United States Patent [19]

Jespersen et al.

[11] **3,739,965**

[45] **June 19, 1973**

[54] **DISPENSER FOR FLEXIBLE SHEET MATERIAL AND A PERFORATING MECHANISM ADAPTED TO BE USED THEREIN**

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[73] Assignee: **Georgia-Pacific Corporation**, Portland, Oreg.

[22] Filed: **Jan. 6, 1971**

[21] Appl. No.: **104,415**

Related U.S. Application Data

[62] Division of Ser. No. 793,808, Jan. 24, 1969, Pat. No. 3,575,328.

[52] **U.S. Cl.** **225/96**, 83/334, 83/337, 83/660, 83/678, 225/96, 225/106

[51] **Int. Cl.** **B26f 3/02**

[58] **Field of Search** 225/2, 4, 96, 100, 225/101, 106; 83/334, 335, 660, 678, 332, 345

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Primary Examiner—J. M. Meister

Attorney—Birch, Swindler, McKie & Beckett

[57] **ABSTRACT**

A mechanism for perforating a web of flexible sheet material which is adapted to be used in a flexible sheet material dispenser, said mechanism comprising; a rotatably mounted roller, a rotatably mounted knife positioned adjacent the roller and having a radially outward portion defining a cutting edge for perforating the web as the web passes between the roller and the knife, the roller being operatively connected to the knife for synchronous rotation therewith and having a slot therein for receiving the radially outward knife portion as the knife rotates past the roller, and means associated with the knife for orienting the cutting edge substantially in the direction in which the radially outward knife portion moves with respect to the web during the entrance of the portion into the slot so that when the portion enters the slot the cutting edge will effectively perforate the web.

9 Claims, 23 Drawing Figures

United States Patent [19] [11] **3,739,965**

Jespersen et al. [45] **June 19, 1973**

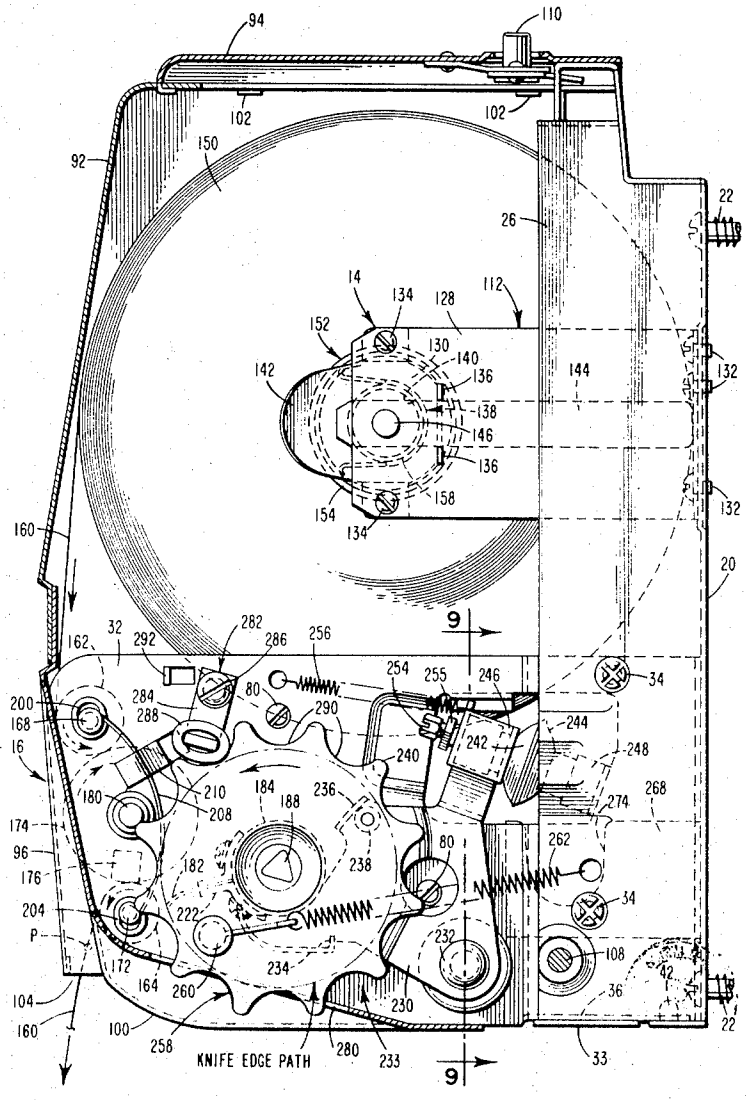


FIG. 2

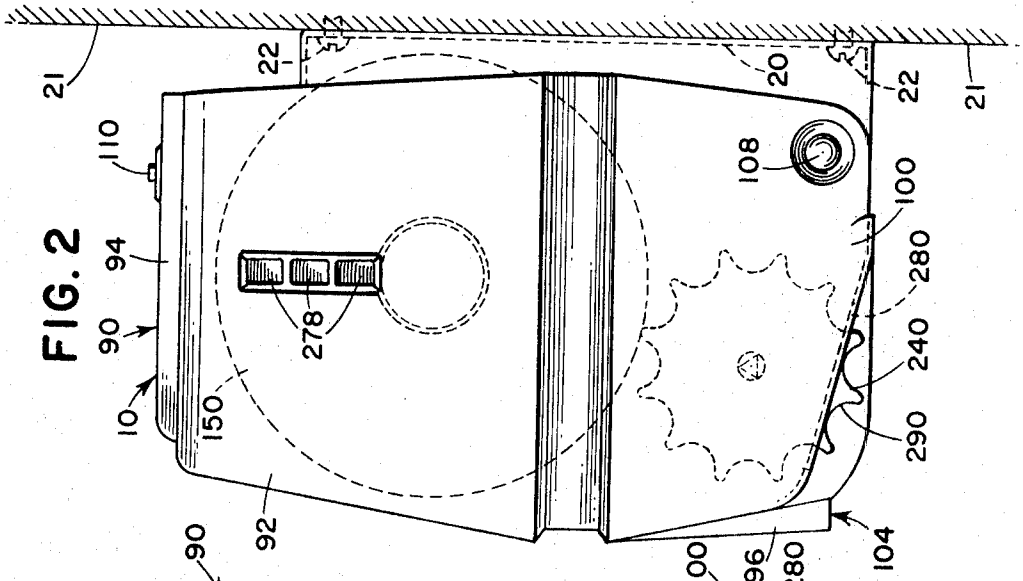
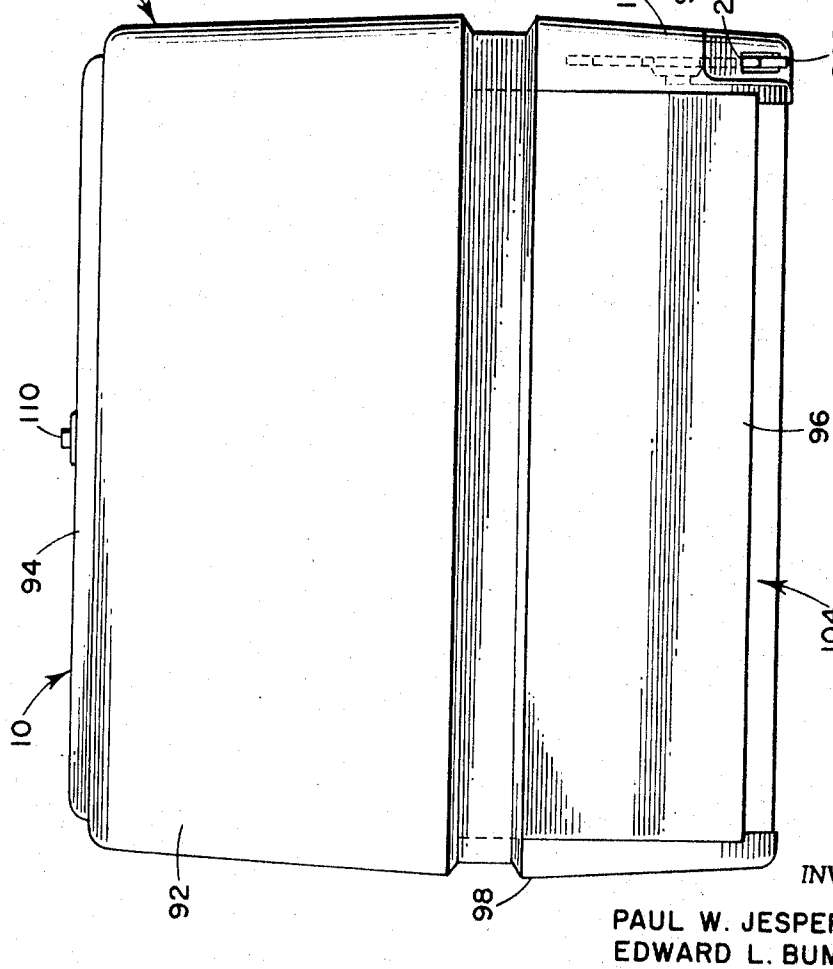


FIG. 1



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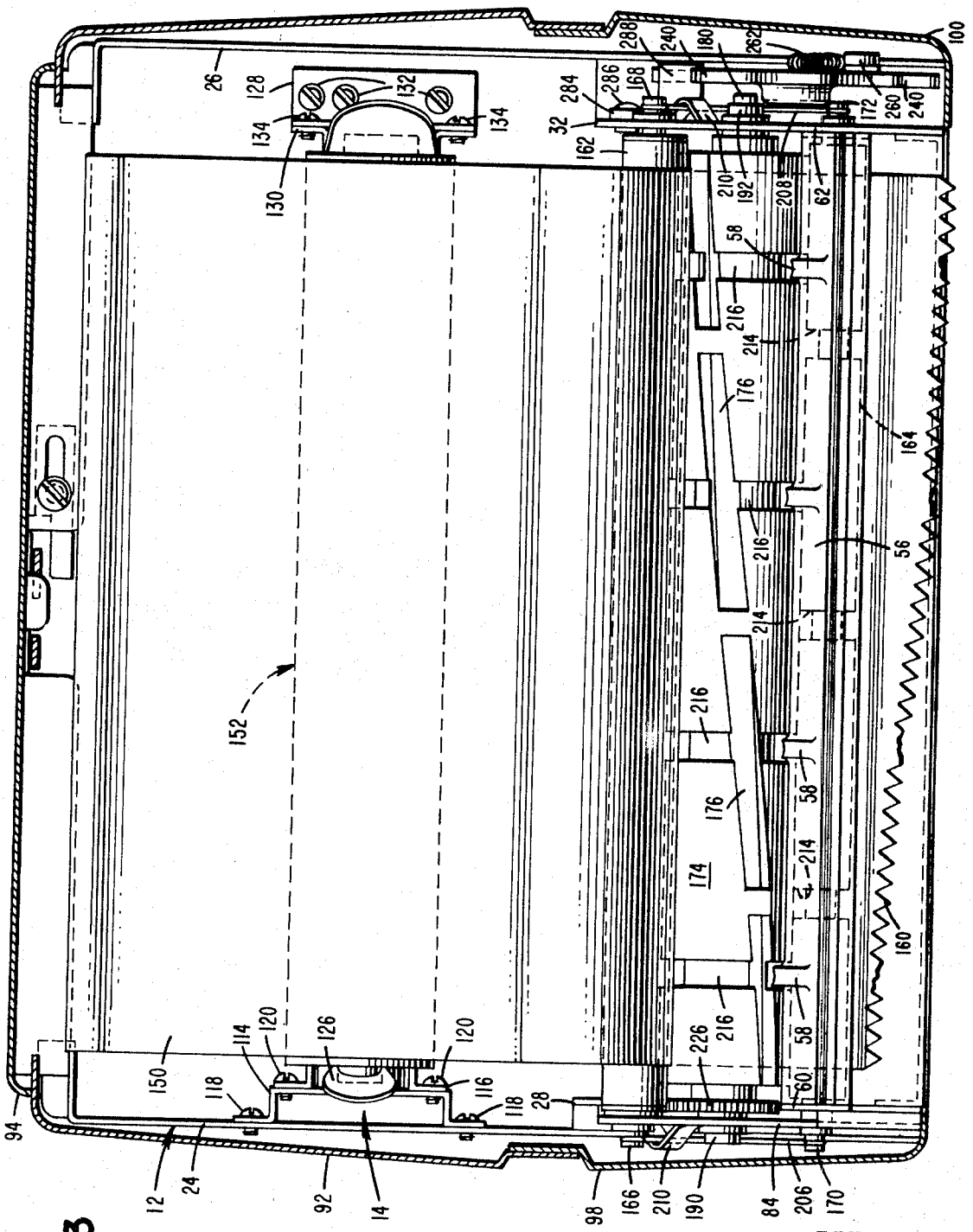


