United States Patent

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[54] **BAG MAKING MACHINE**
46 Claims, 16 Drawing Figs.

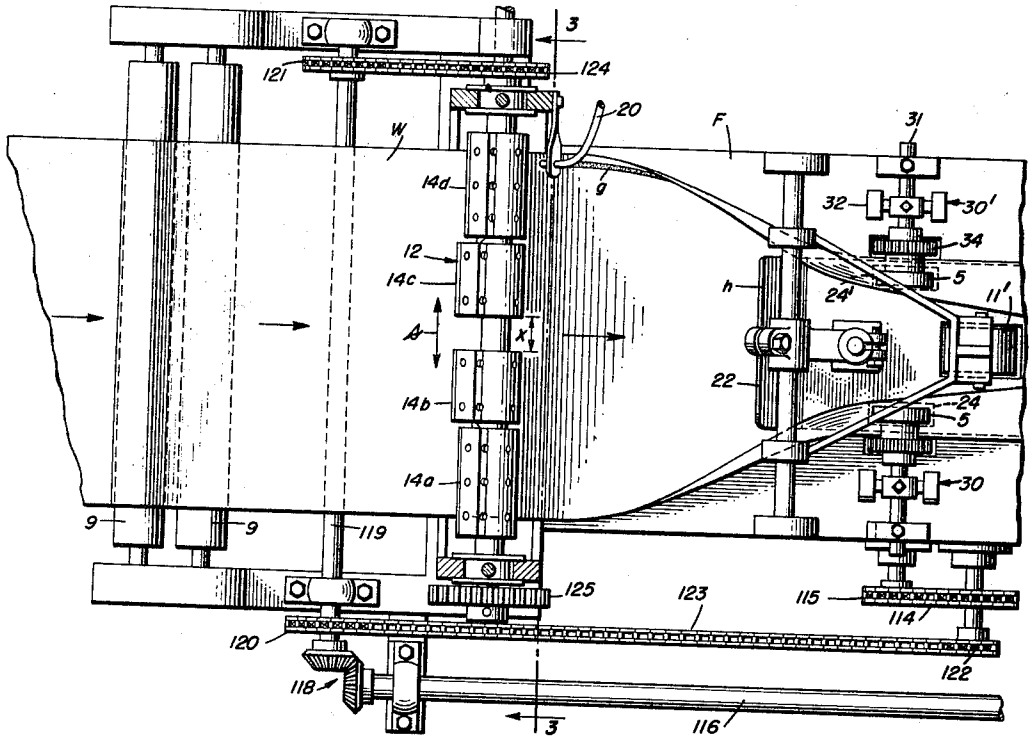
[52] **U.S. Cl.** **93/19,** 93/8
[51] **Int. Cl.** **B31b 23/14**
[50] **Field of Search** 93/8, 19, 20

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Primary Examiner—H. A. Kilby, Jr.
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ABSTRACT: A machine for making notion and millinery type bags having a lip on one layer extending beyond the edge of the other layer, the machine including means for transversely perforating the paper web in successive steps in advance of and following a folding of the web into tube form, and means to repetitively rupture the tube along the perforations to form individual bag lengths.

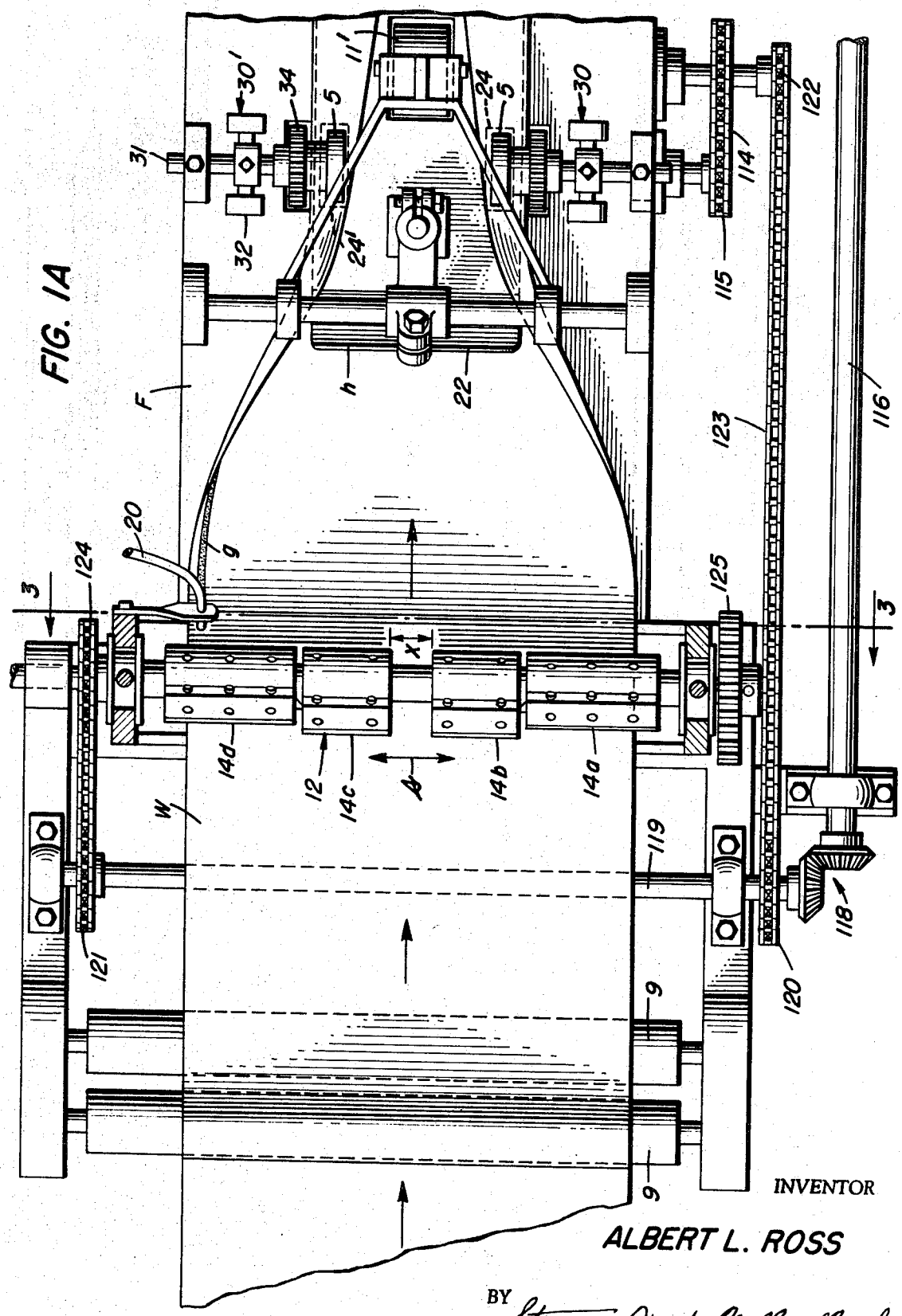


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FIG. 1A



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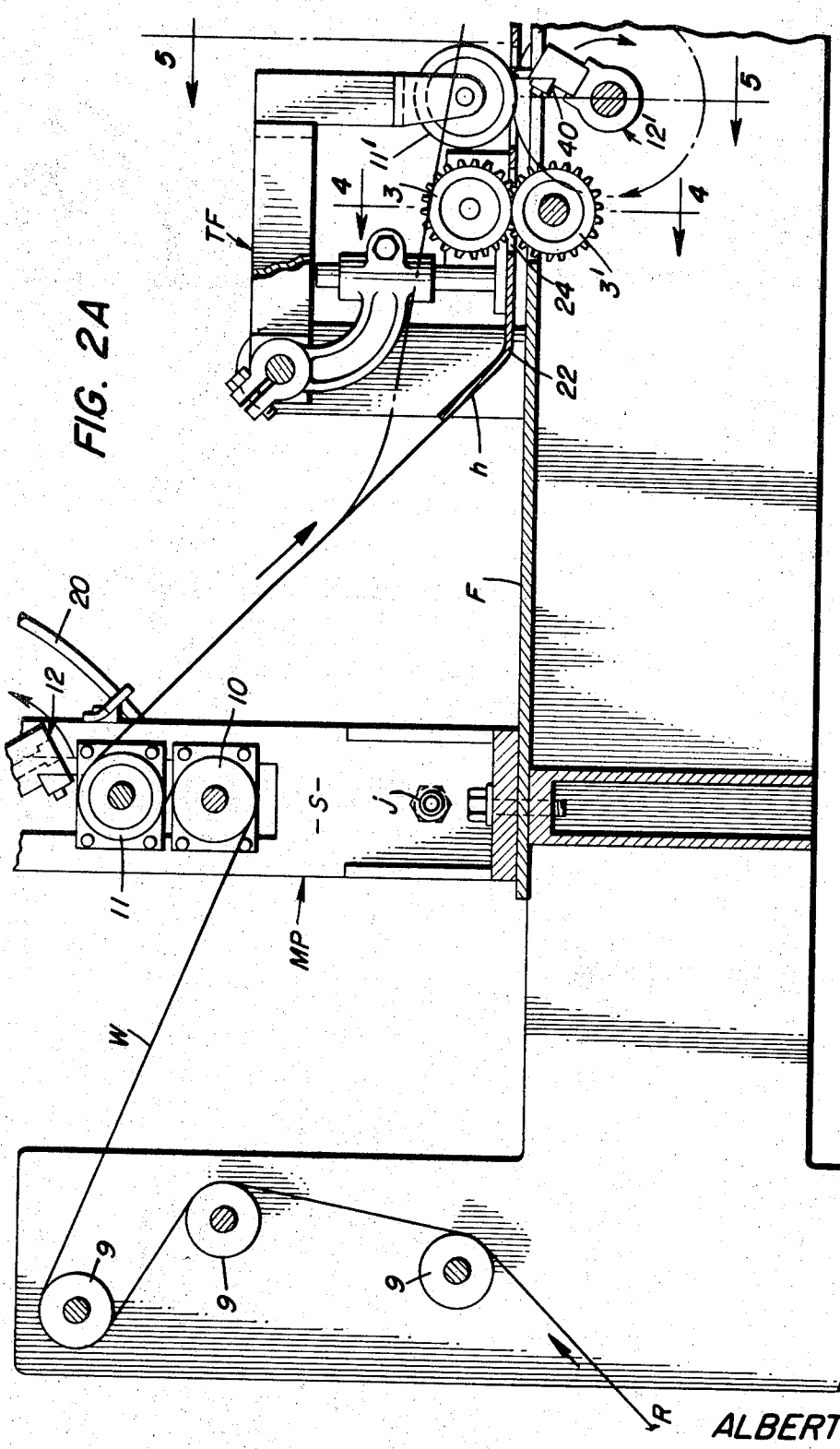


FIG. 2A

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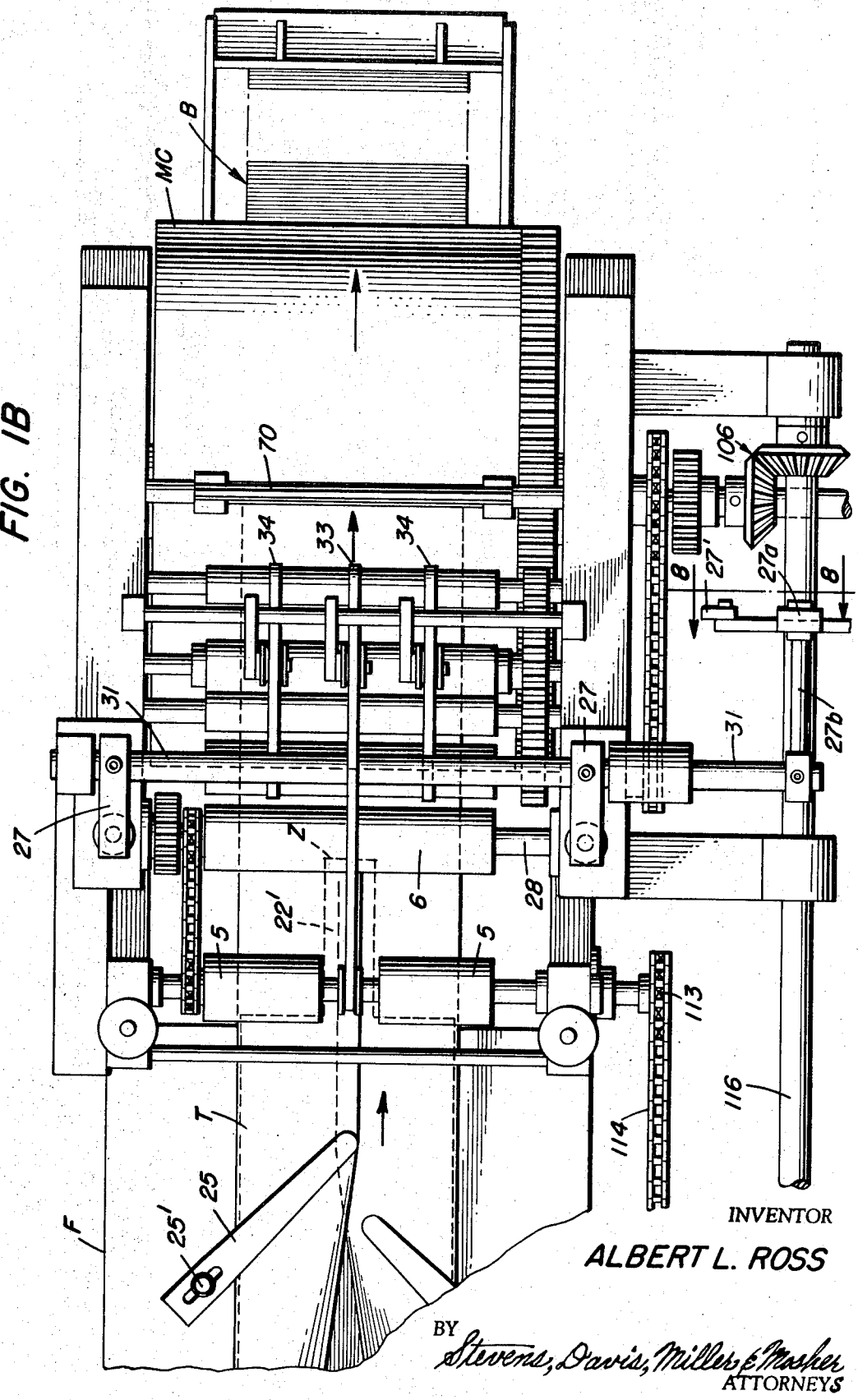
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FIG. 1B



