple them together, a rotary collating cylinder, a plurality of cutting mechanisms each comprising a cutting cylinder and a gutter cylinder, sheet taking devices carried by one of these two cylinders, means supporting the cylinder carrying the devices adjacent and in spaced relationship with respect to the periphery of the collating cylinder, means feeding a plurality of webs to the sheet taking devices of each cutting mechanism, a further rotatable cylinder, a punch member carried by the further cylinder, a rotary stapling mechanism, the said further cylinder and the stapling mechanism being disposed adjacent the periphery of the collating cylinder, sheet taking devices carried by the collating cylinder and operating to take a plurality of product lengths from the cutting mechanisms in succession and then to carry the product lengths first to the further cylinder and then to the stapling mechanism and means operating the punch member to perforate at least some of the product lengths in the zone in which the stapling mechanism is to insert a staple.

6. In rotary sheet folding mechanism, the combination of a rotatable cylinder, sheet taking devices carried by the cylinder and operating to take a plurality of sheets to be folded, a first pair of rollers, a folding off member carried by the cylinder and operating to project the sheets between the two rollers, the periphery of the rollers being shaped to provide conjointly a passage for the reception of the folded over edge of the sheets, and a second pair of rollers to which the sheets are propelled by the cylindrical parts of the first rollers.

7. In rotary sheet folding mechanism, the combination of a rotatable cylinder, sheet taking devices carried by the cylinder and operating to

take a plurality of sheets to be folded, a first pair of rollers, a folding off member carried by the cylinder and operating to project the sheets between the two rollers, the periphery of the rollers being shaped to provide conjointly a passage for the reception of the folded over edge of the sheets, a second pair of rollers to which the sheets are propelled by the cylindrical parts of the first rollers, and crushing members carried by the second pair of rollers and disposed to flatten the folded over edge of the sheets.

8. In combination a plurality of rotary cutting mechanisms, means feeding a plurality of webs to each cutting mechanism, a rotary collating cylinder, sheet taking devices carried by the cylinder, and operating to take a plurality of product lengths in succession from each cutting mechanism, a first pair of rollers, a folding off member carried by the collating cylinder and operating to project the product lengths between the two rollers, the periphery of the rollers being shaped to provide conjointly a passage for the reception of the folded over edge of the product lengths, and a second pair of rollers to which the product lengths are propelled by the first pair of rollers.

9. In combination a rotary collating cylinder, a plurality of cutting mechanisms each comprising a cutting cylinder and a gutter cylinder, sheet taking devices carried by one of these two cylinders, means supporting the cylinders carrying the devices adjacent and in spaced relationship with respect to the periphery of the collating cylinder, means feeding a plurality of webs to the sheet taking devices of each cutting mechanism, sheet taking devices carried by the collating cylinder, and operating to take a plurality of product lengths from the sheet taking devices of each cutting mechanism in succession as the cutting mechanisms sever the plurality of webs into product lengths, a first pair of rollers, a folding off member carried by the collating cylinder and operating to project the product lengths between the two rollers, the periphery of the rollers being shaped to provide conjointly a passage for the reception of the folded over edge of the product lengths, and a second pair of rollers to which the product lengths are propelled by the first pair of rollers.

10. In combination a plurality of rotary cutting mechanisms, means feeding a plurality of webs to each cutting mechanism, a rotary collating cylinder, sheet taking devices carried by the cylinder, and operating to take a plurality of product lengths in succession from each cutting mechanism, a first pair of rollers, a folding off member carried by the collating cylinder and operating to project the product lengths between the two rollers, the periphery of the rollers being shaped to provide conjointly a passage for the reception of the folded over edge of the product lengths, a second pair of rollers to which the product lengths are propelled by the first pair of rollers, and crushing members carried by the second pair of rollers and disposed to flatten the folded over edge of the sheets.