FIG. 3

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FIG. 4

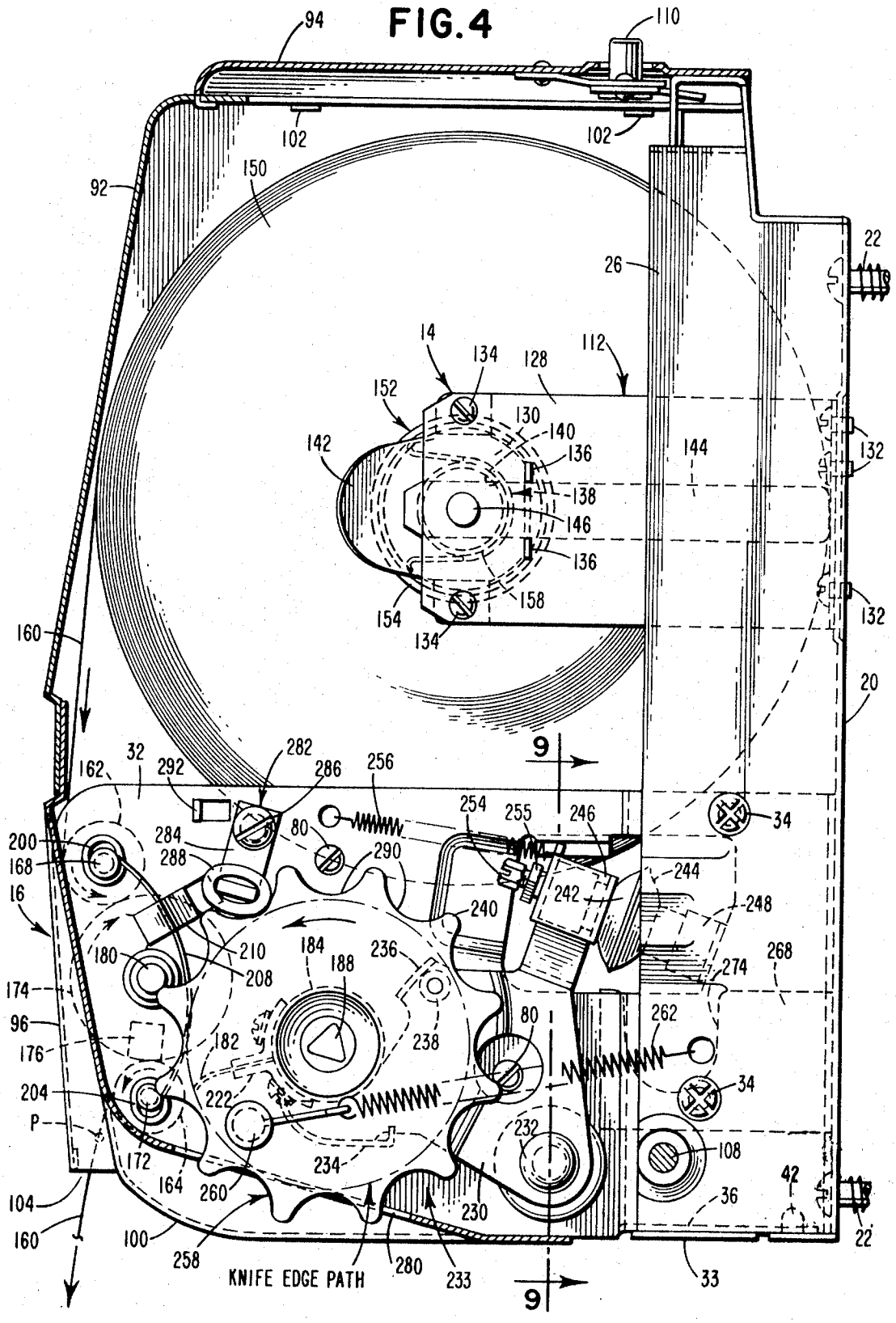
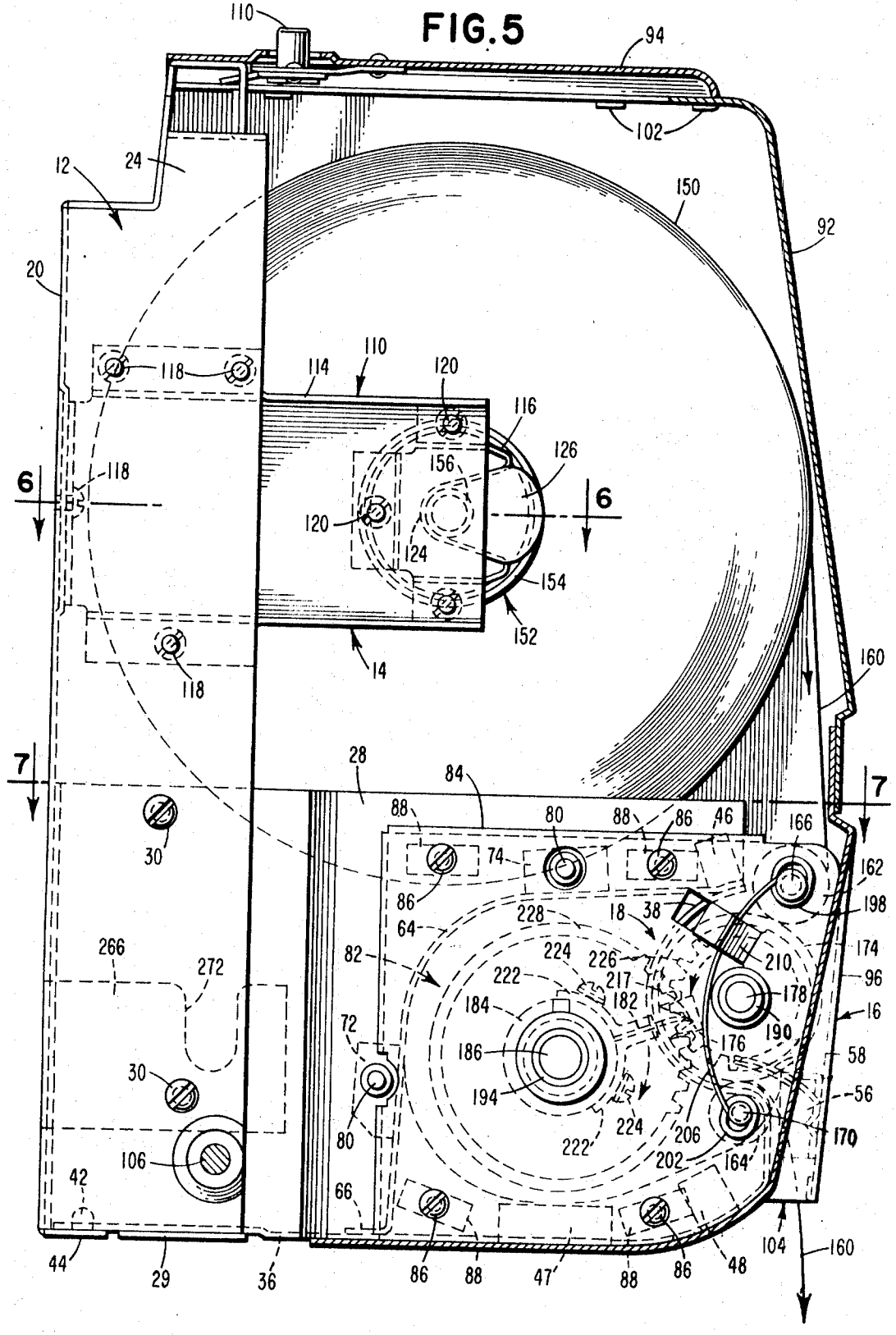

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FIG. 5


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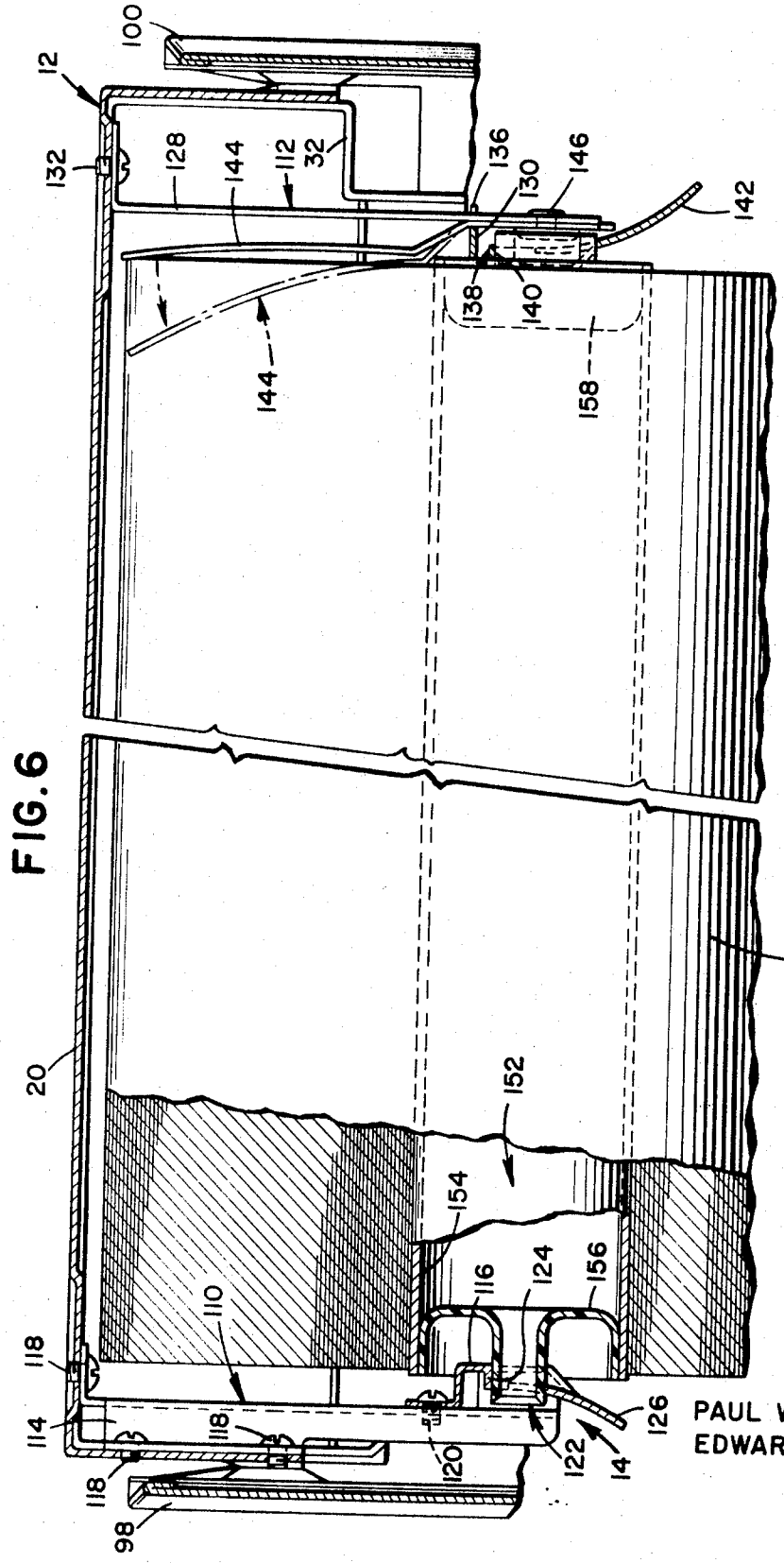