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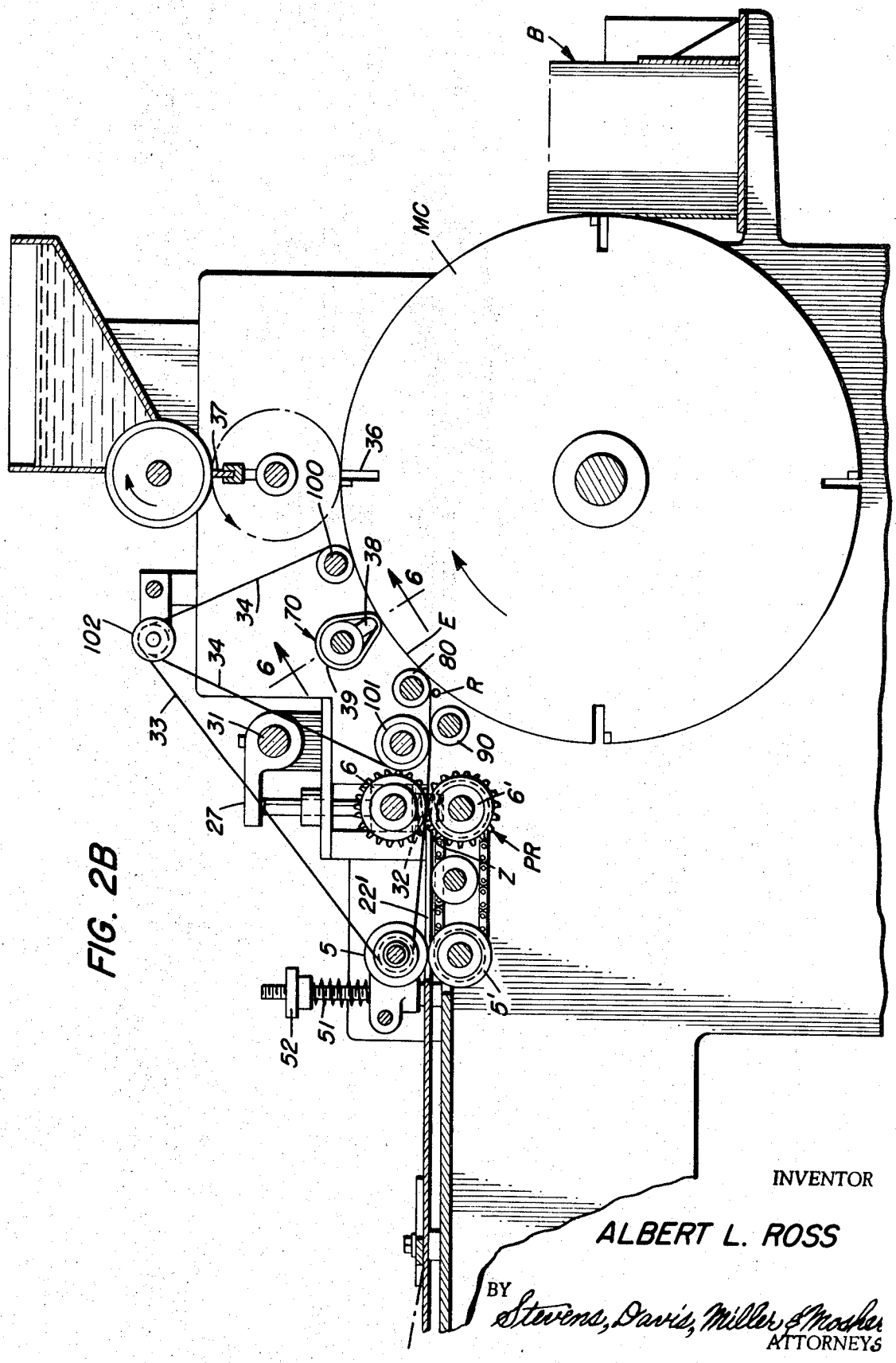


FIG. 2B

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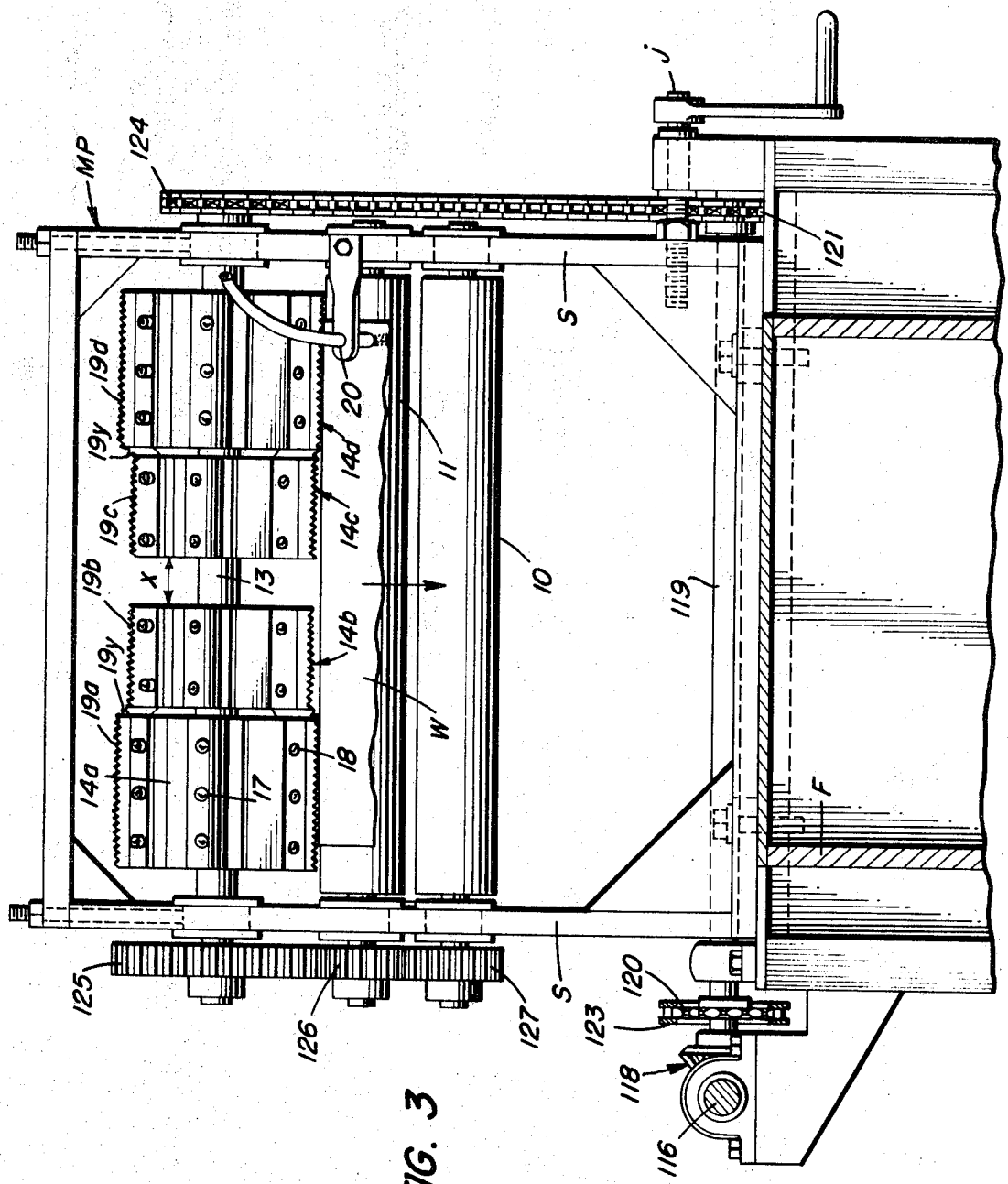


FIG. 3

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FIG. 4

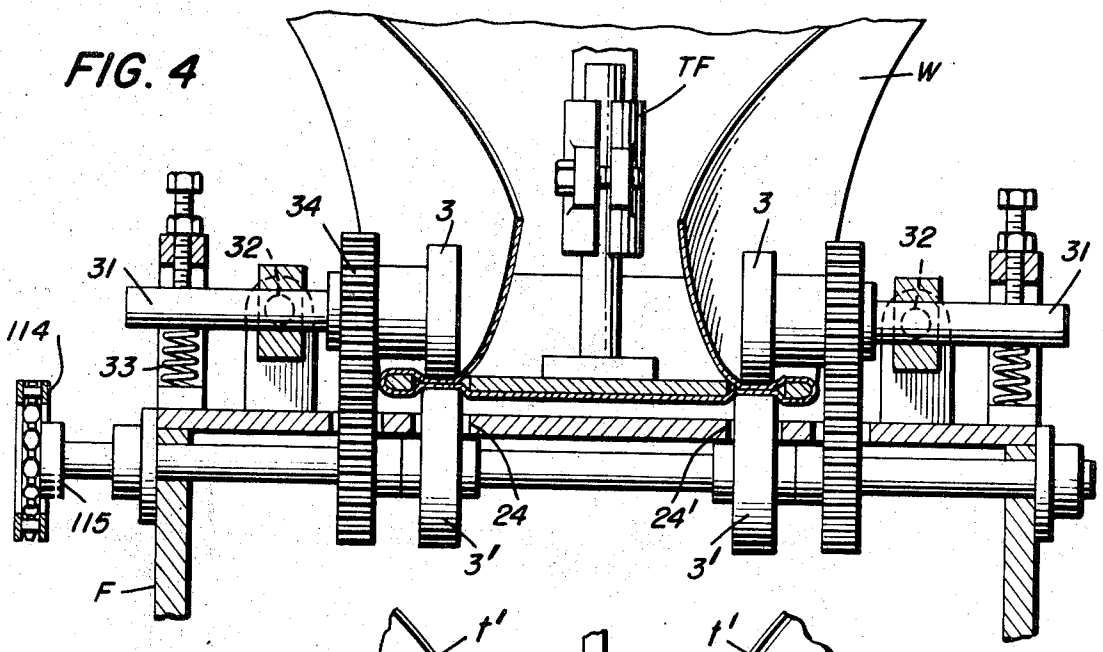
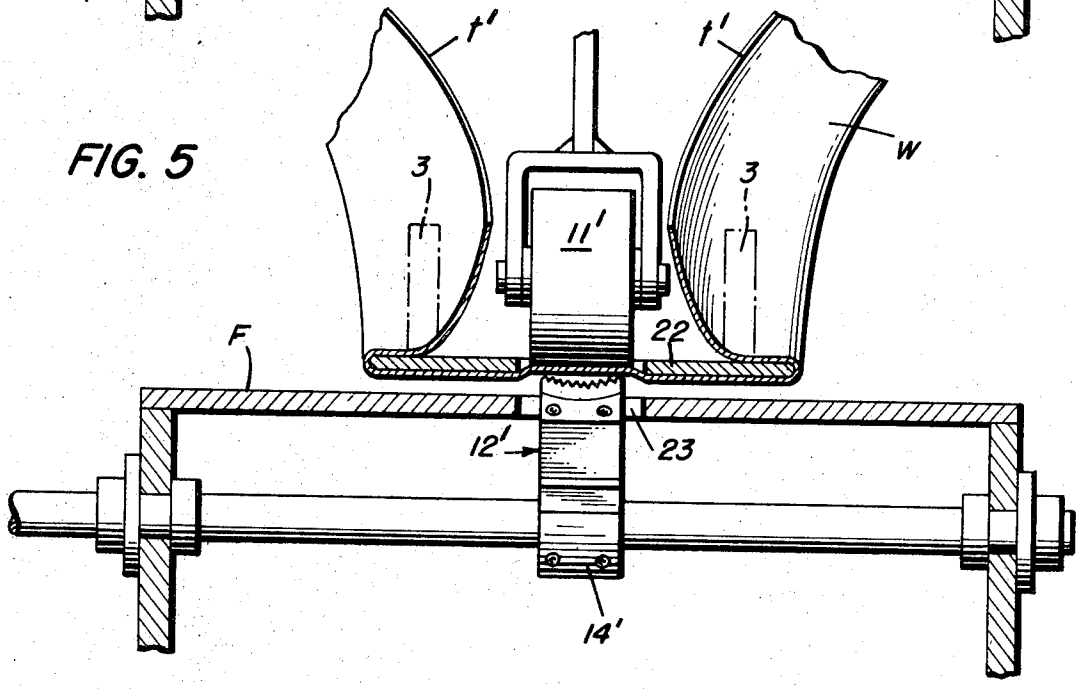