11. In combination a rotary stapling mechanism, a first rotatable cylinder, a punch member carried by the cylinder, a second rotatable cylinder, means on the second cylinder to take a plurality of sheets, the said second cylinder being rotated to present the sheets first to the first cylinder and then to the stapling mechanism, means operating the punch member to perforate at least some of the sheets in the zone in which the stapling mechanism is intended to insert a staple, a first pair of rollers, a folding off member carried by the second cylinder and operating to project the product lengths between the two rollers, the periphery of the rollers being shaped to provide conjointly a passage for the reception of the folded over edge of the product lengths, and a second pair of rollers to which the product lengths are propelled by the first pair of rollers.

12. In combination a rotary stapling mechanism, a first rotatable cylinder, a punch member carried by the cylinder, a second rotatable cylinder, means on the second cylinder to take a plurality of sheets, the said second cylinder being rotated to present the sheets first to the first cylinder and then to the stapling mechanism, means operating the punch member to perforate at least some of the sheets in the zone in which the stapling mechanism is intended to insert a staple, a first pair of rollers, a folding off member carried by the second cylinder and operating to project the product lengths between the two rollers, the periphery of the rollers being shaped to provide conjointly a passage for the reception of the folded over edge of the product lengths, a second pair of rollers to which the product lengths are propelled by the first pair of rollers, and crushing members carried by the second pair of rollers and disposed to flatten the folded over edges of the sheets.

13. The method of forming and stapling a plurality of sheets cut from a plurality of webs and then folding the stapled sheets which consists in separating a plurality of webs into separate groups cutting the webs of each group into product lengths, then collecting the various groups of severed product lengths, preforating at least some of the collected lengths in the zone in which the product is to be stapled, then inserting a staple through the perforations and the unperforated lengths, and then folding the stapled sheets.

14. The method of forming a folded stapled product which consists in separating a plurality of webs into separate groups each of which is severed into product lengths, in collecting the various groups of severed product lengths, perforating at least some of the collected lengths in the zone in which the product is to be stapled, then inserting a staple through the perforations and the unperforated products, then folding the stapled product lengths, gripping the folded product back of the fold, and then flatten the folded over edge of the product.

15. In combination a plurality of rotary cutting mechanisms, means feeding a plurality of webs to each cutting mechanism, a rotary collating cylinder, sheet taking devices carried by the cylinder, a second rotatable cylinder, a punch member carried by the second cylinder, a rotary stapling mechanism, the sheet taking devices on the collating cylinder operating to take in succession product lengths from each of the cutting mechanisms, and then to present the product length to the second cylinder and then to the rotary stapling mechanism, means operating the punch member to perforate at least some of the product lengths in the zone in which the stapling mechanism is to insert a staple, a first pair of rollers, a folding off member carried by the collating cylinder and operating to project the product lengths between the two rollers, the periphery of the rollers being shaped to provide conjointly a passage for the reception of the folded over edge of the product lengths, and a second pair of rollers

to which the product lengths are propelled by the first pair of rollers.

16. In combination a rotary collating cylinder, a plurality of cutting mechanisms each comprising a cutting cylinder and a gutter cylinder, sheet taking devices carried by one of these two cylinders, means supporting the cylinders carrying the devices adjacent and in spaced relationship with respect to the periphery of the collating cylinder, means feeding a plurality of webs to the sheet taking devices of each cutting mechanism, a further rotatable cylinder, a punch member carried by the further cylinder, a rotary stapling mechanism, the said further cylinder and the stapling mechanism being disposed adjacent the periphery of the collating cylinder, sheet taking devices carried by the collating cylinder and operating to take a plurality of product lengths from the cutting mechanisms in succession and then to carry the product lengths first to the further cylinder and then to the stapling mechanism means operating the punch member to perforate at least some of the product lengths in the zone in which the stapling mechanism is to insert a staple, a first pair of rollers, a folding off member carried by the collating cylinder and operating to project the product lengths between the two rollers, the periphery of the rollers being shaped to provide conjointly a passage for the reception of the folded over edge of the product lengths, and a second pair of rollers to which the product lengths are propelled by the first pair of rollers.

17. The method of forming a folded stapled product which consists in perforating at least some of the sheets, to be stapled in the zone at which a staple is to be inserted and thereafter inserting a staple through the perforation, then folding the stapled product lengths, and then flattening the folded over edge of the product.

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