FIG. 6

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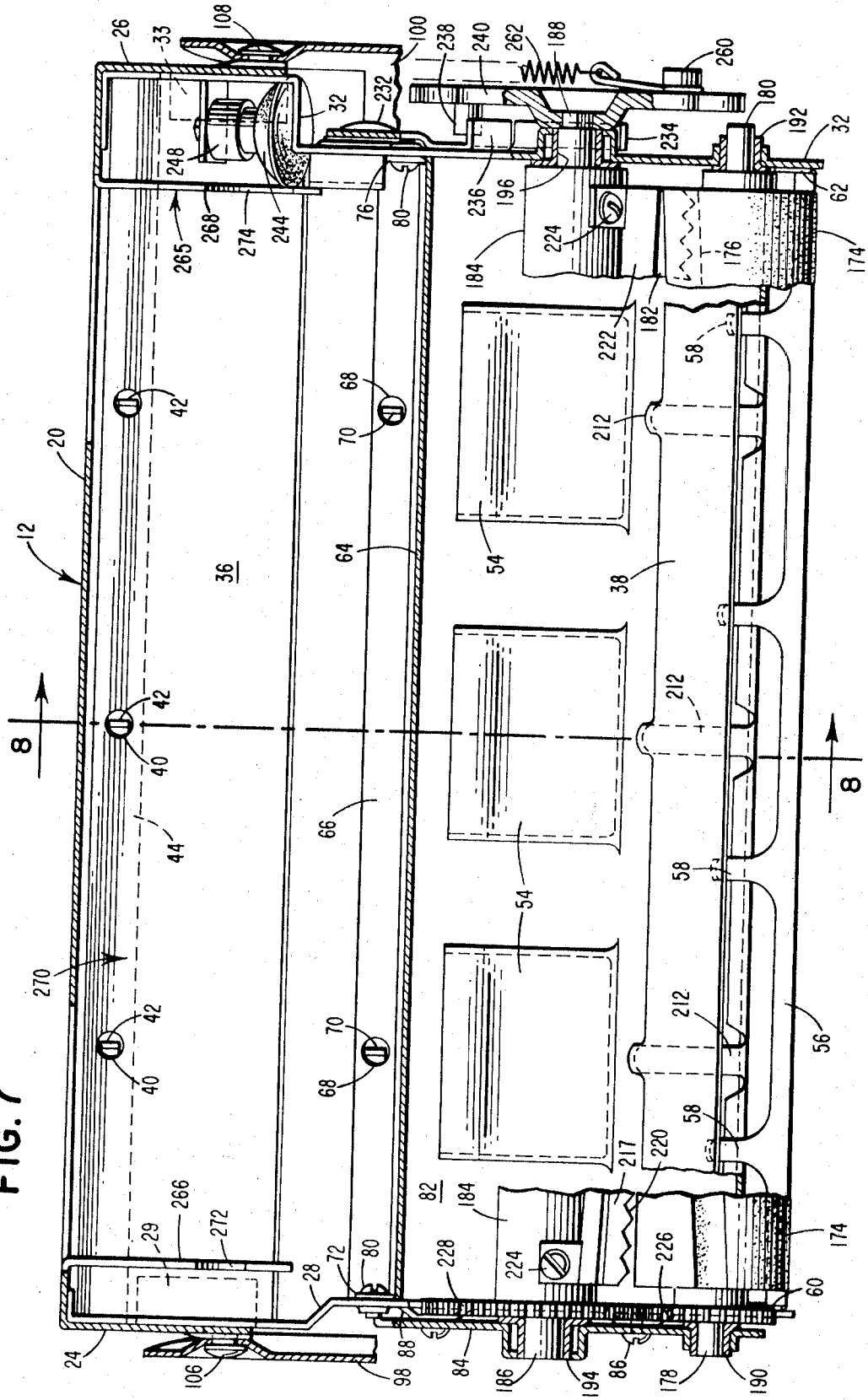

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FIG. 7

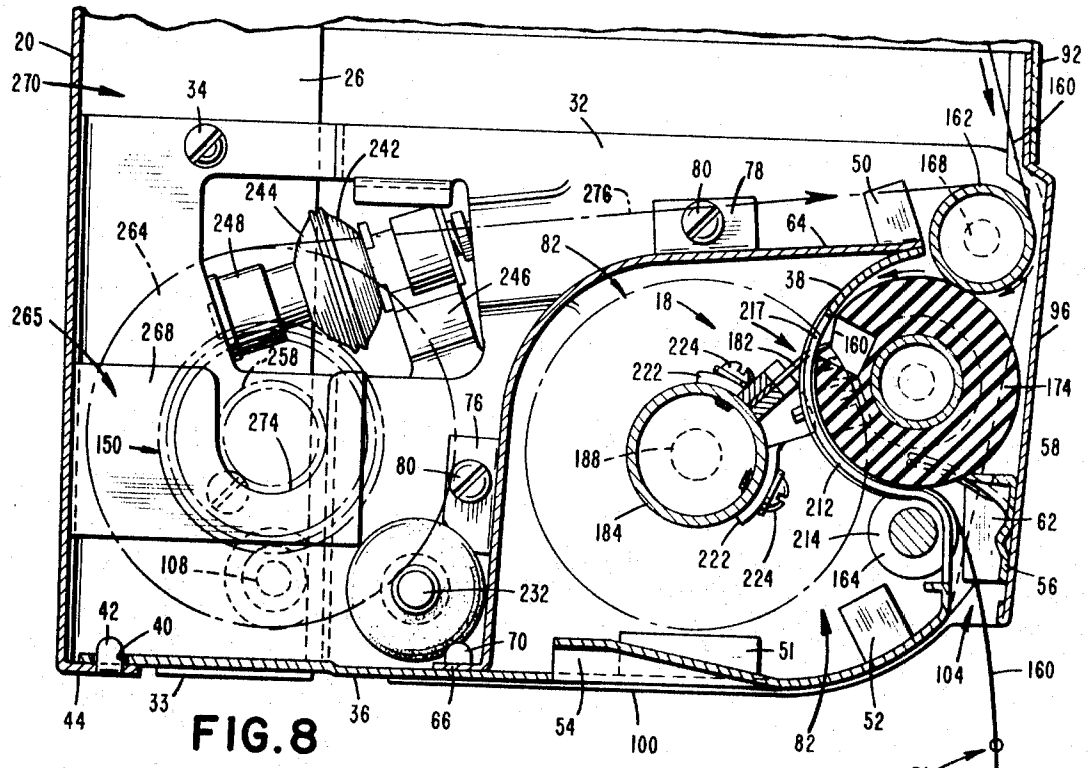
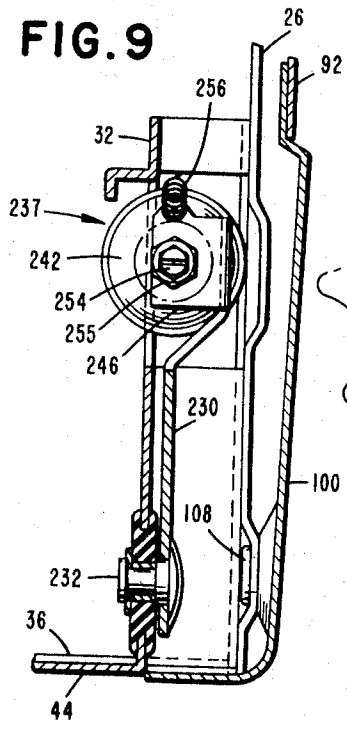


FIG.8

FIG.9



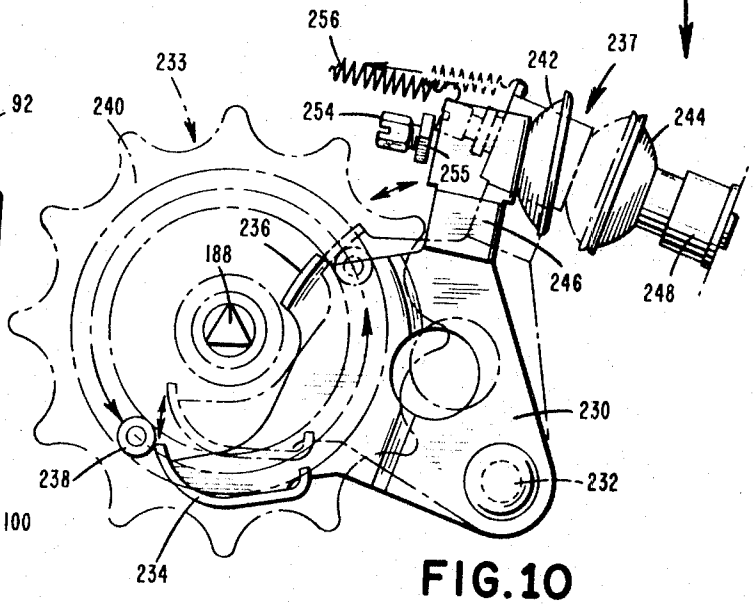


FIG.10

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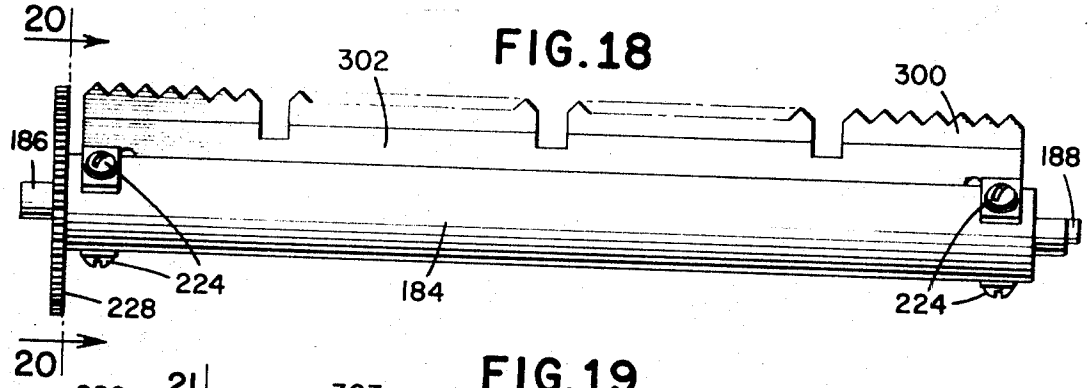