FIG. 5



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FIG. 6

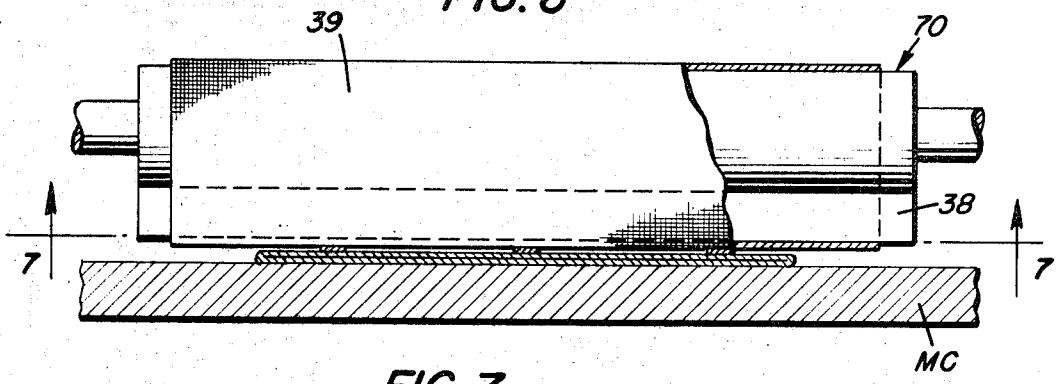
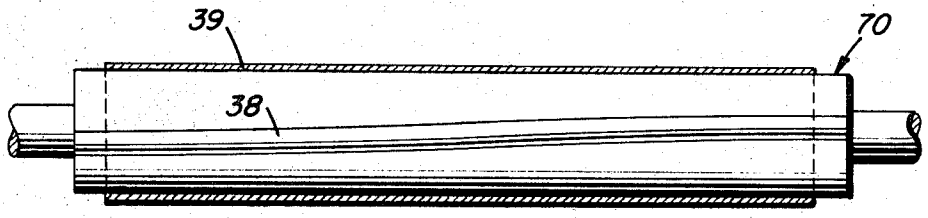


FIG. 7



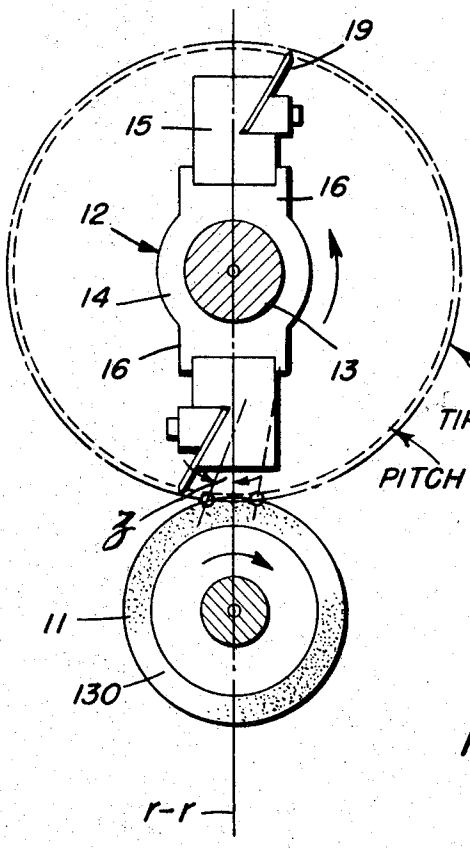
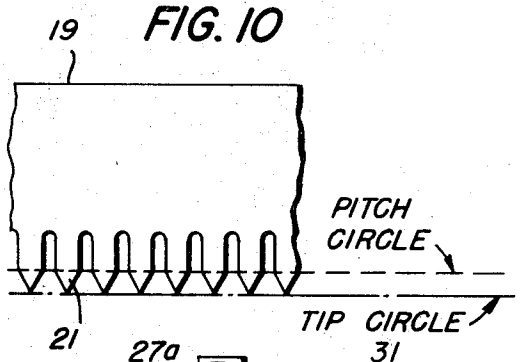


FIG. 9

FIG. 10



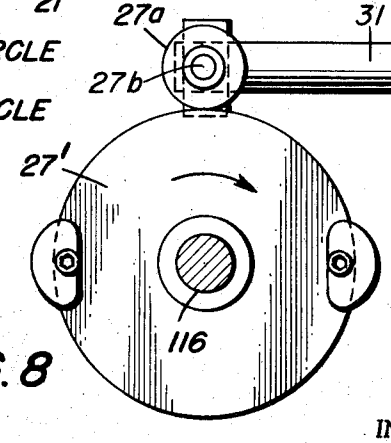


FIG. 8

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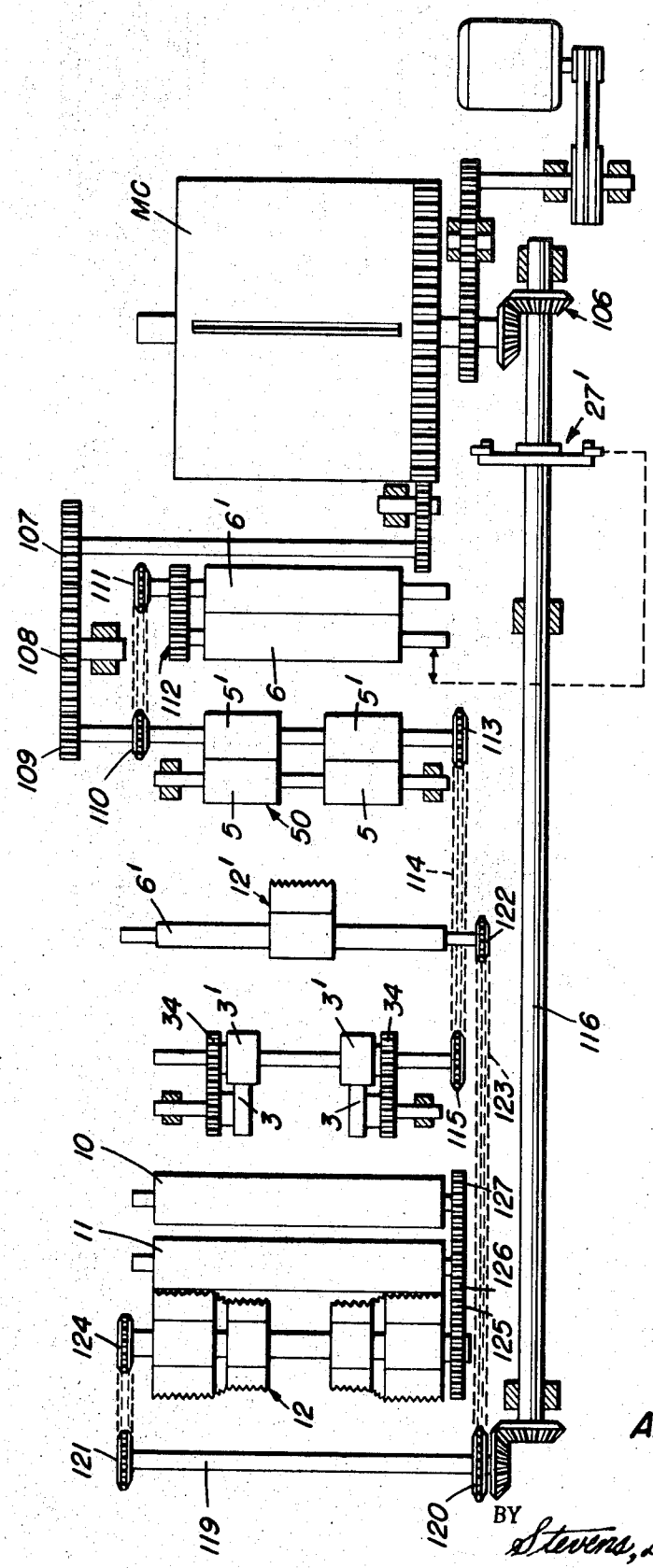


FIG. 11

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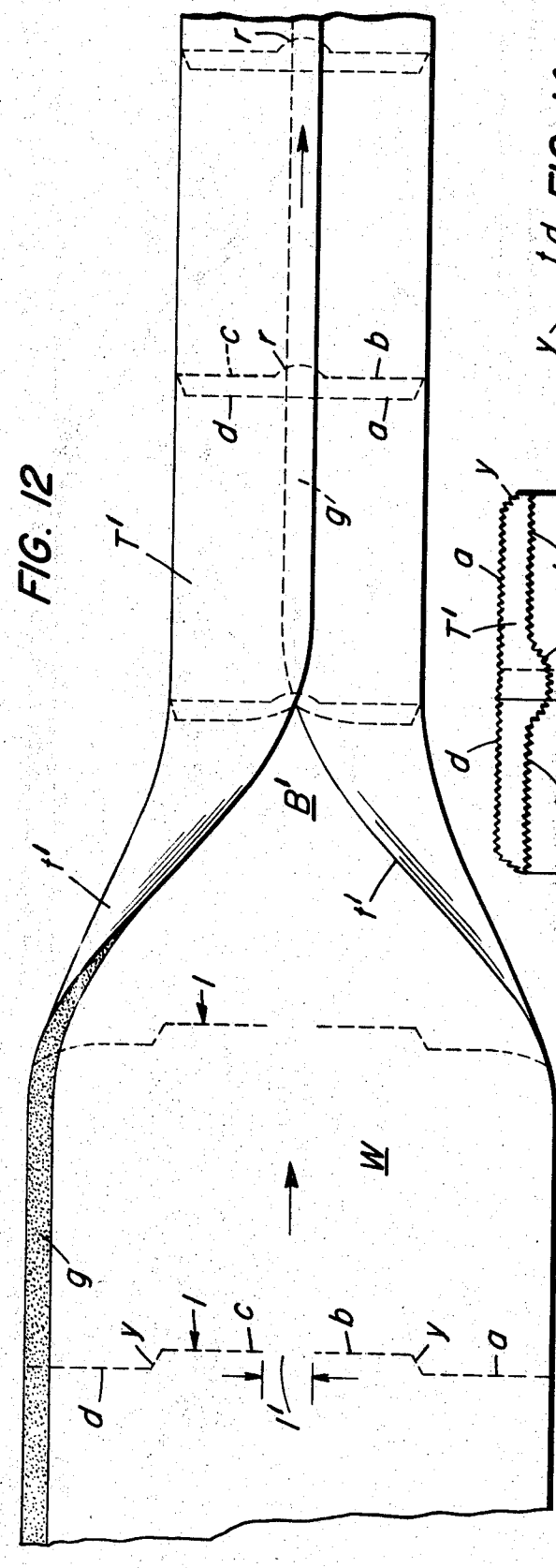


FIG. 12

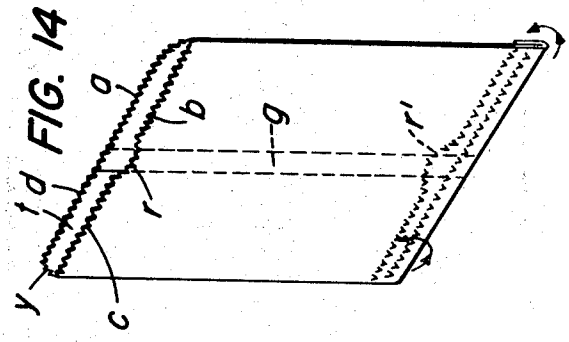


FIG. 14

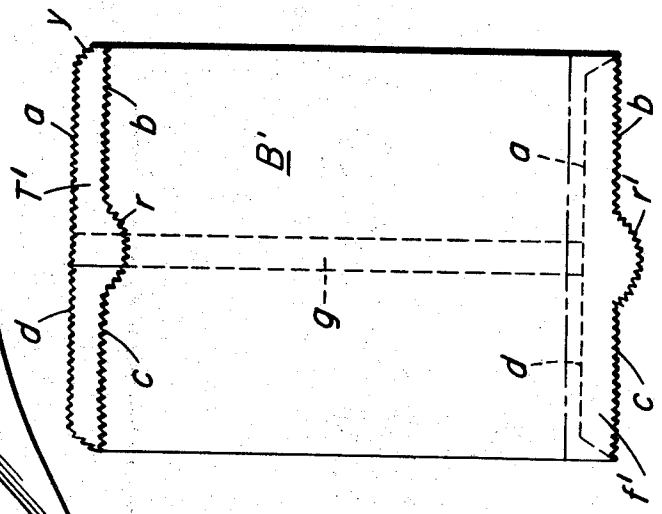


FIG. 13

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BAG MAKING MACHINE

The invention relates to improvements in machines for continuous high speed production of paper bags and is especially directed to a novel arrangement of parts whereby a continuous paper web is drawn through various stages of the machine to be successively perforated along transverse lines, then longitudinally folded over into tube form, and finally ruptured along the perforation lines to form respective separate bag units.