FIG. 18

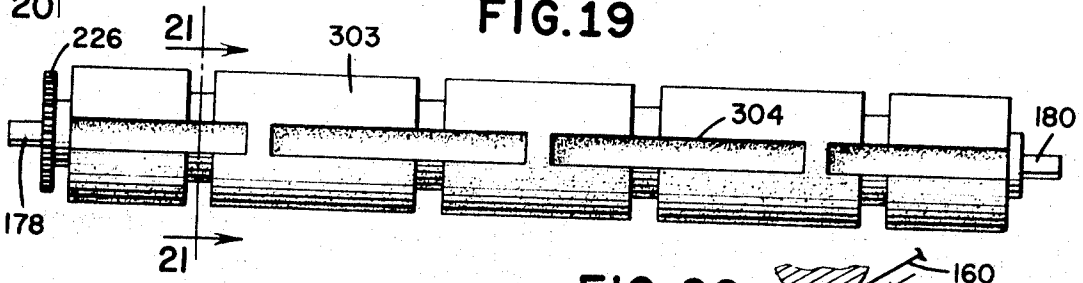


FIG. 19

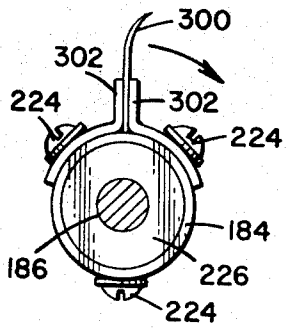


FIG. 20

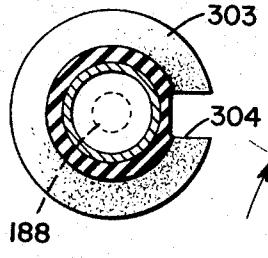


FIG. 21

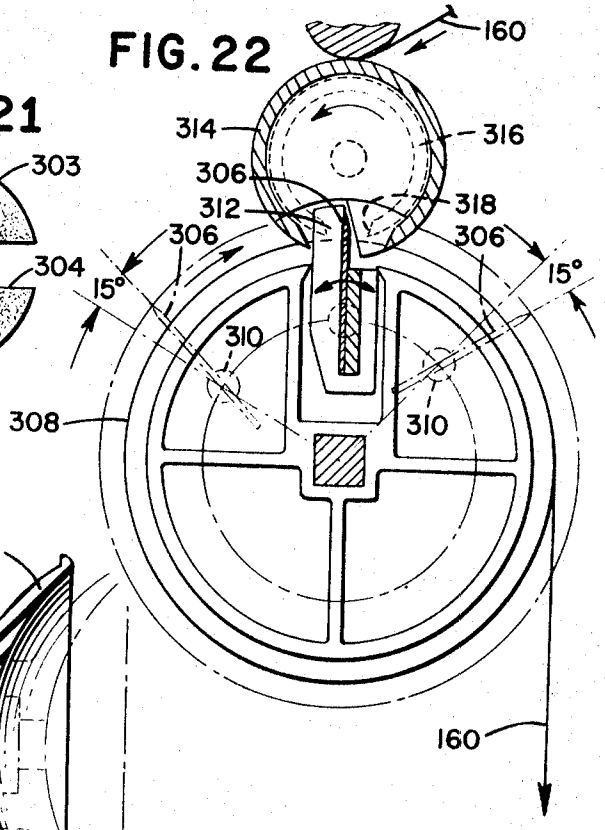


FIG. 22

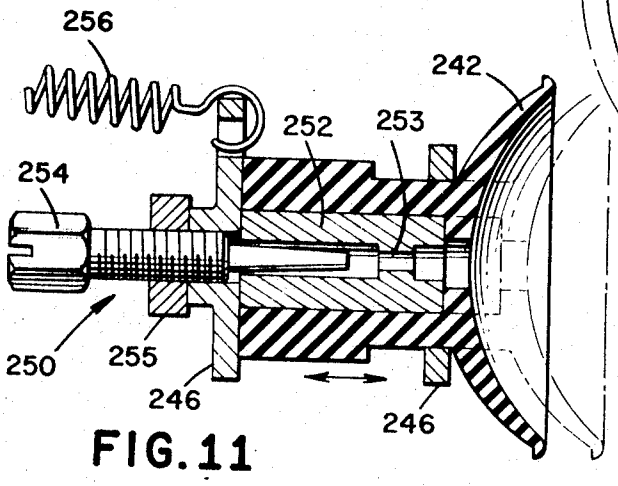


FIG. 11

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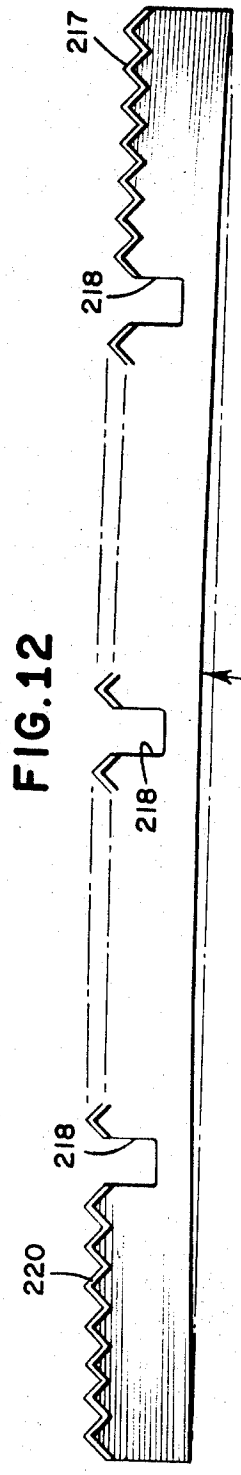


FIG. 12

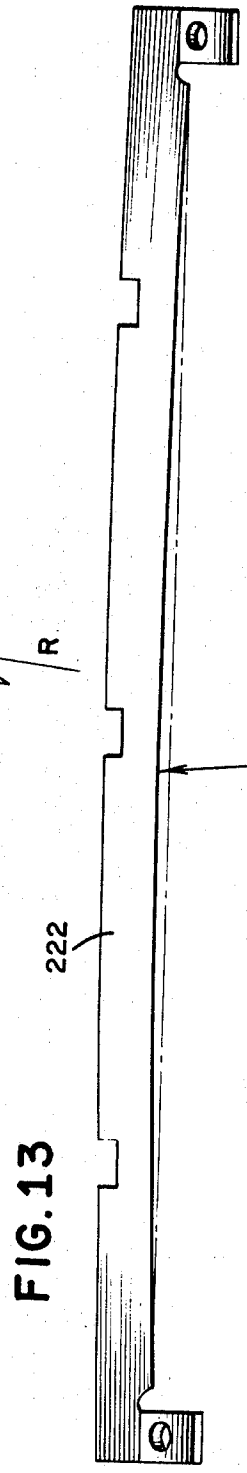


FIG. 13

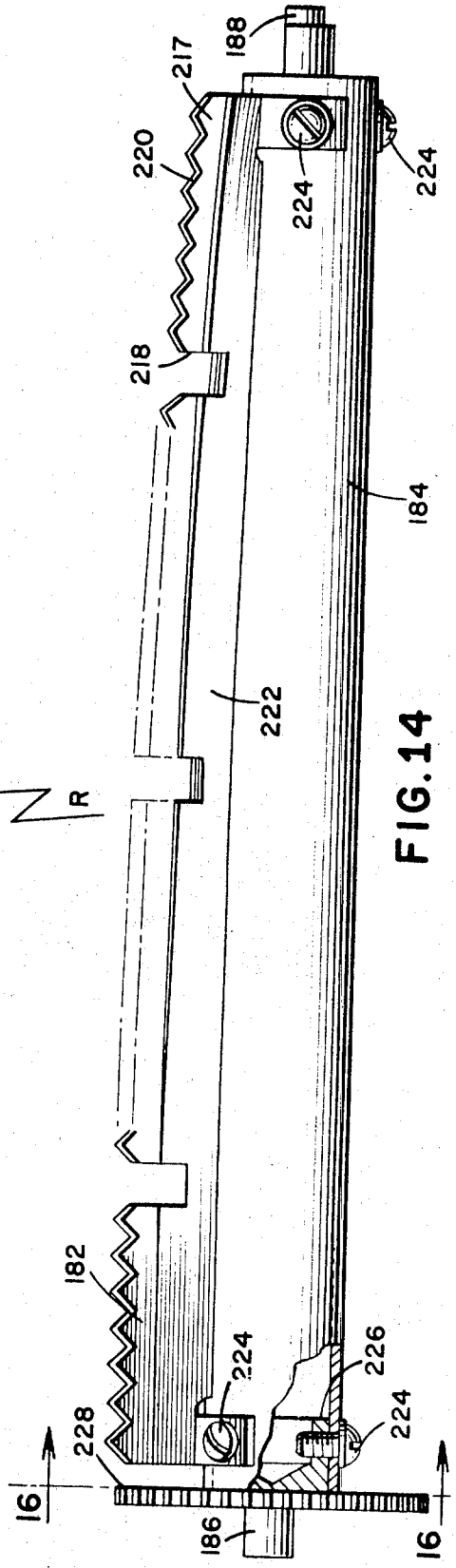


FIG. 14

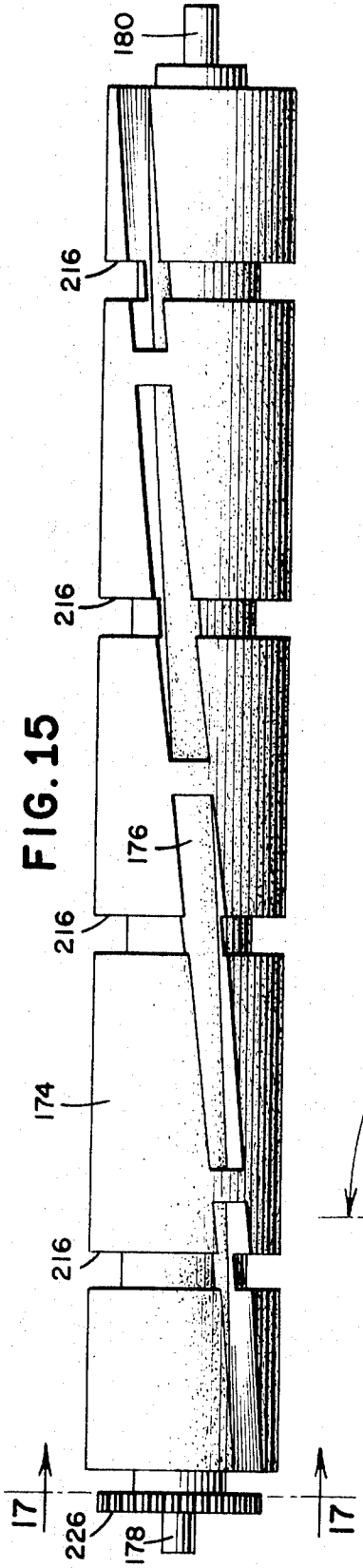


FIG. 15

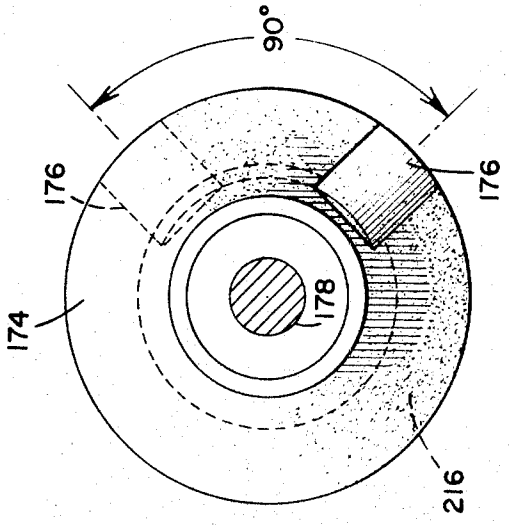


FIG. 17

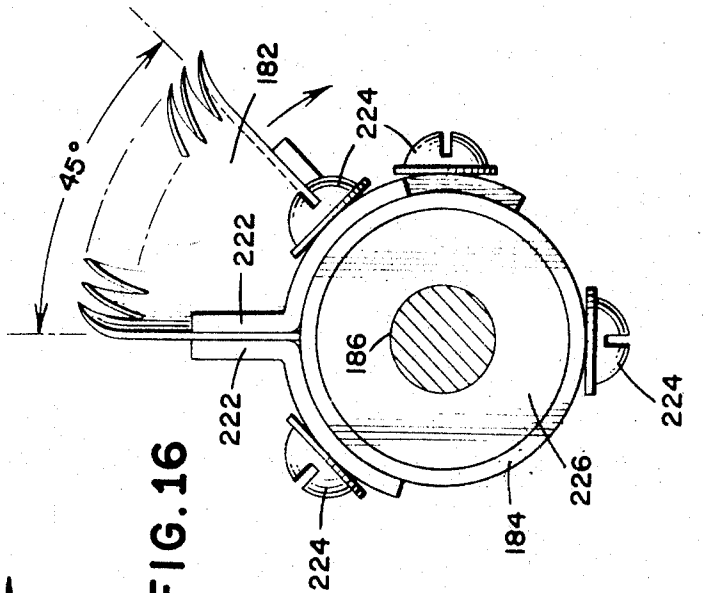


FIG. 16

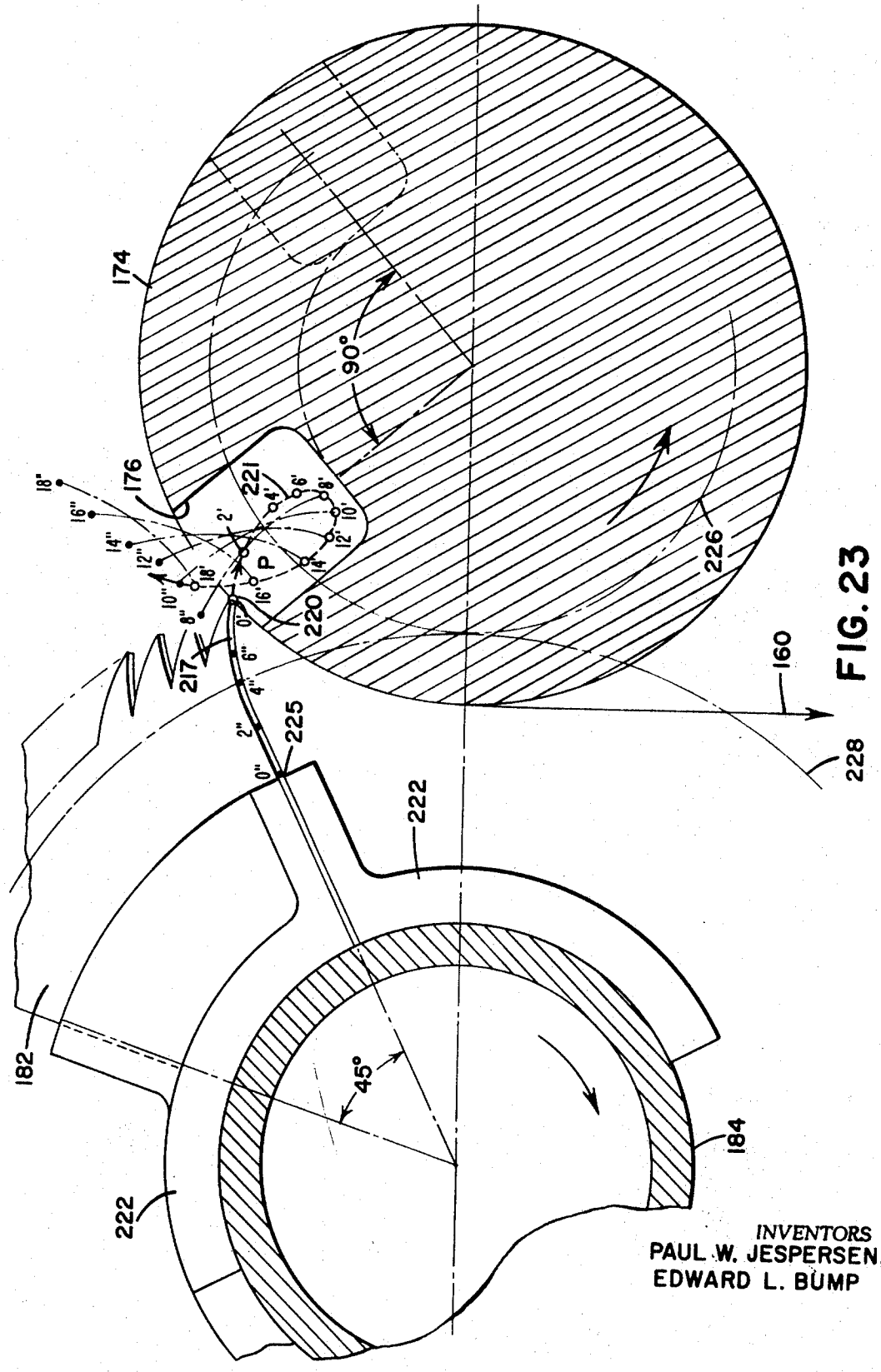


FIG. 23

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DISPENSER FOR FLEXIBLE SHEET MATERIAL AND A PERFORATING MECHANISM ADAPTED TO BE USED THEREIN

RELATED APPLICATION

The present application is a divisional application of application Ser. No. 793,808, filed Jan. 24, 1969, now U.S. Pat. No. 3,575,328.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to dispensers, and specifically to a flexible sheet material dispenser and a mechanism adapted to be used therein for perforating a web of flexible sheet material.

2. Description of the Prior Art

Dispensers for flexible sheet material, such as paper toweling have long been known which include mechanisms for perforating or severing a web of such material to divide the web into individual sheets. Representative of such dispensers are those disclosed in Hamilton et al. U.S. Pat. No. 1,133,640; Schroeder U.S. Pat. No. 1,449,062; Shelley U.S. Pat. No. 1,543,299; Walsh et al. U.S. Pat. No. 2,278,029; and Agamaite U.S. Pat. No. 2,560,061. The perforating or severing mechanisms used in these dispensers generally include a rotatably mounted knife and a cooperating rotatably mounted roller having a slot therein for receiving the radially outward portion of the knife as the knife rotates past the roller. The web of flexible sheet material is passed between the roller and the knife to be perforated or severed when the radially outward knife portion enters the slot in the roller.

Such mechanisms are satisfactory for perforating or severing relatively unstretchable flexible sheet materials, such as uncreped paper toweling. However, with the increased use of relatively stretchable flexible sheet materials, such as embossed and creped paper toweling, the prior art perforating and severing mechanisms have proved unsatisfactory because the web of sheet material tends to stretch about the cutting edge of the knife instead of being perforated or severed thereby. This problem results principally from the orientation of the cutting edge during the entrance of the radially outward knife portion into the slot; the cutting edge being oriented nonparallel to the direction in which the radially outward knife portion moves with respect to the web, causing the edge to slide along the web. Although precision rotary shears are known which could be employed for obviating this problem, for example, the rotary shears shown in Kalko U.S. Pat. No. 1,989,012, such shears are much too expensive to be used in flexible sheet material dispensers designed for installation in both commercial and private washrooms and kitchens.

SUMMARY OF THE INVENTION

The perforating mechanism of the present invention offers an economical solution to the above-described deficiency of the perforating and severing mechanisms used in the prior art flexible sheet material dispensers.

Basically described, the perforating mechanism of the invention comprises; a chassis, a roller rotatably mounted on the chassis, a knife rotatably mounted on the chassis adjacent the roller and having a radially outward portion defining a cutting edge for perforating a web of flexible sheet material as the web passes between the roller and the knife, the roller being operatively connected to the knife for synchronous rotation therewith and having a slot therein for receiving the radially outward portion as the knife rotates past the roller, and means associated with the knife for orienting the cutting edge substantially in the direction in which the radially outward knife portion moves with respect to the web during the entrance of the portion into the slot so that when the portion enters the slot the cutting edge will effectively perforate the web.

A web guiding means preferably is employed in conjunction with the perforating mechanism which holds the web of flexible sheet material tautly about the roller at all times to further reduce any tendency of the web to stretch about the cutting edge of the knife.

The dispenser of the invention, in which the above-described perforating mechanism is adapted to be used, preferably includes an adjustable stop mechanism for stopping the rotation of the knife and the roller and thus arresting the movement of the web with the perforations last-produced in the web either outside or inside the dispenser so that when an individual sheet of material is torn from the web along such last-produced perforations, the leading edge of the web may or may not be immediately accessible to a user, as desired.

With the foregoing in mind, it is an object of the present invention to provide a flexible sheet material dispenser having a mechanism for effectively perforating a web of flexible sheet material, and particularly a web of relatively stretchable flexible sheet material.

It is also an object of the invention to provide a mechanism for perforating a web of flexible sheet material which mechanism includes a knife and a means for orienting the cutting edge thereof in the direction which is most effective for perforating the web.

It is a further object of the invention to provide a flexible sheet material dispenser which includes an adjustable stop mechanism for regulating the position of the leading edge of a web of flexible sheet material such that the leading edge may be positioned either outside or inside the dispenser and thus be either immediately or not immediately accessible to a user.

It is an additional object of the invention to provide a flexible sheet material dispenser having a mechanism for perforating a web of flexible sheet material, which dispenser embodies a compact and rugged structure and which is economical to manufacture, and thus is ideally suited for both commercial and private installations.