The type of bags to which the invention is directed are flat bottom bags referred to in the trade as merchandise, variety, notion, and millinery bags, or flats and squares. This type of bag is characterized in that it comprises no bottom folds as does the well known accordion type grocery bag. This bag resembles a flattened tube whose sides may either consist of single fold lines or it can have gusset sides.

Bag making machines per se are of course well known; however, there are various problems and disadvantages in the known machines, and it is the purpose of the present machine to overcome such problems.

The feeding of a paper web (sheet) through a machine necessarily entails a pulling of the web from the outlet end of a component through which said web passes in contrast to a feeding or pushing of the web from the inlet side of such component. Pulling, in contrast to pushing, is necessary because a paper web is flexible and nonrigid and, therefore, cannot sustain itself in a fixed plane, especially in a horizontal plane, unless it is maintained under tension. The paper web, therefore, must possess a certain degree of tensile strength in order for it not to rupture as it is pulled through the various machine components which successively perform operations thereon to convert it into bags, this prerequisite giving rise to problems, however, in the instance in which one of said operations comprises the cutting of a line of perforations transversely across the web along which the web is eventually ruptured to form the respective separate bag lengths.

In various of the prior art machines, this problem does not necessarily exist because such machines employ a rotating knife or other analogous cutting means to finally cut the paper web into separate bag units. The machine of this invention, however, is of the type wherein the severing of the web into separate bag units is accomplished by a bursting technique which involves subjecting the web to tension forces which result in tensile rupture occurring along a preweakened transverse line, namely: a line of perforations. This bursting technique has various advantages over the rotating knife means and is especially suited to produce a bag whose ends are not defined by straight lines and is especially suited to produce a bag wherein one layer forms a lip extending longitudinally beyond the end of the other layer. In other words, a knife will cut along a straight line and, in any event, will cut both overlying bag layers along a common line. On the other hand, the bursting technique permits the formation of bags having any desired end configuration, such as curved or of a wavy pattern, etc., and further permits the overlying bag layers to sever along respective lines which are axially displaced relative to each other whereby lips are formed at each end of the bag, the lip at one end then being foldable to seal that end while the lip at the other end allows for easy gripping of one layer by the consumer in order to open the bag.

The bursting technique, per se, is well known; however, it presents various problems which prior art machines do not resolve. One of these problems is that the necessary preweakening of the web by means of the perforations results in a web which is so weak in tension that it may rupture prematurely, that is, before all required operations have been performed thereon. One expedient proposed in the prior art to overcome this problem involves making the perforations after the web has been folded over to form a tube. This, however, involves a very serious disadvantage in that it is extremely difficult to perforate one bag layer without also perforating the underlying layer; and in the case of bags having lips, results in unwanted perforation holes being made along the bottom of the lip in correspondence to the perforations which are made in the edge of the shorter bag layer.

The machine of this invention overcomes this problem by providing a novel arrangement of components whereby a major portion of the web is perforated before it is folded over into tube form with only a small transverse section of the web remaining unperforated until after the web has passed through that portion of the machine in which it is subjected to the highest pulling stresses, the small unperforated web section then being perforated and the fully perforated web at this point having sufficient tensile strength to continue to be pulled through the remainder of the machine without rupturing prematurely.

Another aspect of the invention is directed to a novel arrangement of the machine feed rollers whereby the final bursting tension which is applied to separate each bag unit from the continuous web is isolated and prevented from being transmitted back along the web to points at which the phase relationship between the paper and the respective paper driving means is critical and may not be disturbed.

Still another aspect of the invention involves a novel arrangement of parts whereby the leading end of the paper tube, immediately following the perforation line along which a previous bag unit has just been separated, is prevented from falling loose or out of the desired plane of travel.

This last mentioned aspect of the invention involves an arrangement whereby the bag unit is gripped along the surface of the conventional main cylinder before the bag unit is separated from the remainder of the paper and whereby separation occurs along a perforation line which is immediately adjacent to the surface of said main cylinder.

Another aspect of the invention resides in an arrangement whereby the conventional pinch bar and pinch roller combination is replaced by a pinch bar which coacts directly with the main cylinder so that it is no longer necessary to change either said pinch bar or pinch roller in order to effect a change in bag length.

Another aspect of the invention resides in an arrangement which requires a minimum number of paper feed rollers to advance the paper through the machine without excessively straining the paper in tension.

Another aspect of the invention resides in an arrangement whereby the axis along which the paper is fed to the former plate may be laterally adjusted, while the machine is operating, in order to obtain the optimum lateral orientation of the paper relative to said plate.

Another aspect of the invention resides in an arrangement of parts whereby changeover from one bag length to another may be effected quickly and easily, and specifically, by changing only a few of the paper driving parts.

Still another aspect of the invention resides in a novel construction of the pinch bar whereby it grips the paper tube in progressive fashion beginning at one side thereof and progressing to the other side whereby said tube ruptures progressively, rather than simultaneously, across its width.

Still another aspect of the invention resides in the arrangement of parts whereby the bursting tension is applied to a portion of the paper tube which is bent around a corner rather than being applied to a portion of the tube which lies in a common flat plane with the remainder of the tube.

Another aspect of the invention resides in a novel disposition of rotary perforator blades relative to the plane of the web which is to be perforated whereby said blades penetrate the web and then rotate away therefrom in a clean manner without snagging beneath the web.

The objects of the invention generally are to realize the foregoing features and also to realize the following results:

a. Primarily, a superior bag which is characterized by neatly trimmed edges at both ends thereof, which edges may be variously configured rather than being straight;

b. A bag having a lip at the open end thereof together with a thumb recess in the edge of the shorter bag layer;

c. A machine which is very simple to operate and to adjust, particularly as to producing bags of different length;

d. A machine which is highly reliable in that it is not prone to causing premature rupturing in the paper, in that it avoids snagging or any interruption in the smooth flow of the paper through the machine, in that it is capable of continuing to advance the paper smoothly therethrough even if premature rupture of a portion of the paper occurs, and in that it continuously maintains a constant phase relationship between its paper driving means and the paper, whereby said machine does not require frequent shutdown and can operate at a relatively high production rate;

e. A machine which can be easily adjusted to vary the edge outline of the bags produced thereby; and,

f. A machine which is simpler and more economical to construct than known machines and which is simpler and more economical to operate and to maintain.

Other objects are those which are inherent in the features disclosed herein of which a detailed description follows of preferred embodiments with reference being made to the accompanying drawings, wherein:

FIGS. 1A and 1B are top plan views of the bag making machine of this invention;

FIGS. 2A and 2B are longitudinal vertical sectional views of the machine shown in FIGS. 1A and 1B;

FIG. 3 is a transverse sectional view taken along line 3–3 of FIG. 2B;

FIG. 4 is a sectional view taken along line 4–4 in FIG. 2A;

FIG. 5 is a sectional view taken along line 5–5 in FIG. 2A;

FIG. 6 is a plan view of the pinch bar with the cover cut away;

FIG. 7 is a plan view of the pinch bar with the cover shown in section so as to expose the spiraled ledge;

FIG. 8 is a sectional view taken along line 8–8 in FIG. 1B showing cam means for reciprocating the top pinch roller;

FIG. 9 is a schematic end view of the main perforator rollers showing the angular relationship of the blades;

FIG. 10 is a partial plan view of a blade;

FIG. 11 is a diagram of the power drive transmission arrangement of the machine;

FIG. 12 is a top plan view of a paper web showing its progressive formation into tube form as it travels from left to right through the machine; and,

FIGS. 13 and 14 are respective views of a bag produced by the machine.

Referring to FIGS. 1A, 1B, 2A, and 2B, it is seen that the machine comprises a stationary metal support structure or frame F on which are mounted the respective components for advancing a bag material in the direction of the arrows, starting as a flat sheet or web of paper W coming off a not shown supply roll at R at the left hand end of the machine and discharging at the right hand end in the form of completed individual bags B. In advancing from the left to the right hand end of the machine the paper web W is successively acted upon generally as follows:

1. First, the web passes through the main perforator assembly MP which perforates the web, in a direction transverse to the web length, completely across its width excepting for a small extent along the middle of said width, the resulting line of perforations being shown at 1 in FIG. 12 with 1′ indicating the nonperforated extend;

2. Second, the web passes through the tube former assembly TF which folds the flat web over into the form of a flat tube and also perforates the aforementioned nonperforated extend 1′ thereof;

3. Third, the flat tube passes through a pinch roller assembly PR which operates in conjunction with the main cylinder assembly MC to sever the tube into individual bag lengths, the main cylinder assembly finally functioning to fold over and seal one end of each bag length thereby forming a closed bottom on each bag.

The machine embodies a variety of specific inventive features which will subsequently be discussed in detail; however, it also embodies the following general inventive features which are mentioned at this time in order to give the reader an initial broad understanding of the invention.

Primarily, it is recalled that the web W must be pulled through the machine from left to right and in this regard the very first positive feed rollers are those denoted 30 which are located in advance of the final perforator assembly 40 but at a point intermediate the ends of the tube former assembly TF. In other words, the paper web is pulled off the not shown supply roll at R, then through the main perforator assembly MP, and then through a portion of the tube former assembly TF by only one positive feed roller assembly 30 and without any other positive feed roller assembly being interposed between the tube former TF and the supply roll at R. The importance of this feature is that the web W is maintained uniformly tensioned, without any wrinkling, buckling or slacking, along its entire length from the not shown supply roll at R all the way up to a point along the tube former TF at which the folding of the web into tube form has commenced. This uniformity of tension and the elimination of any slack along the web length is critically important to having the main perforator assembly MP effect the transverse lines of perforations at a uniform distance apart from each other so as to obtain bags of uniform length. The interposition of another positive feed roller means at any point between the supply roll and the main perforator assembly MP is undesirable because the interposition of such an additional positive feed roller means would introduce the possibility of lengthwise misalignment of the web portion being fed to the main perforator assembly relative to the web portion being drawn away from the main perforator by the main feed rollers 30. In other words, by having only one positive feed roller means 30 pulling the web W off the supply roll, there is assured a continuous lengthwise alignment of the web from its supply roll all the way up to the feed roller means 30, while if another positive feed roller means were interposed between said supply roll at R and the roller means 30, it would be possible for the additional roller means to feed the web to the main perforator along a direction of travel which is angled (not along the same straight line) relative to the direction along which the roller means 30 draws the web away from MP. Such a situation would result in the perforation lines 1 not running perfectly perpendicular to the lengthwise axis of the web and the bags not having square corners.

In fact, according to the present invention the entire main perforator assembly MP is transversely adjustable relative to the machine frame F for the purpose of aligning the web portions on both sides of MP along a common rectilinear direction of travel. Such adjustment is achieved by rotatably mounting the rollers 10, 11, and 12 all in a perforator stand S which in turn is adjustably mounted on frame F whereby said stand may be displaced transversely relative to said frame (i.e., along the direction of arrows S in FIG. 1A) and then be positively fixed in any particular transverse position. In practice, the machine operator effects the adjustment while the machine is running, usually immediately after a new supply roll has been started, relying upon visual observation to determine when the web is being pulled evenly across its entire width in the lengthwise extent thereof from the main perforator rollers to the tube former assembly, this being the purpose of the adjustment.

The adjusting means may comprise any conventional arrangement for transversely displacing the stand S relative to frame F and for firmly holding said stand in a fixed position once the adjustment has been effected. For example, the stand may be provided with elongated slots in its base through which extend hold down bolts which are threadedly received in the frame F, said slots permitting the stand S to be transversely shifted relative to frame F with said bolts being tightenable to firmly hold the stand fixedly in place. A jacking screw means *j* including a threaded shaft which extends through a correspondingly threaded hole in stand S is turnable by means of a hand crank in order to traversely shift said stand relative to the frame.

The specific location of the first positive feed roller means 30 at a point ahead of the final perforator assembly 40, but at

a point along the tube former TF at which the web has already been partially folded over into tube form, is in itself very important for two reasons. First is the fact that the highest pulling force which is required to advance the web through the machine is the force needed to pull the web through the tube former, especially the heel *h* at the front end thereof; therefore, the web must have sufficient tensile strength to be pulled through said tube former TF without rupturing. According to the present machine such tensile strength in the web is assured by positioning the first positive feed rollers **30** ahead of the final perforator rolls **40** so that the web is not completely perforated until after the highest pulling forces have been applied thereto. In other words, at no point from the supply roll at R and up until the folding of the web has commenced, is the web completely perforated, the final perforation being effected at **40** at a point along the web which is under considerably less tension than that portion of the web length ahead of rollers **30**.

An additional broad feature of the invention resides in the relationship between the pinch roller assembly PR, the second feed roller means **50**, and the main cylinder assembly MC. In this regard, it should be noted that the aforementioned bursting technique, whereby the paper tube T is caused to rupture along the transverse perforation lines, is realized by passing the tube between two sets of successively spaced rollers the downstream one of which rotates at a higher surface speed than the upstream set, the difference in speed between the two sets of rollers acting to pull the tube apart and the aforementioned line of perforations serving as the weak point along which rupture is assured to occur.

This feature is realized in the present machine by providing the pinch roller assembly PR whose rollers **6**, **6'** rotate at a slower surface speed than that of the main cylinder assembly MC against whose surface the tube is periodically gripped by pinch bar **70** so that tube T is ruptured along a transverse perforation line located between bar **70** and pinch rollers **6**, **6'**, this action being repeated along the tube length as the tube T is continuously advanced from left to right through the machine.

In the present machine, the pinch roller assembly PR is unique in that it is interposed between the second set of positive feed rollers **50** and the main cylinder assembly so that when pinch rollers **6**, **6'** grip tube T (FIG. **13**) they not only slow its speed relative to the surface speed of main cylinder MC and pinch bar **70**, but they also slow its speed relative to second positive feed rollers **50** whereby a slack develops in the tube T between rollers **50** and pinch rollers **6**, **6'**. This slack serves the purpose of absorbing any pulling force on the tube towards the right which may be transmitted past pinch rollers **6**, **6'**. If such pulling force were to be transmitted past the pinch rollers, the tube would in many instances rupture ahead of said pinch rollers instead of after thereof. This feature is further important because the web from the supply roll at R up to the second feed rollers **50** must be maintained in a uniformly taut condition and no slippage may occur between the tube and either of the perforator rollers MP or **40** or the first feed rollers **30**, since, if any slippage were to occur, the final perforations performed at **40** would not be properly aligned laterally with the initial perforations performed at MP. For this reason, it is essential that the sudden bursting tension be isolated from the upstream side of rollers **50**, such isolation generally being provided by the very fact that rollers **50** and rollers **6**, **6'** positively grip tube T therebetween so that, theoretically, said tube cannot slip relative to rollers **50** or rollers **6**, **6'**, but said isolation being further positively assured by building up a slack in tube T between rollers **50** and rollers **6**, **6'** to act as a buffer or tension reliever between said rollers. In other words, even if the sudden bursting tension were transmitted past rollers **6**, **6'**, the slack between rollers **6**, **6'** and **50** would absorb and prevent said tension from being transmitted along the tube past rollers **50** to the final perforation rollers **40**.

Another broad aspect of the invention as embodied in the present machine resides in the fact that the pinch bar **70** is associated directly with the main cylinder rather than constituting part of a separate pinch bar assembly located ahead of said main cylinder. The arrangement, as disclosed herein, is such that the tube end portion is already engaged along the surface of the main cylinder at the moment that bursting of the tube occurs so that it is possible for the line of perforations along which bursting occurs to be located as close as possible to the main cylinder thereby minimizing the distance that the newly formed leading edge of the remaining tube must travel before it in turn contacts surface of the main cylinder. On the other hand, as is common in the prior art, if pinch bar **70** were part of a pinch bar assembly ahead of the separate from the main cylinder, since bursting of the tube must occur ahead of such a pinch bar assembly, the result would be that after bursting occurs the newly formed tube leading edge would have to travel a considerable distance before it came into contact with the surface of the main cylinder. It is highly desirable to minimize this distance since the tube material is paper and, therefore, requires support unless it is being pulled between any two points. In this regard, it should be noted that once bursting of the tube has occurred, the newly formed tube leading edge is free and is actually being pushed, rather than pulled, until it engages subsequent rollers (such as the main cylinder), so that said leading edge could very easily fall or bend downwardly if it had to travel a considerable distance from the aforementioned separate pinch bar assembly up to the main cylinder.

Other aspects of the invention which reside in details of the individual components will now be discussed.

The paper web W comes off a freely rotatable not shown supply roll at R and is passed over a number of freely rotatable rollers **9** which are mounted at the inlet end of the machine. The number and disposition of rollers **9** is not critical, the use and arrangement thereof being well known and being to provide tautness in the web as it is being pulled off the supply roll, from rollers **9** the web W passes to the rollers of the main perforator assembly MP which are arranged as follows.

Roller **10** is analogous to rollers **9** in construction. Roller **11**, however, is an anvil roller for the perforator roller **12**. Rollers **10**, **11**, and **12** are all positively driven; however, rollers **10** and **11** are spaced apart from each other so that the web is not gripped between the respective surfaces of these rollers and thereby it may slip relative to roller **10** which may be called a slip roller. Anvil roller **11** is covered or coated on its cylindrical surface with a resilient frictional material such as rubber; however, the web W can also slip relative to this roller.

The two rollers **10** and **11**, therefore, constitute a slip roller combination in that the web may slip relative to either of them. In this regard it should be noted that the term "positive feed rollers" as used herein is applied to rollers which normally do not permit any slippage of the web relative thereto. Such avoidance of slippage relative to a particular roller means is realized through the fact that the upper and lower rollers of a pair (for example **3** and **3'**) are so close to each other that they simultaneously grip a particular point of the web therebetween. In the case of slip rollers, on the other hand, the web is not gripped between any two rollers; instead, as in the case of rollers **9**, **10**, and **11**, the rollers act independently of each other at different points along the web.

If the web is of relatively weak material, it should be passed over the lower slip roller **10**, as is shown in FIG. **2A**, said roller **10** serving to reduce the tensile stress along the web from first positive feed rollers **30** to the supply roll at R. On the other hand, if the web is of relatively strong material, it may pass from the rollers **9** directly to anvil roller **11** without passing over roller **10**.

In this regard, it should be noted that while slip rollers **10** and **11** serve to assist in drawing the web W from its supply roll, and in effect rollers **10** and **11** constitute feed rollers, the actual rate at which the web is fed to between the anvil and perforator rollers, **11** and **12**, is controlled only by the first positive feed rollers **30**. In other words, roller **10** will not feed the web to rollers **11** and **12** faster than the web is drawn by the rollers **30** because said web will simply slip on rollers **10** and **11** if these rollers travel too fast.

Main perforator roller **12** comprises a central power driven shaft **13** about which are clamped removable sleeves **14** which in turn comprise a pair of diametrically opposed radial arms **16** at the ends of which are demountable attached the blade holders **15** Sleeves **14** are fixed relative to said shaft **13** by means such as set screw **17** The blade holders **15**, in turn, are bolted onto the ends of arms **16** by means such as machine screws **18**, said holders **15** removably carrying the perforator blades **19**

It will be noted in FIGS. **1A** and **3** that the disclosed main perforator roller **12** is made up of four separate sleeves **14**, denoted **14***a* to **14***d*, positioned successively along the axis of shaft **13** with a middle space X separating the two inner sleeves **14***b* and **14***c*. The space X corresponds to the nonperforated extend **1'** of web W (see FIG. **12**) while the sleeves **14***a* and **14***d* correspond to the portions *a* and *d* of perforation line **1** and sleeves **14***b* and **14***c* correspond to portions *b* and *c*.

With reference to FIGS. **13** and **14**, it will be seen that the completed bag is in the form of a flat tube having an open upper end and a closed bottom end. Primarily, the tube itself is defined by two flat layers which are integrally joined along straight side edges and which for the sake of convenience will be called the top T' and bottom B' layers of the bag and correspondingly of the tube while it is still in the machine.

Following the advance of the web from left to right in FIG. **12**, it is seen that the outer perforations *a* and *d* of two successive perforation lines ultimately constitute the opposite edges *a*—*d* of the top layer T' while the laterally inner perforations *b* and *c* of two successive perforation lines ultimately constitute the opposite edges *b*—*c* of the bottom layer B'.

Since the outer perforations *a*—*d* are longitudinally offset from the inner perforations *b*—*c*, each bag and tube top layer T' comprises a lip *f* extending longitudinally beyond edge *b*—*c* at one end of the tube bag length (that is: the tube length between two successive lines of perforations **1**–**1**) and each bag and tube bottom layer B' comprises a lip *f'* extending longitudinally edge *a*—*d* at the opposite end of the tube bag length. The lip *f'* is ultimately folded over back over the top layer T' and glued thereto to form a closed bottom for the bag, this occurring when the bag is on the main cylinder.

In fact, glue or paste is applied by applicator **20** along one side edge portion *g* of web W as the web leaves the main perforator assembly and, as is shown in FIG. **12**, the web is eventually folded over into tube form with the glued edge portion *g* overlapping the opposite edge of the web and becoming glued thereto so as to form an integral top layer T'.

An important feature of the perforator roller assembly **12** is that the perforator blades **19***a*—*d* are carried at an angle relative to a radial line extending from the axis of shaft **13**. Specifically, (see FIG. **9**) blade **19** forms an angle *z* of from 15 to 45° relative to straight line *r*—*r* which interconnects the respective axes of rotation of the perforator and anvil rollers, said angle being measured at the moment that the rotary arc of the tips of the blade teeth first intersects the rotary arc of the surface of the anvil roller, said teeth, as is well known, penetrating into the resilient covering on the anvil roller along the extent of overlap of the two arcs. As is also clear from FIG. **9**, the blade **19** lies in a nonradial plane relative to the rotational axis of the roller **12** and said blade forms said angle *z* with a radial line of roller **12** at a point between the axis of roller **12** and the tip circle of the blade teeth. The significance of this angular disposition of the blades **19** is that the blade cutting teeth, after they have perforated the web, separate from the web in a very smooth manner without becoming snagged or caught in the web. If the plane of blades **19** extended radially from the axis of shaft **13**, as is conventional, the blade teeth would tend to shovel beneath the web and thereby lift the web away from the anvil roller **11** as the blades rotated away from said roller. On the other hand, by being angled backwardly, as disclosed herein, the blade teeth **21** are drawn out of the web in a generally perpendicular direction relative to the web surface rather than along a circular arc and this provides clean, relatively abrupt separation between the two.

The blades **19** are accurately fitted to the blade holders **15** while the latter are off the perforator roller **12** so as to provide a particular pitch diameter of the blade cutting teeth relative to the axis of shaft **13**. In practice, a plurality of blade holders could be set up in advance with respective blades providing different pitch diameters and, when necessary to switch the perforator rollers from one pitch diameter cutting blade to another, it is merely necessary to dismount the existing blade holders **15** from sleeves **14** and attach thereto other holders having blades already prefitted for the new desired pitch diameter

The tube former assembly TF comprises a former plate **22** of generally well known type which is configured so that the web will fold over upon itself (as shown in FIG. **12**) to form a tube as said web is drawn along the undersurface of said plate **22**.

The first positive feed rollers **30** are located as far downstream along the former plate **22** as possible, this, however, being limited by the fact that said feed rollers must be located in advance of the final perforator assembly **40** and this latter component must be located at a point along the plate **22** at which the web has not yet been folded over to such an extent as to physically prevent the anvil roller **11'** of the final perforator assembly **40** from contacting the surface of bottom tube layer B'. In other words, the final perforation of nonperforated extend **1'** (see FIG. **12**) must occur before the folding of the web is completed and this determines the furthest downstream position of final perforator assembly **40** and correspondingly of first positive feed rollers **30**.

In order for the anvil and perforator rollers **11'** and **12'** of the final perforator assembly to act upon the web, an opening **23** is provided in plate **22** along the central axis of the tube.

Since the first positive feed rollers **30** are located at a point at which the folding of the web has already commenced, the upper ones of said rollers cannot extend completely across the web since they would then interfere with the upwardly extending only partially folded over top layer sections *t'* of the web (see FIGS. **1A** and **2A**). The first positive feed roller means, therefore, comprises two separate coaxially aligned upper rollers **3** and a pair of axially aligned and spaced apart on a common shaft bottom rollers **3'**, which grip the edge portions of the partially formed tube T therebetween through respective openings **24** and **24'** in the former plate **22**.

Each top feed roller **3** is rotatably mounted on a respective shaft **31** which in turn is pivotally mounted in bearings **32** so that said shaft **31** may pivot about an axis transverse to the axis of rotation of the roller **3**. A spring **33** whose tension is adjustable acts upon shaft **31** to urge the top roller **3** downward into contact with the bottom roller **3'**. The bottom rollers **3'** are positively driven from the main cylinder MC and each top roller **3** is integral with a gear **34** which engages corresponding gears driven by the bottom rollers so that the top feed rollers **3** are both positively driven by the bottom feed rollers **3'** in a 1 to 1 speed ratio. The top and bottom rollers are laterally adjustable to suit different width former plates for making bags of different widths.