These and other objects of the invention will become apparent upon a consideration of the detailed description of the preferred embodiments thereof given in connection with the following drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front view of the dispenser of the invention;

FIG. 2 is a right end view of the dispenser shown in FIG. 1;

FIG. 3 is a front view of the dispenser shown in FIG. 1 with the housing thereof shown in cross-section;

FIG. 4 is a right end view of the dispenser shown in FIG 1 with the housing thereof shown in cross-section;

FIG. 5 is a left end view of the dispenser shown in FIG. 1 with the housing thereof shown in cross-section;

FIG. 6 is a sectional view taken on line 6—6 of FIG. 5;

FIG. 7 is a sectional view taken on line 7—7 of FIG. 5 with selected elements of the dispenser being broken away for clarity;

FIG. 8 is a sectional view taken on line 8—8 of FIG. 7;

FIG. 9 is a sectional view taken on line 9—9 of FIG. 4;

FIG. 10 is an enlarged elevational view of the stop mechanism and associated elements used in the dispenser shown in FIG. 1;

FIG. 11 is a sectional view of one of the vacuum cups of the timing means used in the dispenser shown in FIG. 1;

FIG. 12 is an elevational view of the knife of a first embodiment of the perforating mechanism of the invention, which mechanism may be used in the dispenser shown in FIG. 1;

FIG. 13 is an elevational view of one of the knife mounting brackets for the knife shown in FIG. 12;

FIG. 14 is an elevational view of a knife roller assembly for rotatably supporting the knife shown in FIG. 12;

FIG. 15 is an elevational view of the slot roller used in conjunction with the knife shown in FIG. 12;

FIG. 16 is a sectional view taken on line 16—16 of FIG. 14;

FIG. 17 is a sectional view taken on line 17—17 of FIG. 15;

FIG. 18 is an elevational view of a knife roller assembly for rotatably supporting the knife of a second embodiment of the perforating mechanism of the invention, which mechanism also may be used in the dispenser shown in FIG. 1;

FIG. 19 is an elevational view of the slot roller used in conjunction with the knife shown in FIG. 18;

FIG. 20 is a sectional view taken on line 20—20 of FIG. 18;

FIG. 21 is a sectional view taken on line 21—21 of FIG. 19;

FIG. 22 is a schematic sectional view of a third embodiment of the perforating mechanism of the invention, which mechanism also may be used in the dispenser shown in FIG. 1; and

FIG. 23 is a diagrammatic-sectional view showing the operation of the perforating mechanism which is comprosed of the knife roller assembly shown in FIG. 14 and the slot roller shown in FIG. 15.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The dispenser of the invention is designated in the drawings by reference numeral **10**, and basically comprises a chassis **12** (FIG. 3), a supporting means **14** (FIG. 6) for rotatably supporting a roll of flexible sheet material, such as a roll of creped paper toweling **150**, a guiding means **16** (FIGS. 4 and 5) for guiding a web of paper toweling **160** from roll **150** to a position to be grasped by a user so that the user may pull the web out of dispenser **10**, and a perforating mechanism **18** (FIGS. 5 and 8) for perforating web **160** at intervals therealong to divide the web into individual sheets.

THE CHASSIS AND THE HOUSING

Chassis **12** includes a back plate **20** (FIGS. 2 and 4–8) which is adapted to be secured to a wall **21** (FIG. 2) by suitable fasteners, such as screws **22**. Integral with back plate **20** are a left end flange **24** (FIG. 5) and a right end flange **26** (FIG. 4). A left end plate **28** is affixed to left end flange **24** by suitable fasteners, such as sheet metal screws **30**. A right end plate **32** is similarly affixed to right end flange **26** by suitable fasteners, such as sheet metal screws **34**. A bottom plate **36** (FIGS. 4, 5, 7 and 8) extends forwardly from the bottom of back plate **20** and curves upwardly near the front of the dispenser, terminating in an upstanding arcuate portion **38**. The rear portion of bottom plate **36** has a plurality of holes **40** therein which register with a corresponding plurality of lugs **42** that are carried by a bottom flange **44** integral with back plate **20**. Also, the rear portion of bottom plate **36** is connected to left end plate **28** and right end plate **32** by tabs **29** and **33**, respectively; the tabs being integral with the end plates and being spot welded to the bottom plate. The forward portion of bottom plate **36** is connected to left end plate **28** by tabs **46, 47** and **48** (FIG. 5) and to right end plate **32** by tabs **50, 51** and **52** (FIG. 8); the tabs being integral with the bottom plate and being spot welded to the end plates. A plurality of louvers **54** (FIGS. 7 and 8) are formed in bottom plate **36** to permit air to circulate within dispenser **10**.

Chassis **12** also includes a stripper **56** (FIGS. 3, 5, 7 and 8) having a plurality of upstanding arcuate fingers **58**, the function of which is described below, and which is attached to left end plate **28** and to right end plate **32** by tabs **60** and **62**, respectively; the tabs being integral with the stripper and being spot welded to the end plates. An arcuate shield **64** (FIGS. 5, 7 and 8) extends upwardly from approximately the midpoint of bottom plate **36** and forwardly to the upward extremity of arcuate bottom plate portion **38**. The lower portion of shield **64** is defined by a flange **66** having a plurality of holes **68** therein which register with a corresponding plurality of lugs **70** carried by bottom plate **36**. The upper portion of shield **64** is connected to left end plate **28** by tabs **72** and **74**, and to right end plate **32** by tabs **76** and **78**; the tabs being integral with the shield and being attached to the end plates by suitable fasteners, such as sheet metal screws **80**. Shield **64** and bottom plate **36** defined an elongated cavity **82** within dispenser **10** within which guiding means **16** and perforating mechanism **18** are disposed. The right end of cavity **82** is enclosed by right end plate **32** and the left end of the cavity is enclosed by a cover plate **84** (FIGS. 5 and 7). Cover plate **84** is connected to left end plate **28** by a plurality of suitable fasteners, such as sheet metal screws **86** which engage a corresponding plurality of bosses **88** formed in the end plate. A removable cover plate, such as plate **84**, is used for enclosing the left end of cavity **82** so that access readily may be had to the interior of the cavity for servicing guiding means **16** and perforating mechanism **18**.

Chassis **12** is enclosed by a housing **90** (FIGS. 1 and 2). Housing **90** comprises an upper portion **92**, a cap portion **94**, a lower front portion **96**, a lower left end portion **98**, and a lower right end portion **100**. Cap portion **94** is attached to upper portion **92** by a plurality of tabs **102** (FIGS. 4 and 5). The other portions of the housing are connected together in an appropriate manner, such as by spot welding the portions together where the edges thereof overlap. Lower front portion **96** defines an opening **104** through which web **160** (FIG. 3) may be withdrawn from dispenser **10** by a user, as described below. Lower left and right end portions **98** and **100** each include an integral bottom flange (FIGS. 3–5, 8 and 9) which is adapted to enclose the

respective left or right outer portions of bottom plate **36.**

Housing **90** is connected to chassis **12** by pivot pins **106** and **108**; pin **106** pivotally connecting lower left end housing portion **98** to left end flange **24** of back plate **20,** and pin **108** pivotally connecting lower right end housing portion **100** to right end flange **26** of back plate **20.** This arrangement permits housing **90** to be pivoted outwardly about pins **106** and **108** away from chassis **12** to expose the internal elements of dispenser **10.** A lock **110** preferably is attached to the rear of cap portion **94** for releasably securing the housing to the chassis to prevent unauthorized access to the interior of the dispenser. Lock **110** preferably is a combination locking and latching device of the type disclosed in U.S. Pat. No. 3,500,667 owned by the assignee of the present application.

THE SUPPORTING MEANS

Supporting means **14** comprises a pair of substantially horizontally opposed supporting members **110** and **112** (FIGS. **3 – 6**). Supporting member **110** (FIGS. **3, 5** and **6**) is mounted at the left end of chassis **12** and includes a mounting bracket **114** and a hub **116.** Mounting bracket **114** is attached to back plate **20** and left end flange **24** by suitable fasteners, such as sheet metal screws **118.** Hub **116** is attached to the forward end of bracket **114** by suitable fasteners, such as sheet metal screws **120.** Hub **116** has a recess **122** therein defined by an arcuate bearing surface **124** and the arcuate inner edge of a guide lip **126.**

Supporting member **112** (FIGS. **3, 4** and **6**) is mounted at the right end of chassis **12** and includes a flexible mounting bracket **128** and a hub **130.** Mounting bracket **128** is attached to back plate **20** by suitable fasteners, such as sheet metal screws **132.** Hub **130** is attached to the forward end of bracket **128** by suitable fasteners, such as sheet metal screws **134,** and carries a pair of lugs **136** which register with a corresponding pair of slots formed in the bracket. Hub **130,** similarly to hub **116,** has a recess **138** therein defined by an arcuate bearing surface **140** and the inner arcuate edge of a guide lip **142.**

A braking spring **144** has one end affixed to the inner surface of hub **130** by a suitable fastener, such as rivet **146,** and extends rearwardly from hub **130,** between lugs **136,** and terminates adjacent back plate **20.**

Supporting means **14** is adapted to rotatably support roll **150.** The roll preferably is of the type disclosed as the first embodiment (FIGS. **1 – 3**) in U.S. Pat. No. 3,438,589 owned by the assignee of the present application. The roll has a unipartite internal supporting means **152** comprising a cylindrical core **154** and a pair of trunnion members **156** and **158** attached to the ends of the core. The outer ends of trunnion members **156** and **158** extend axially outwardly beyond the ends of roll **150,** and are adapted to engage recesses **122** and **138,** respectively. The outer ends of the trunnion members have different cross-sectional dimensions; and recesses **122** and **138** have different internal dimensions corresponding to the cross-sectional dimensions of the outer ends of the trunnion members. Thus, roll **150** may be supported by supporting means **14** only when each recess is engaged by the trunnion member outer end having a cross-sectional dimension corresponding to the internal dimension of that recess; and specifically only when recess **122** is engaged by the outer end of trunnion member **156** and recess **138** is engaged by the outer end of trunnion member **158.** This feature insures that roll **150** will be placed in dispenser **10** in the proper manner for web **160** to be passed through guiding means **16** and perforating mechanism **18,** and out of the dispenser through opening **104.**

To insert roll **150** into supporting means **14,** the outer ends of trunnion members **156** and **158** are placed against guide lips **126** and **142,** respectively, and the roll is then pushed rearwardly. When this occurs bracket **128** will flex outwardly permitting the outer ends of the trunnion members to engage, and seat in, recesses **122** and **138.** After the roll has been thus inserted into the supporting means, flexible mounting bracket **128** urges hub **130** toward hub **116** to prevent any inadvertent disengagement of the roll.

As the roll is inserted into the supporting means, the roll end nearest spring **144** will contact the spring and move the spring outwardly to the position shown in solid lines in FIG. **6.** Thereafter, as web **160** is withdrawn from the roll, spring **144** will frictionally engage the roll end and brake the rotation of the roll, to thus prevent uncontrolled spinning thereof.

THE GUIDING MEANS AND THE PERFORATING MECHANISM

Guiding means **16** includes an upper pinch roll **162** and a lower pinch roll **164** (FIGS. **3 – 5** and **8**). Upper pinch roll **162** is mounted on stub shafts **166** and **168** which are journaled for rotation in cover plate **84** and right end plate **32,** respectively. Similarly, lower pinch roll **164** is mounted on sub shafts **170** and **172** which are also journaled for rotation in cover plate **84** and right end plate **32,** respectively.