The final perforator assembly **40** is analogous, as to basic constructional features, to the main perforator rollers **11** and **12** including the feature of the blade being angled backwardly relative to a radial line. The sleeve **14'** of the final perforator roller could, if desired, carry only one radial arm and blade holder instead of two. In any event, as is seen in FIG. **2A**, the perforator roller **12'** is located below the former plate **22** and coacts with the anvil roller **11'** through the opening **23** in plate **22**. Further, as is seen in FIG. **5**, the perforator roller **12'** carries only one blade **19'** which can be straight or curved in accordance with the desired configuration of thumb recess *r* in the tube bottom layer B' (see FIG. **13**). As is seen in FIG. **13**, the effect of the final perforation is to provide a protrusion *r'* at the opposite end of the bottom layer B' on whose top end the thumb recess *r* is formed. The final perforator anvil roller **11'** may be free running or driver.

It should be noted at this point that the respective blades **19***a* to **19***d* of FIGS. **3** and **1B** include short corner blades **19***y* shaped to provide a slanting line of perforations *y* joining the perforations *a* and *d* of the top layer T' to those *b* and *c* of the bottom layer B'. These slanting lines of perforations *y* ultimately appear in the finished bag (FIG **13**) as trimmed corners and give thereto a very neat, clean look.

The corner blades **19***y* can be separate from or integral with respective ones of the other blades **19***a* to **19***d* and when separate can be interchanged with other similar corner blades to provide differently shaped trimmed corners *y* or corners *y* of different lengths. In the latter instance, the blades **19***a* to **19***d* would be interchanged with other analogous blades of different lengths to compensate for the changed length of blades **19***y* if it were desired to maintain the same bag width. The sleeves **14***a* to **14***d* are themselves slidably adjustable along the length of shaft **13** so that if the bag width were being increased, sleeves **14***a* and **14***d* could be moved further apart from sleeves **14***b* and **14***c*, respectively, and a longer corner blade **19***y* would then be inserted between the sleeves **14***a* and **14***b* as well as between **14***c* and **14***d*. Bags of different width could of course also be produced simply by changing the length of blades **19***a* to **19***d* and without changing the distance between outer blades **19***a* and **19***d* relative to the inner blades **19***b* and **19***c*.

The corner blades **19***y*, when separate from the other blades, are fitted in their own holders which in turn are mounted on the sleeves **14** of the outer blades **14***a* and **14***d*.

Correspondingly, the concave and convex configuration of recess *r* and protrusion *r'* add a finishing aesthetic touch to the bag which it would lack if the line *b*—*c* were straight all the way across. It should be noted that while recess *r* has been disclosed as being arcuately concave, it could have any other desired aesthetic configuration, such as square cornered, serrated, etc. It should also be noted that an important purpose of recess *r* is functional rather than aesthetic. That is, recess *r* facilitates gripping of the bag between the user's thumb and index finger with the thumb being easily slidable between the top and bottom layers, T' and B', to open the bag. Bags of the type disclosed herein usually are relatively difficult to open and may result in a certain amount of fumbling in order to be opened. The provision of an effective opening means such as recess *r* constitutes a significant improvement over heretofore known bags of this type.

Referring to FIG. **1B**, the machine may include free running rollers or flattening arms **25** which assist in completing the flattening of the two folded over sections *t'* of the tube top layer T' with one overlapping the other so that glued edge portion *g* seals the two sections together. Arms **25** may be of relatively heavy flexible material which is free to flex about its point of attachment **25'** to the machine frame F, said arms merely resting upon the tube sections and depending upon their weight to flatten the tube sections *t'*.

The second positive feed rollers **50** also comprise two coaxially aligned upper rollers **5** which grip the tube T against a single bottom roller **5'**. In this regard it will be noted that plate **22** extends all the way up to point Z in FIGS. **1B** and **2B** which is just before the pinch rollers PR. As is seen in FIG. **1B**, the plate **22** is full width up to just before the second positive feed rollers **50** and then is of a narrower width so as to be able to pass between the two upper rollers **5** without interfering with these upper rollers. The narrower width tongue portion **22'** of plate **22** provides positive guiding and support for the tube. Said tongue portion rests upon the lower roller **5'** and extends therefrom in cantilever fashion up to point Z or a support may be provided beneath said tongue in the region between rollers **50** and rollers PR. In any event, the top rollers **5** grip the tube against the bottom roller **5'**. The top rollers **5** are resiliently urged towards the bottom roller **5'** by spring means **51** whose tension is adjustable via means **52**.

The pinch roller assembly PR comprises an upper roller **6** and a lower roller **6'** which coact with each other to grip the tube therebetween. The upper roller **6** is mounted on a rotary shaft **28** which in turn is reciprocable relative to the lower roller **6'** parallel thereto. Normally, the upper pinch roller **6** is maintained spaced from the lower pinch roller **6'** by virtue of adjustable spring means **32** which urges shaft **28** in an upward direction; however, said shaft **28** is periodically pushed downwardly by a means **27** which is driven by cam **27'** which in turn is driven by the main cylinder MC and when this occurs the two pinch rollers **6** and **6'** firmly grip the tube therebetween.

The aforementioned cam means is programmed to permit the top pinch roller **6** to positively grip the tube against the bottom pinch roller **6'** from a time beginning before the pinch bar **70** grips the tube against the main cylinder up until after rupture along the perforation line has occurred. The pinch rollers **6** and **6'** rotate at a slower speed than second feed rollers **50** so that a slack develops in the tube between feed rollers **50** and pinch rollers PR while the latter are gripping said tube. Also, the pinch rollers rotate at a slower surface speed than the main cylinder and pinch bar **70** so that when said pinch bar **70** grips the tube against the main cylinder a bursting tension is created in the tube between the pinch rollers and pinch bar. As has been previously stated, any bursting tension which is transmitted along the tube to upstream of the pinch rollers PR will be absorbed by the previously built up slack between feed rollers **50** and pinch rollers PR so that none of said bursting tension will be transmitted back past the feed rollers **50**.

After bursting of the endmost tube section has occurred, the aforementioned spring means **32** causes the top pinch roller **6** to lift thereby releasing the tube. At this point, belt **33**, which is in frictional contact with a portion of the surface of said main cylinder and is driven by said cylinder to run at the same speed as said cylinder with a portion of said belt also sliding along the top surface of the tube, pushes the tube towards the cylinder at a speed faster than the feed speed of feed rollers **50** so that the aforementioned slack is taken out of the tube. Two analogously driven shorter run belts **34** which also are in frictional contact with the surface of the main cylinder also engage the upper surface of the tube and push it along towards the cylinder. The belts **33** and **34** are passed around various rollers as shown in FIG. **2B**, rollers **80**, **100**, and **101** being positively driven rollers, as also is guide roller **90** which supports the tube thereon. Rollers **80**, **90**, and **101** are in effect slip rollers which contact the tube and urge it towards the main cylinder. Roller **102** is free running.

These belts **33** and **34** serve an important function at this point since, after separation of the front end tube section has occurred, there is no positive pulling force applied to the tube between feed rollers **50** and the main cylinder until pinch bar **70** again grips the tube against said cylinder. Without any positive pulling force, the paper tube has a tendency to bend, buckle, or otherwise fall out of a straight plane of travel. The three belts, therefore, serve to push the tube forward while keeping it straight. In this regard, it should be noted that the belts may slip relative to the tube. Additionally, the belts remain in contact with the paper tube part way around the main cylinder and only release the tube at a point after rupture has occurred and a tucker blade **37** has tucked the bottom end of the bag into the cylinder clamp **36**.

Long run belt **33** passes over a free running pulley **35** mounted on the shaft of feed rollers **5**; however, the feed rollers **5** are driven independently of said pulley.

The pinch bar **70** is unique in that it coacts with the main cylinder directly instead of with another cooperating pinch bar. This is especially important for high speed production since separation of the bag portion from the remaining tube occurs while the bag portion is against the main cylinder and, therefore, said bag does not have to travel over a bottom pinch bar or other rollers before it reaches the main cylinder. In fact, separation or rupture actually occurs substantially at point R in FIG. **2B**.

Pinch bar **70** comprises a rotary shaft from which extends a radial ledge **38**. A removable cover **39** of resilient material is stretch fitted around the outer periphery of said shaft and

ledge An important feature of said pinch bar is the fact that ledge **38** is slightly spiraled along the length of the bar whereby the bar does not grip the tube all at once along its entire width; instead, as the bar rotates the point of gripping moves transversely across the tube The degree of spiral is no less than about one-eighth of an inch per foot of length of the pinch bar **70** and the result thereof is that the bursting tension is applied beginning at one side progressively along the tube width so as to achieve a gradual splitting effect which is very smooth and provides a neat break. This progressive application of tension along the tube width can be analogized to the common practice of store clerks who supply a combined tearing and pulling action when separating a length of wrapping paper from a supply roll. In any event, the action provided by the spiraled pinch bar **70** of this machine is not a pure tearing; it is basically a tension bursting effect carried out in a very smooth and neat manner relative to heretofore applied techniques.

Another significant feature of the machine resides in the fact that the bursting force is applied to a portion of the tube which forms a considerable angle with the remaining portion of the tube. Specifically, the bursting tension is applied to end portion E which bends around corner defining means such as roller **80** so as to form an angle of about 45° with the remaining portion of the tube ahead of said roller **80**.

In known machines the bursting tension is applied to the tube end while it is in a common plane with the remainder of the tube. The arrangement in the present machine whereby the tube end is angled relative to the remainder of the tube results in a smoother and generally better rupturing effect relative to that realized in such known machines.

The drive arrangement of the machine is as follows, reference being had to FIG. **11**.

Power is transmitted from a power source such as an electric motor to the main cylinder MC which drives shaft **104** and which, in turn, is drivingly associated through drive transmission means such as shown in FIG. **11**, with the first and second positive feed roller means **30** and **50**, the pinch roller means PR, the main perforator rollers **11** and **12** and the slip roller **10**, and the final perforator roller **12'**.

It is seen, therefore, that the rotational speed of all the aforementioned rollers is established relative to the speed of a single driving member, namely: the main cylinder, thereby assuring a constant rotational speed relationship between all rollers. This is important since it is essential to good operation that the speed at which the paper travels between successive roller means accurately follow particular speed relationships. Specifically, the paper speed relative to the main and final perforator rollers must be the same in order to assure proper alignment of the final perforations made at **40** with the initial perforations made at MP, and this necessarily means that the surface, that is: the circumferential speed of the two sets of perforation rollers must be the same. Further, it means that the surface speed of the first and second positive feed rollers **30** and **50** must be the same as that of the perforation rollers.

The surface speed of the pinch rollers PR, on the other hand, must be slower than that of the second feed rollers **50** in order to build up the already described slack in the paper between rollers **50** and PR, and it must also be slower than the surface speed of the main cylinder and the pinch bar **70** in order to realize the bursting tension between pinch bar **70** and pinch rollers PR.

The surface speed of the main cylinder as well as of the belts **33** and **34** and of the guide rollers **80**, **90**, **101** must be faster than that of the feed rollers **50** in order to remove any of the aforementioned slack which may remain in the paper after rupture has occurred and the top pinch roller **6** has lifted and released the paper.

In order to accurately maintain the foregoing speed relationships and to avoid any possibility of variations therein, the machine of this invention is disclosed as having all paper driving rollers driven by positive drive means, such as gears or chains and sprockets, from a single driving member, the main cylinder.

The machine of this invention is adapted to produce bags of different widths and also of different lengths. Variations in width are achieved by well known means which involve use of corresponding different width paper webs and former plates **22**. Variations in bag length, however, are realized in a particularly simple and rapid manner in the present machine, keeping in mind the following conditions.

First, the surface speeds of the first and second feed rollers and the circumferential speeds of the blades on the two perforation rollers **12** and **12'** must always be the same relative to each other.

Second, it is desired to provide the same amount of slack per unit of paper length between the feed rollers **50** and the pinch rollers PR for all bag lengths.

Third, the main cylinder of the present machine is arranged to be driven at a constant rotational speed regardless of bag length. This means that the surface speed of the main cylinder and of the pinch bar **70** is always the same for all bag lengths.

In view of the foregoing conditions, in order to change bag length it is necessary to change the lengthwise intervals at which the perforator blades contact the paper without, however, changing the circumferential speed of the perforator blades relative to the surface speed of the feed rollers and this is accomplished as follows:

1. The rotational speed of the first and second feed rollers **30** and **50** and of the pinch rollers PR is changed by an equal amount relative to the rotational speed of the main cylinder. This means that the speed relationships between said feed rollers and between the feed rollers and the pinch rollers remains unchanged.

2. The rotational speed of the two perforation rollers **12** and **12'** is left unchanged relative to the main cylinder but the blade holders are replaced so as to provide blades having a different pitch diameter relative to the preceding blades.

For purposes of illustration only, assuming that it is desired to double the bag length, the rotational speed of feed rollers **30** and **50** and of pinch rollers PR is also doubled so that the paper is made to travel at double its previous speed and the same amount of slack develops between rollers **50** and PR as previously did. Further, the blade holders on the perforation rollers **12** and **12'** are replaced with holders providing blades with double the tooth pitch diameter as the previous blades while the rotational speed of said perforation holders remains unchanged. This means that the circumferential speed of the new blade teeth is doubled and thereby is the same as the doubled surface speed of the feed rollers, but that the blade teeth meet the paper at points therealong which are spaced apart double the previous spacing dimension.

A significant feature of the machine of this invention is the fact that the output capacity (number of bags per minute) is only dependent upon the speed of the main cylinder and is single in any way affected by changes in the bag length. For example, a preferred embodiment of the machine is capable of producing 700 bags per minute of a width of from 4 to 6¼ inches and a length of from 10 to 18 inches, and it will continue to produce 700 bags per minute regardless of whether they are 10 or 18 inches long. The output depends solely upon the main cylinder speed and this is usually arranged to run at a single speed.

The replacement of blade holders **15** and **15'** is a relatively simple and rapid matter according to the construction of the perforator rollers as set forth herein. The changing of the rotational speeds of the two feed roller means and of the pinch rollers is also a very simple matter because of the novel drive arrangement which is as follows, with reference to FIG. **11**, wherein a preferred embodiment of realization is illustrated.

The main cylinder MC is driven from an external power source such as an electric motor and from said cylinder all other components of the machine are driven. Specifically, the cylinder MC drives a bevel gear set **106** which in turn drives a countershaft **116** which runs longitudinally along the machine from the location of the main cylinder up to the area of the main perforator stand. Integral with the main cylinder along one edge thereof is a ring gear **105** which engages gear **128**

which is integral with one end of rotary shaft **104** at whose opposite end is secured the main change gear **107** which in turn engages with an intermediate gear **108** which engages the gear **109** rigidly mounted on the shaft of the lower one **5'** of the second positive feed rollers **50**. A gear **110** rigidly mounted on the shaft of roller **5'** engages a gear **111** rigidly mounted on the shaft of lower pinch roller **6'**, the lower and upper pinch rollers **6'** and **6** being geared together through gears **112**. In this regard, it should be noted that the up and down reciprocations of upper pinch roller **6** under the action of spring **32** and cam means **27** is only in the order of one thirty-second of an inch so that gears **112** do not disengage when upper pinch roller **6** is lifted by said spring. The upper pinch roller **6** does not necessarily contact the bottom pinch roller **6'** at the same circumferential location on the upper pinch roller every time the upper pinch roller is moved downwardly by the cam, this serving to spread the wear evenly over the upper pinch roller surface.

A sprocket gear **113** rigidly mounted on the shaft of lower feed roller **5'** drives a chain **114** which in turn drives a sprocket wheel **115** rigidly mounted on the shaft of lower first feed roller **3'**.

The thus far described drive arrangement clearly is such that during operation a constant speed relationship is maintained between the first and second feed rollers **30** and **50**, the pinch rollers PR, and the main cylinder MC. In order to change the speed relationship of the feed rollers **30** and **50** and of the pinch rollers relative to the main cylinder without changing the speed relationship of the two feed roller means **30** and **50** relative to each other or relative to the pinch rollers PR, it is only necessary to replace the change gear **107** with a different sized one. To accommodate different sized change gears **107**, the intermediate gear **108** is adjustably mounted in accordance with any well known means.

Returning to the drive arrangement in FIG. **11**, it is seen that shaft **116** drives a second bevel gear set **118** which in turn drives a countershaft **119**, which, in turn, rigidly carries two sprocket wheels **120** and **121**. Wheel **120** drives sprocket wheel **122** which is rigidly mounted on the shaft of the final perforator roller **12'** through a chain **123** while wheel **121** drives wheel **124** rigidly mounted on the shaft of main perforator roller **12**. This last shaft rigidly carries a second change gear **125** which drives the main anvil roller **11** and the slip roller **10** through respective gears **126** and **127**.

From the thus described drive arrangement it is clear that a constant rotational speed relationship is assured between the two perforator rollers **12** and **12'** as well as between these rollers and the main anvil roller **11** and the slip roller **10** without there being any possibility of the speeds of these rollers or the relationship of one relative to the other being disturbed by changes in the rotational speeds of the feed roller means **30** and **50** and the pinch roller means PR.

The shaft of main perforator roller **12** is vertically adjustable on stand S whereby its axis of rotation may be moved towards or away from the axis of anvil roller **11** in accordance with perforator blades of different pitch diameter being mounted on roller **12**. Accordingly, the second change gear **125** is replaceably mounted on the shaft **13** of the main perforator roller **12** since a change in blade pitch diameter necessitates a different diameter change gear **125** to correspondingly alter the rotational speed of anvil roller **11** and slip roller **10**.

Gear **127** is removably mounted on the shaft of slip roller **10** since, as previously stated, said roller **10** need not be positively driven when papers having particular tensile strength are employed.

To summarize, whenever it is desired to change the length of bags being produced by the machine of this invention, it is only necessary to:

1. replace main change gear **107**;
2. replace second change gear **125**; and,
3. replace the blade holders **15** and **15'** on the main and final perforator rollers **12** and **12'**.

Significantly absent herefrom is any requirement that a change in bag length necessitates a change of either a pinch roller PR or the pinch bar **70** as is commonly the situation in many known machines. According to the present invention, the pinch bar **70** and rollers PR remain permanently on the machine regardless of changes in bag length.

The amount of slack which is developed in the paper extending between feed roller means **50** and pinch rollers PR is illustrated by the following approximate data relating to a particular machine: gear **110** has a pitch diameter of 3 inches and comprises eighteen teeth while gear **111** has a pitch diameter of 2 15/16 inches and comprises 20 teeth, the center to center distance between rollers **5'** and **6'** being 6 11/16 inches, the aforementioned pitch diameters corresponding to the surface diameters of the respective rollers to which said gears are attached.

The particular most desirable amount of slack can depend upon such factors as the speed of the main cylinder and the type of paper being used, it being understood that the inventive concept does not depend upon a definite and precise figure being given in this regard.

In order to realize most efficient operation of the machine, it has been found that the top feed rollers **3** and **5** should be positively driven by the bottom rollers **3'** and **5'** through gears and that the top rollers **3** and **5** should be slightly larger in diameter than the related bottom feed rollers **3'** and **5'**, this possibly being related to the fact that the paper stretches to a different degree along its top layer T' relative to its bottom layer B'.

The final perforator anvil roller **11'** may be either positively driven, such as through gears associated with the perforator roller **12'**, or roller **11'** may be free running.

It was previously mentioned that the blade teeth of the perforator rollers penetrate into the resilient surface covering of the anvil rollers. In this regard, it is to be noted that the pitch circle of the blade teeth should generally be tangent to the surface of the anvil roller with adjustment being made if necessary to accommodate the thickness of the bag material W which passes between the perforator and anvil rollers. This means that the tips of the blade teeth circumscribe an arc about the axis of the perforator roller which overlaps the circular arc defined by the surface of the anvil roller about its axis. Said tips, therefore, first contact the anvil roller surface at the point that the respective arcs first intersect and said tips then progressively penetrate into the anvil roller surface generally up to the depth of the pitch circle of said teeth and then progressively depart from said surface.

In order to obtain as clean a separation as possible of said teeth from the anvil roller surface as well as from the bag material they should preferably move perpendicularly away from the anvil surface as well as the bag material into both of which said teeth have penetrated. If the blade teeth were radially disposed relative to the perforator axis, they would progressively incline towards a parallel disposition relative to the anvil surface and the bag material as said teeth rotated away from the point at which maximum penetration occurs, and such progressive inclination of the teeth would cause them to grip beneath either one or both the anvil surface and the bag material. This characteristic is manifested by the bag material being lifted away from the anvil roller surface as the blade rotates away therefrom and may result in a tearing of said material along the perforations. Furthermore, the life of the resilient material on the anvil roller may be shortened from a corresponding tearing or gouging thereof by said teeth.

The inclined arrangement of the blade as set forth herein relative to a radial line from the perforator roller axis results in said teeth pulling out of the bag material and out of the anvil roller surface along a generally perpendicular direction thereby providing a clean separation and consequently a neatly defined line of perforations in the bag material.

The main perforator roller has been shown herein as including two sets of blades diametrically opposite to each other while the final perforator roller has been shown with only one

blade station. It is to be noted, however, that each perforator roller may be designed to include any number of blade stations provided that the speed relationship of the perforator rollers is correspondingly adjusted relative to the feed rollers.

An important feature of the resulting bag itself is that the inclusion of the thumb recess *r* makes it possible to shorten the height of lip *f*. An important function of lip *f* is to provide the user with a handy gripping edge for opening the bag, it being relatively difficult to open this type bag since the two layers thereof generally tend to stick together. The thumb recess *r* effectively lengthens the overall height of said lip thereby enhancing the opening function thereof and making it possible to actually shorten said lip relative to bags which do not include such a recess *r*. When it is considered that bags are produced by the many thousands, even a saving of one-eighth of an inch in the height of lip *f* will be seen to represent a significant cumulative saving of paper.

Additionally, recess *r* and its complementary portion *r'* at the bottom of the bag serve a decorative purpose. In this regard, recess *r* need not be continuously arcuately concave as illustrated but can follow a rectilinear squared pattern, a wavy pattern, or conform to any other design for aesthetic purposes or to provide distinctiveness so as to identify the bags of one manufacturer or merchandiser relative to another.

The bag making material of which web W is composed may be paper or any other suitable flexible material such as glassine, foils, plastics, and synthetics. The term "paper" as used herein is only intended to identify a typical bag material.

It is furthermore to be noted that the machine need not necessarily seal the bottom end of each tube section which is received upon the main cylinder. Often the tube sections may be left open at both ends thereof and sold to a purchaser in that condition. It is not an essential part of this invention, therefore, that the machine produce closed-bottom bags.

As previously noted, in various known bag making machines the element which is the counterpart of pinch bar **70** of this machine is located ahead of the main cylinder, and, since rupture occurs at a point ahead of the pinch bar, after each rupture occurs the tube must jump past the pinch bar in order to reach the main cylinder and this constitutes a serious disadvantage which often results in a disruption of the smooth flow of the bag material through the machine with a backup occurring in the vicinity of such known pinch bars. This disadvantage is avoided according to the machine of this invention.

It is also to be noted that in various known machines a pinch roller is driven from the main cylinder while the second feed rollers are driven by the main change gear so that a changing of said change gear would result in a changing of the speed relationship between the second feed rollers and the pinch roller and a consequent change in the tube slack therebetween. Any change in the amount of tube slack can affect the operation of the entire machine adversely and would, therefore, require extensive and time consuming adjustments and changing of parts, which inconvenience is entirely avoided according to the present machine.

The herein presented specific details of preferred embodiments of realization of the various aspects of the invention are not intended to be limitative of the scope of the claims as filed originally or subsequently by way of amendment, such details being intended to be illustrative rather than limitative of the scope of the invention, it being intended to cover within the scope of the claims all equivalents, substitutions, or modifications relative to the present disclosure which are obvious or well within the purview of one skilled in the art.

I claim:

1. A machine for making bags of the type commonly called flats and squares, notion or millinery bags, comprising: a tube former for folding a flat bag material into the form of a continuous flat tube, a first perforator means located in advance of said former, a second perforator means located along the extent of said former at a point corresponding to said web having been folded over into tube form to a considerable extent but before completion of such folding, a tension applying means located after said former and being for applying a tension to said tube on opposite sides of a line of perforations thereacross made by said perforator means whereby rupture of said tube occurs along said line of perforations, said first and second perforator means each being arranged to perforate said web in a transverse direction along respective mutually exclusive extents of its width so as to form in combination a continuous line of perforations across the entire width of said web.

2. The machine of claim **1**, said former comprising a former plate having an upwardly extending heel at its front end and an elongate portion extending therefrom in the direction of travel of said web, an opening in said elongate portion, said second perforator means comprising a perforator roller and an anvil roller rotatively mounted about respective axes above and below said plate and cooperating with each other through said opening, a first positive feed roller means located ahead of and in close proximity to said second perforator means and comprising an upper and lower feed roller means rotatively mounted about respective axes above and below said plate and cooperating with each other through a corresponding opening in said plate.

3. The machine of claim **2**, said upper first feed roller means comprising two coaxially aligned and transversely spaced apart upper rollers located closely adjacent the lateral edges of said plate, the last mentioned opening comprising an opening in said plate for each of said upper feed rollers, said upper feed rollers being engageable with said lower feed roller means through said opening.

4. The machine of claim **2**, said second perforator means being aligned along the longitudinal middle axis of the machine said upper first feed rollers being symmetrically aligned on opposite sides of said longitudinal axis.

5. The machine of claim **1**, said first perforator roller and a main anvil roller cooperatively associated with each other and mounted about mutually parallel axes on a common stand, said stand being adjustable transversely to the longitudinal direction of travel of said web through the machine.

6. The machine of claim **2**, said first perforator means comprising a main perforator roller and anvil roller mounted about mutually parallel axes and cooperatively associated with each other for perforating said web, the perforator rollers of said first and second perforator means each comprising a rotary shaft having a toothed perforator blade mounted thereon for rotation therewith, means mounting said blade on said shaft whereby the pitch diameter of the blade teeth relative to a particular said shaft may be changed at will, the outermost arc of said teeth intersecting the circumferential arc of said anvil roller.