Perforating mechanism **18** includes a roller **174** (FIGS. **3 – 5, 7, 8, 15** and **17**) which is positioned between pinch rolls **162** and **164** and which has an intermittent helical slot **176** therein. Slot **176** extends generally axially of roller **174** and opens radially outwardly from the surface thereof. The slot roller is supported by stub shafts **178** and **180** which are journaled for rotation in cover plate **84** and right end plate **32,** respectively. Perforating mechanism **18** also includes a knife **182** which is rotatably mounted by a roller **184.** Roller **184** is supported by stub shafts **186** and **188** which are journaled for rotation in cover plate **84** and right end plate **32,** respectively. The bearing surfaces for shafts **178, 186, 180** and **188** preferably comprise low-friction bushings **190, 194, 192** and **196,** respectively; the former two bushings being secured to cover plate **84** and the latter two to right end plate **32.**

Stub shafts **166, 170, 168** and **172** are journaled by elongated bearing surfaces **198, 202, 200** and **204,** respectively; the former two surfaces being integrally formed in cover plate **84** and the latter two being integrally formed in right end plate **32.** This arrangement permits each of the pinch rolls to move into contact with slot roller **174** to form a nip therebetween. A biasing spring **206** is connected to stub shafts **166** and **170,** and a similar biasing spring **208** is connected to stub shafts **168** and **172** for urging the pinch rolls toward the slot roller. Biasing springs **206** and **208** are held in position by U-shaped brackets **210,** one of which is attached to cover plate **84** and another of which is attached to right end plate **32** in any convenient manner, such as by spot welding. In order to permit the surfaces of lower pinch roll **164** and slot roller **174** to contact

one another, the upstanding arcuate portion **38** of bottom plate **36** comprises a plurality of spaced apart, relatively narrow arcuate strips **212** (FIG. 7), and pinch roll **164** has a plurality of circumferential slots **214** therein (FIG. 3), within which strips **212** are accommodated.

From roll **150**, web **160** is directed around upper pinch roll **162**, between the upper pinch roll and slot roller **174**, around the slot roller, between the slot roller and lower pinch roll **164**, around the lower pinch roll and out of the dispenser through opening **104**. As will be apparent from the foregoing description, pinch rolls **162** and **164** insure that web **160** will be held tautly about slot roller **174** at all times. When a user withdraws the web from the dispenser by exerting a pulling force on the leading edge thereof, pinch roll **164** will move slightly out of contact with slot roller **174**; however, as soon as the pulling force is relaxed biasing springs **206** and **208** will immediately move the pinch roll back into contact with the slot roller.

Slot roller **174** also has a plurality of circumferential slots **216** therein, within which are accommodated fingers **58** of stripper **56**. Fingers **58** insure that web **160** will be directed out of opening **104** instead of adhering to the slot roller and becoming wound thereabout.

Knife **182** is helically twisted along the length thereof and includes a radially outward portion **217** which is curved forwardly in the direction of rotation of the knife and which defines a serrated cutting edge **220** (FIGS. **4, 5, 7, 8, 12, 14** and **16**). The knife also has a plurality of notches **218** therein within which strips **212** of bottom plate portion **38** are accommodated as the knife rotates into proximity with and past slot roller **174**. As the knife rotates past the slot roller, radially outward knife portion **217** enters slot **176** and cutting edge **220** progressively perforates the entire width of web **160** except for the sections of the web that are aligned with notches **218**. The unperforated sections of the web have sufficient tensile strength to permit a user to draw the web out of the dispenser by exerting a smooth, continuous pulling force thereon. However, after the web has been perforated, an abrupt increase in the pulling force will cause the web to part along the perforations last-produced therein by cutting edge **220**.

Knife **182** is attached to knife roller **184** by a pair of mounting brackets **222**. The knife is first affixed to the mounting brackets, conveniently by welding, and a helical twist is then imparted to the knife and the brackets. The brackets are thereafter attached to roller **184** by a plurality of bolts **224** which threadably engage a pair of hubs **226** disposed internally of the roller at the ends thereof. The knife and mounting brackets are bowed slightly outwardly at the centers thereof (FIGS. **12** and **13**) so that after the helical twist is imparted thereto, the entirety of the radially inward surfaces thereof will abut the surface of roller **184**. Additional bolts **224** may be used for securing roller **184** to hub **226** to insure that the hubs are firmly anchored within the roller.

Slot roller **174** and knife roller **184** are operatively interconnected to insure that the rollers will rotate in synchronism with one another. For this purpose a gear **226** is affixed to one end of the slot roller which engages and meshes with a gear **228** affixed to the same end of the knife roller. In the embodiment shown in the drawings, gear **228** has twice as many teeth as does gear **226**, so that the slot roller will rotate at twice the rotational speed of the knife roller. Due to this difference in the rotational speeds of the two rollers, slot **176** must be twisted through an arc which is twice as large as the arc through which knife **182** is twisted. Thus, the knife may be helically twisted through an arc of 45° (FIG. **16**) and slot **176** helically twisted through an arc of 90° (FIG. **17**).

To preclude slippage of web **160** about the slot roller, the roller preferably is made from a substance having a relatively high coefficient of friction, such as rubber. When a user exerts a pulling force on the leading edge of the web, the frictional force exerted by the web on the slot roller causes the slot and knife rollers to rotate in synchronism with one another.

The path of movement of cutting edge **220** with respect to slot **176** during the perforating cycle of the knife is shown in FIG. **23** by dashed line **221**. Also shown in this figure are the relative positions of edge **220** and a point **225** on the knife located at the radially outward extremity of brackets **222**; the positions of the former by points **0′, 2′, 4′, 6′, 8′, 10′, 12′, 14′, 16′** and **18′**, and the corresponding positions of the latter by points **0″, 2″, 4″, 6″, 8″, 10″, 12″, 14″, 16″** and **18″**.

The positions of radially outward knife portion **217** with respect to slot **176** during the perforating cycle are indicated by the broken lines which connect the corresponding positional points of edge **220** and point **225** i.e., lines **0′ – 0″, 2′ –2″, 4′ – 4″, 6′ – 6″, 8′ – 8″, 10′ – 10″, 12′ – 12″, 14′ – 14″, 16′ – 16″** and **18′ – 18″**. As shown, while portion **217** is moving from position **0′ – 0″** to position **6′ – 6″**, i.e., during the entrance of the portion into slot **176**, cutting edge **220** is oriented substantially in the same direction as the direction in which portion **217** is moving.

The same relationship between the orientation of the cutting edge and the movement of portion **217** is maintained with respect to web **160** as is maintained with respect to slot **176**. Thus, as described above, web **160** is held tautly about slot roller **174** by pinch rolls **162** and **164** and by the pulling force exerted on the web by a user. As a consequence of this feature, when slot **176** rotates into proximity with knife **220** the portion of the web which overlies the slot is curved in conformance with the curvature of the surface of roller **174**, and there is no relative movement therebetween. Thereafter, when portion **217** reaches position **0′ – 0″** and slot **176** reaches the position shown in FIG. **23**, i.e., when cutting edge **220** initially contacts web **160**, the orientation of the cutting edge substantially coincides with the direction in which portion **217** is moving with respect to the web. This relationship is maintained as portion **217** moves from position **0′ – 0″** to position **6′ –6″**, i.e., during the entrance of the portion into the slot. Thus, the forward curvature of portion **217** orients cutting edge **220** substantially in the direction in which portion **217** moves with respect to the web, as well as with respect to slot **176**, during the entrance of the portion into the slot.

The structure and resulting operation of perforating mechanism **18** provides several advantages over the prior art perforating and severing mechanisms. The orientation of the cutting edge results in an effective perforation of the flexible sheet material web by reducing any tendency of the edge to slide along the web. Also, the mechanism is economical to manufacture, and embodies a rugged and compact structure which is able to

withstand the prolonged and abusive wear encountered in commercial washroom and kitchen installations.

THE STOP MECHANISM AND THE TIMING MEANS

Dispenser **10** also includes a mechanism **233** (FIGS. **4** and **10**) for stopping the rotation of knife roller **184** and slot roller **176** abruptly and thus arresting the movement of web **160** abruptly, so that an individual sheet of paper toweling may be torn from web **160** along the perforations last-produced therein by knife **182.** Stop mechanism **233** includes stop lever **230** which is pivotally connected to right end plate **32** by a pivot pin **232** and has a cam follower **234** and a stop lug **236** integrally affixed thereto. The stop mechanism also includes a feed wheel **240** which is secured to the end of stub shaft **188,** being one of the shafts which support knife roller **184,** and has a camming pin **238** affixed thereto. Camming pin **238** is adapted to coact with camming pin **234** and stop lug **236** to stop the rotation of knife roller **184** and slot roller **174.** As the knife roller is rotated incident to the exertion of a pulling force on web **160** by a user, camming pin **238** is rotated about the axis of shaft **188.** While the knife roller is rotating, stop lever **230,** cam follower **234** and stop lug **236** are in the positions shown in full lines in FIG. **10.** In this position, the cam follower is positioned in the rotational path of camming pin **238,** so that when the pin reaches the position shown in full lines in FIG. **10,** it engages the underside of, and cams the follower upwardly. This action pivots stop lever **230,** cam follower **234** and stop lug **236** to the positions shown in dotted lines in FIG. **10.** In this position, the stop lug is positioned in the rotational path of camming pin **238,** so that when the pin disengages the underside of the cam follower, it thereafter engages the stop lug. This causes knife roller **184** and slot roller **174** to stop abruptly and thus abruptly arrests the movement of web **160,** resulting in an abrupt increase in the pulling force exerted on the web. As explained above, this permits an individual sheet of paper toweling to be torn from the web along the perforations last-produced therein by knife **182.**

A timing means **237** is associated with stop mechanism **233** for regulating the length of time during which the stop mechanism is effective for preventing the rotation of the knife and slot rollers. Timing means **237** comprises a pair of opposed, resilient vacuum cups **242** and **244;** cup **242** being connected by a bracket **246** to stop lever **230** and cup **244** being attached by a mount **248** to a flange integral with right end plate **32.** When camming pin **238** engages the underside of cam follower **234** and pivots stop lever **230** upwardly to position stop lug **236** in the rotational path of the camming pin, vacuum cup **242** is pivoted rearwardly into vacuum-gripping relationship with cup **244.** As long as cups **242** and **244** remain in vacuum-gripping relationship, stop lug **236** will remain in the rotational path of camming pin **238** and prevent knife roller **184** and slot roller **174** from being rotated.

Preferably, vacuum cup **242** is made of a relatively hard resilient material, such as hard rubber; and vacuum cup **244** is made of a relatively soft resilient material, such as soft rubber. This arrangement minimizes the compression force required to engage the cups in vacuum-gripping relationship, yet provides a sufficient vacuum-gripping force between the cups, i.e., the force required to pull the cups apart, to insure that the cups will not be pulled apart when camming pin **238** engages stop lug **236.** The resiliency of cups **242** and **244,** and particularly of relatively soft resilient cup **244,** provides a cushion for absorbing the dynamic forces generated by the abrupt engagement of pin **238** with lug **236** and thus minimizes wearing of the stop mechanism components.