7. The machine of claim **6**, said perforator rollers each comprising a blade holder removably mounted on each of said shafts for easy interchange with other analogous holders, a said blade being mounted in said holder to provide a particular pitch diameter of the blade teeth.

8. The machine of claim **6**, said perforator and anvil rollers being parallelly displaceable relative to one another in order to accommodate different ones of said blades having different pitch diameters.

9. The machine of claim **6**, the perforator blade on each said perforator roller being a flat blade which in end view lies in a plane which is nonradial relative to the rotational axis of the perforator roller and which forms an acute angle with a straight line interconnecting the axes of said perforator roller and the corresponding anvil roller at a point between the perforator roller axis and said outermost arc at the moment that the blade teeth first intersect the circumferential arc of the anvil roller.

10. The machine of claim **9**, said angle being in the order of 15 to 45°.

11. The machine of claim **6**, said main perforator roller comprising a plurality of coaxially aligned sleeves which are rotatively and axially adjustable relative to each other on said shaft, a blade holder removably mounted on each said sleeve,

said holder being interchangeable on said sleeve with other analogous holders.

12. The machine of claim 6, wherein said main perforator roller and main anvil roller are drivingly interconnected by a gear on the main perforator roller interengaging a gear on the main anvil roller, one of said gears being removably mounted on its corresponding roller in order to permit interchange with other sized gears so as to compensate for a change in the pitch diameter of said blade teeth.

13. The machine of claim 1, said first perforator means comprising a main perforator and a main anvil roller mounted about mutually parallel axes for cooperation with each other to perforate said web, a slip roller mounted parallel to the main anvil roller and ahead thereof relative to the travel of said web through the machine, gear means drivingly interconnecting said slip roller with said main anvil roller.

14. The machine of claim 1, including a main cylinder rotatively mounted at one end of the machine for rotation in the direction of web travel through the machine, said cylinder being adapted to carry bag length portions of said tube along its circumferential surface past a tucker bar and to a bag receiving station at the outlet end of the machine, said tension applying means comprising a rotary pinch bar operatively associated with said cylinder so as to periodically provide an interface therebetween to grip said tube between said bar and cylinder and thereby advance said tube in said direction of travel, a tube restraining means located ahead of said cylinder and bar and being adapted to restrain said tube relative to the speed of advance imparted thereto by said cylinder and bar whereby a tensile force is imparted to said tube in the extent thereof between said restraining means and said bar and cylinder.

15. The machine of claim 14, said restraining means comprising a pinch roller assembly including an upper and lower pinch roller for gripping said tube therebetween and for advancing same towards said main cylinder at a speed lower than the speed imparted to said tube by said cylinder and pinch bar, control means for periodically separating said pinch rollers relative to each other to an extent sufficient for them to release the tube which is therebetween.

16. The machine of claim 14, further including a positive feed roller means for advancing said tube from said second perforator means towards said restraining means, said positive feed roller means being located at a distance from and ahead of said restraining means, control means to periodically cause said restraining means to successively grip and release said tube, the advance of said tube being restrained by such gripping relative to said main cylinder and relative to said feed rollers, said control means being timed to effect gripping of said tube by said restraining means for a period of time just prior to and during the aforementioned periodic gripping of said tube by said pinch bar whereby a slack develops in said tube in the longitudinal extent thereof between said feed rollers and said restraining means before said tube is gripped by said pinch bar.

17. The machine of claim 16, wherein said restraining means comprises an upper and a lower pinch roller for gripping said tube therebetween, and thereby advancing said tube from said feed rollers toward said main cylinder, said control means being adapted to periodically separate said pinch rollers from each other so as to release the tube therebetween and successively to bring said pinch rollers together so as to grip the tube therebetween, said pinch rollers being driven and being adapted to advance said tube during the aforementioned gripping thereof at a speed slower than the speed imparted thereto by said feed rollers.

18. The machine of claim 17, said feed rollers being driven at a speed so as to advance said tube at a slower speed than the speed of advance imparted thereto by the pinch bar and main cylinder.

19. The machine of claim 14, including a corner defining means mounted adjacent to said main cylinder between said restraining means and said pinch bar, said pinch bar being arranged relative to said main cylinder whereby an angle path for the tube is defined leading from said restraining means around said corner means and to the interface between said pinch bar and said main cylinder.

20. The machine of claim 19, wherein said corner means is a slip roller.

21. The machine of claim 14, wherein said pinch bar comprises a tube gripping surface which periodically passes adjacent to the surface of said main cylinder pursuant to rotation of said bar and thereby defines said interface, said tube gripping surface being spiraled relative to the axis of rotation of said main cylinder.

22. The machine of claim 21, said pinch bar and main cylinder being rotatively mounted about mutually parallel axes and said gripping surface on said bar being spiraled relative to the axis of said bar.

23. The machine of claim 14, wherein said pinch bar comprises a rotary shaft having a radially extending protrusion which is continuous along the shaft length and which defines an outer peripheral edge of limited circumferential extent, said edge periodically meeting the surface of said main cylinder to grip said tube therebetween.

24. The machine of claim 23, said edge being spiraled along the axial extent of said pinch bar shaft.

25. The machine of claim 23, wherein said pinch bar includes a cover of flexible material tightly fitted around the periphery of said pinch bar shaft and said peripheral edge, said cover being replaceably fitted on said shaft.

26. The machine of claim 16, including a driven belt means arranged to travel from said restraining means towards said main cylinder adjacent to the tube path defined between said restraining means and said cylinder, said belt means being adapted to slidingly engage a surface of the tube and thereby urge same towards said cylinder.

27. The machine of claim 26, said belt means including a belt which extends from the location of said positive feed rollers towards said main cylinder.

28. The machine of claim 26, said belt means extending along a portion of the surface of said main cylinder to a point beyond the location of said pinch bar, said belt means extending between said pinch bar and the surface of said main cylinder.

29. The machine of claim 28, said belt means being driven at a surface speed equal to that of said main cylinder.

30. A bag making machine of the type having a main cylinder assembly for receiving a flat tube of bag material along the outer circumferential surface of a rotary cylinder and tucker means cooperatively associated with said cylinder for forming a closed bottom end on said tube, said machine comprising a severing means for successively dividing said tube into preestablished bag lengths, said severing means including:

a. a means for establishing a continuous line of weakness transversely along both layers of the tube width at successive locations along the length of said tube;

b. a tube feed means for advancing the continuous tube with said lines of weakness therein towards said main cylinder at a first speed of advance; and

c. a rotary pinch bar operatively associated with said main cylinder for periodically meeting same and gripping the tube thereagainst and thereby pulling it away from said feed means at a faster speed than said first speed whereby the tube portion along the main cylinder severs from the tube portion extending between said feed means and said main cylinder along a one of said lines of weakness, said pinch bar having a spirally extending surface along the axial extent thereof whereby as said bar rotates said surface meets the surface of said main cylinder progressively along the axial direction of said bar so that a said tube is correspondingly gripped between said surfaces progressively across its width.

31. The machine of claim 30, including a corner defining means along the tube path extending from said feed means to

the point at which said pinch bar meets said cylinder, said feed means together with said corner means and said pinch bar defining an angled tube path whereby said pinch bar and cylinder exert a pulling force to a portion of the tube which extends from said pinch bar to said corner means and which is angled relative to a following portion of the tube which extends back from said corner means to said feed means

32. A bag making machine of the type having a main cylinder assembly for receiving a flat tube of bag material along the outer circumferential surface of a rotary cylinder and tucker means cooperatively associated with said cylinder for forming a closed bottom end on said tube, said machine comprising a severing means for successively dividing said tube into preestablished bag lengths, said severing means including:

a. a means for establishing a continuous line of weakness transversely along both layers of the tube width at successive locations along the length of said tube;

b. a tube feed means for advancing the continuous tube with said lines of weakness therein towards said main cylinder at a first speed of advance;

c. a rotary pinch bar operatively associated with said main cylinder for periodically meeting same and gripping the tube thereagainst and thereby pulling it away from said feed means at a faster speed than said first speed whereby the tube portion along said main cylinder severs from the tube portion extending between said feed means and said main cylinder along a one of said lines of weakness;

d. wherein said feed means comprises a positive feed roller means for advancing said tube towards said main cylinder and a restraining means spaced from said feed roller means and located between same and said main cylinder, said restraining means being adapted to periodically restrain the travel of the tube relative to the pulling force imparted thereto by said pinch bar and main cylinder; and

e. wherein said restraining means is also adapted to restrain the tube relative to the feed speed imparted thereto by said feed roller means, whereby a slack develops along the extent of said tube between said feed roller means and said restraining means.

33. The machine of claim 32, wherein said restraining means is arranged to exert the aforementioned restraint upon said tube for a period of time commencing prior to said pinch bar meeting said main cylinder to grip the tube thereagainst until after the pinch bar has rotated to a point whereby it releases the tube relative to said cylinder, said restraining means being arranged to then release said restraint upon said tube, and including slip feed means between said feed roller means and said main cylinder for advancing the tube towards the main cylinder at a speed higher than the feed speed of said feed roller means.

34. A bag making machine comprising a means for advancing a bag material along a path of travel from the inlet to the outlet end of said machine, said means comprising in succession from said inlet end to said outlet end: a main perforator roller and associated anvil roller; a tube former plate; a first positive feed roller means located along the length of said tube former plate; a final perforator roller and associated anvil roller located along the length of said tube former plate immediately behind said first feed roller means; a second positive feed roller means; a pinch roller means; a main cylinder and a pinch bar operatively associated therewith for gripping the bag material therebetween; said main perforator and anvil rollers being adapted to transversely perforate a portion of the width of the bag material; said first feed roller means being adapted to draw the bag material off a freely rotatable supply roll, over said main anvil roller, and along a portion of said former plate; said final perforator roller and anvil roller being adapted to transversely perforate the remaining portion of the width of said material so as to form a continuous line of perforations across the entire width of said material; said second feed roller means being adapted to draw the bag material along said plate from said first feed roller means and to advance it towards said pinch roller means at the same speed as said first feed roller means advances said material; said pinch roller means being adapted to periodically engage said bag material and advance same at a slower speed than said second feed roller means; said main cylinder and pinch bar being adapted to periodically grip the bag material therebetween and advance it at a faster speed than either said pinch rollers or said second feed rollers; and including control means to cause said pinch rollers to successively engage and release said bag material.

35. The machine of claim 34, including a slip roller ahead of said main anvil roller, said slip roller being positively driven by said anvil roller.

36. The machine of claim 34, including a drive arrangement wherein said main cylinder is rigidly drivingly interconnected with said pinch bar, with said first and second feed rollers and said pinch roller means, and with said main and final perforator rollers whereby the rotative speed of said main cylinder determines the rotative speed of the aforementioned drivingly interconnected components with no slippage of either of the components being possible relative to said main cylinder.

37. The machine of claim 36, wherein said main cylinder is drivingly interconnected with the first and second feed rollers and the pinch roller means through a first positive transmission train and with the main and final perforator rollers through a second transmission train which is independent of the first train, whereby a change in said first train can be effected to change the rotative speeds of said first and second feed rollers and of said pinch roller means relative to said main cylinder without changing the rotative speeds of said main and final perforator rollers relative to said main cylinder.

38. The machine of claim 37, wherein the driven components in each of said trains are each rigidly drivingly interconnected whereby the rotative speed of any one component in any train necessarily is fixed relative to the rotative speed of all other components in that same train.

39. The machine of claim 38, wherein said first train comprises a main change gear replaceably mounted between said main cylinder and one of the components of said first train, whereby replacement of said change gear by one of different size automatically changes the rotative speeds of all first train components relative to said main cylinder without disturbing the speed relationship between any two first train components.

40. The machine of claim 39, wherein said main and final perforator rollers carry perforator blades the pitch diameter of which is changeable, each perforator and anvil roller being so mounted whereby the distance therebetween is adjustable in accordance with a change in said pitch diameter.

41. The machine of claim 40, including a second change gear replaceably mounted in driving relationship between said main perforator roller and said main anvil roller whereby the rotative speed of said main anvil roller may be changed in accordance with a change in said pitch diameter.

42. The machine of claim 40, wherein said final anvil roller is free running.

43. The machine of claim 41, wherein said main anvil roller is drivingly connected with said final anvil roller whereby a changing of said second change gear automatically changes the rotative speed of both anvil rollers without altering the rotative speed relationship therebetween.

44. The machine of claim 37, said first and second feed rollers comprising respective powered lower rollers and corresponding upper rollers which are geared to the lower rollers, said upper rollers being slightly larger in diameter than the corresponding lower rollers.

45. The machine of claim 37, wherein said pinch roller means comprises an upper and a lower pinch roller, a gear integral with each of these last mentioned rollers, the gear on one engaging the gear on the other, said pinch rollers being parallelly reciprocable relative to each other to a maximum extent which is considerably less than the depth of the teeth on said pinch roller gears.

46. The machine of claim 45, including a spring means urging said pinch rollers apart and a driven cam which periodically urges said pinch rollers towards each other.