To regulate the period of time during which cups **242** and **244** remain in vacuum-gripping relationship, a needle valve **250** (FIG. **11**) is provided for controlling the flow of ambient air into the vacuum environment between the cups. Valve **250** is mounted in bracket **246** and communicates with the interior of cup **242.** The valve includes a cylindrical valve body **252** having an aperture **253** formed therein, and a needle-tipped adjustment bolt **254** which threadably engages an end flange of bracket **246.** Bolt **254** is locked into position by a lock nut **255** which is also threadably engaged by the bolt and which abuts the end flange of bracket **246.** By adjusting the position of bolt **254** with respect to aperture **253,** the rate at which ambient air flows into the vacuum environment between vacuum cups **242** and **244,** and thus the period of time during which the cups remain in vacuum-gripping relationship, may be regulated. A return spring **256** is connected between bracket **246** and the forward portion of right end plate **32** for pivoting stop lever **230** downwardly, and thus moving stop lug **236** out of the rotational path of camming pin **238,** when the air pressure within the environment between vacuum cups **242** and **244** has increased sufficiently to destroy the vacuum-gripping relationship between the cups. The user may thereafter withdraw a further length of web **160** from the dispenser, which will be perforated by knife **182** in the manner described above and which may be torn from the web as an individual sheet of paper toweling when stop mechanism **233** again stops the rotation of knife roller **184** and slot roller **174.**

As mentioned above, feed wheel **240** is secured to the end of stub shaft **188.** Preferably, the wheel is secured to the shaft by a bolt (not shown) which threadably engages the shaft axially thereof. The cross-section of the end of shaft **188** is shaped as an equilateral triangle (FIGs. **4** and **10**), and feed wheel **240** has a similarly shaped opening in the center thereof for accommodating the shaft end therein. The feed wheel may thus be secured to shaft **188** in any one of three rotational positions. In one rotational position of the feed wheel (FIG. **4**) camming pin **238** engages stop lug **236** and the rotation of the knife and slot rollers stopped before the perforations last-produced in web **160,** indicated at P, have been drawn outside dispenser **10.** After a user has torn an individual sheet of paper toweling from the web with the last-produced perforations inside the dispenser, the leading edge of the web will thereafter by positioned within the dispenser and thus not be immediately accessible to the user. This mode of operation encourages economical consumption of roll **150.**

After the time period has elapsed during which timing means **237** maintains stop mechanism **233** effective for preventing the rotation of the knife and slot rollers, the knife and slot rollers are rotated automatically by a feed means **258** to move the leading edge of the web outside the dispenser. Feed means **258** comprises a lug **260** affixed to feed wheel **240** and a feed spring **262** connected between lug **260** and the rear portion of right end plate **32.** Lug **260** is positioned with respect

to camming pin **238** so that spring **262** will be extended when the camming pin engages stop lug **236** (FIG. **4**). Thus, when the stop lug is moved out of the rotational path of pin **238** by return spring **256**, feed spring **262** will contract and thereby impart rotation to feed wheel **240** and shaft **188**. Shaft **188** in turn will impart rotation to knife roller **184** and slot roller **174**, thus moving the leading edge of web **160** outside the dispenser.

In the second rotational position of feed wheel **240** with respect to shaft **188** (FIG. **8**) stop mechanism **233** will stop the rotation of the knife and slot rollers after the perforations last-produced in web **160**, indicated at P are outside dispenser **10**. In this mode of operation, the leading edge of the web is immediately accessible to a user after an individual sheet of toweling has been torn therefrom along the perforations last-produced therein. When this mode of operation is employed, bolt **254** preferably is adjusted so that the time period during which the stop mechanism is effective for stopping the rotation of the knife and pinch rollers is of short duration, i.e., 1 – 2 seconds, permitting a second sheet of toweling to be obtainable as soon as the first sheet is torn from the web. As is apparent, this second mode of operation is less economical than the first mode, but is more convenient to the user's needs than the first mode. The first mode generally would be employed where economical consumption of the paper toweling is a significant factor, such as in commercial washroom installations, and the second mode employed where user convenience is a significant factor, such as in a private kitchen installation. Dispenser **10** is thus ideally suited for either commercial or private installations.

The third rotational position of feed wheel **240** with respect to shaft **188** is not used because in this latter position, knife portion **217** would be within slot **176** when the stop mechanism stopped the rotation of the knife and slot rollers. This would not only permit the web to be at least partially torn along the perforations being produced therein at that time, thus dividing the web before the perforations have passed between slot roller **174** and lower pinch roller **164**, but also would impose undesirable bending forces on blade **182**.

Dispenser **10** also includes a means **265** for rotatably supporting a partially consumed roll of flexible sheet material, such as a partially consumed roll or creped paper toweling **264** (FIG. **8**). Supporting means **265** comprises a pair of opposed flanges **266** and **268**, which are integral with back plate **20** (FIGS. **4, 5, 7** and **8**). Flanges **266** and **268** extend forwardly from back plate **20** into a cavity **270** in the lower rear portion of the dispenser defined by the back plate, bottom plate **36** and shield **64**. Each of the flanges has a U-shaped cutout therein; flange **266** having cutout **272** therein and flange **268** having cutout **274** therein. The internal dimensions of cutouts **272** and **274** corresponding to the cross-sectional dimensions of the outer ends of trunnion members **156** and **158**, respectively. Thus, after roll **150** has been partially consumed, being then designated roll **264**, the roll may be moved from supporting means **14** to supporting means **265**. When the roll is moved from supporting means **14** to supporting means **265**, it is not necessary to withdraw web **160** from guiding means **16** and perforating mechanism **18**. The trunnion members are simply disengaged from supporting members **110** and **112**, and inserted into cutouts **272** and **274**. From this latter position the web extends along path **276** (FIG. **8**) from the top of roll **264** to the top of upper pinch roller **162**.

After partially consumed roll **264** has been moved into cavity **270**, a fresh roll **150** may be inserted into supporting means **14** in the manner described above. The web from roll **150** is merely superimposed on the web from roll **264** and is passed through guiding means **16** and perforating mechanism **18** in the manner described above. Thereafter, as long as any paper toweling remains wound about partially consumed roll **264**, dispenser **10** will dispense a double-ply thickness of the toweling.

This latter feature of the dispenser is particularly suited for commercial installations where it is uneconomical to service the dispenser except at regular intervals, such as daily. In such instances, a custodian need not wait until a roll is completely consumed before servicing the dispenser; nor need he discard a partially consumed roll when servicing the dispenser at the end of a regularly established service interval. He merely moves the partially consumed roll from supporting means **14** to supporting means **265**, and inserts a fresh roll into the former supporting means. To facilitate the custodian's appraisal as to whether or not a fresh roll need be placed in the dispenser at the end of a regularly established service interval, viewing ports **278** (FIG. **2**) are provided in upper housing portion **92** adjacent an end of roll **150**. By observing the diameter of the roll through ports **278**, the custodian will be appraised of the amount of toweling remaining on the roll.

To load dispenser **10**, housing **90** is first pivoted outwardly from about chassis **12**, thus exposing the internal elements of the dispenser. A roll of flexible sheet material, such as roll **150**, is then inserted into supporting means **14** as described above. The web from the roll, such as web **160**, is directed around upper pinch roll **162**, with the leading edge of the web resting on the forward surface of slot roller **174**. Housing **90** is then pivoted upwardly about chassis **12** to enclose the internal elements of the dispenser. Feed wheel **240** is thereafter turned in a counter-clockwise direction as viewed from the right end of the dispenser, causing the web to be fed through guiding means **16** and perforating mechanism **18**. Arcuate strips **212** and lower pinch roll **164** insure that the web will be guided, and held tautly, about slot roller **174**. To permit the feed wheel to be manipulated when the internal elements of the dispenser are enclosed by housing **90**, a slot **280** is provided in lower right end housing portion **100**, through which the lower portion of feed wheel **240** extends (FIG. **4**).

Dispenser **10** also includes means for preventing feed wheel **240** from being rotated in the direction opposite to the proper direction for feeding web **160** through the guiding means and the perforating mechanism. Such means include a ratchet mechanism **282** (FIG. **4**) comprising an L-shaped pawl **284** which is pivotally connected to right end plate **32** by a pin **286**. Inserted over the base of the pawl is a resilient sleeve **288** which engages a plurality of notches **290** formed in periphery of feed wheel **240**. As long as the feed wheel is rotated in the counter-clockwise direction as viewed from the right end of dispenser **10**, the base of pawl **284** and sleeve **288** pivot freely in and out of notches **290**. However, any attempt to rotate the feed wheel in the opposite direction will cause the pawl to bind in one of the notches and prevent rotation of the wheel. A lug **292**

carried by right end plate **32** is positioned above pawl **284** to prevent the pawl from rotating completely about pin **286,** thus insuring that the pawl will remain in the proper position with respect to feed wheel **240** to prevent improper rotation of the wheel.

THE SECOND EMBODIMENT OF THE PERFORATING MECHANISM

A second embodiment of the perforating mechanism of the invention is shown in FIGS. **18–21.** This latter embodiment of the perforating mechanism may be employed in dispenser **10** instead of mechanism **18,** and includes an axially straight knife **300** which is attached to axially straight mounting brackets **302.** In all other respects the knife roller assembly of the second embodiment is identical to the knife roller assembly of the first embodiment, including knife roller **184,** stub shafts **186** and **188,** and gear **228.**

A slot roller **303** is used in conjunction with knife **300.** Roller **303** is similar to slot roller **174,** except that instead of an intermittent helical slot along the length thereof, roller **303** has an intermittent axially straight slot **304** therein for accommodating the radially outward portion of knife **300.**

The only difference in operation between the first and second perforating mechanism embodiments is that helically twisted knife **182** of the first embodiment perforates the web progressively, with only a small section of the cutting edge contacting the web at any one time. This arrangement requires only a relatively small force to be exerted against the web by the cutting edge to accomplish an effective perforation. The cutting edge of knife **300,** on the other hand, perforates the entire width of the web at one time, requiring a slightly greater perforating force. The advantage of the second embodiment over the first is that the latter is somewhat more economical to manufacture, since the knife and mounting brackets need not be helically twisted.

THE THIRD EMBODIMENT OF THE PERFORATING MECHANISM

A third embodiment of the perforating mechanism of the invention is shown in FIG. **22.** This embodiment also may be employed in dispenser **10** instead of the first or second embodiments described above. The third embodiment of the perforating mechanism includes a substantially planar knife **306** which is pivotally mounted on a knife roller **308** by a pair of stub shafts **310** affixed to each end of the knife and journaled in the ends of the knife roller. Also affixed to each end of knife **306** are camming lugs **312** which extend radially outwardly beyond the cutting edge of the knife. Lugs **312** are adapted to be engaged by cams **314** mounted on each end of a slot roller **316** having an axial slot **318** therein. As opposed to the previous embodiments, the surfaces of the knife roller **308** and slot roller **316** contact each other, thereby eliminating the necessity for a lower pinch roll for maintaining web **160** taut about the slot roller.

Knife **306** is normally biased forwardly by a small spring (not shown) through an arc of approximately 15° from a radial orientation with respect to roller **308.** Thus, when the knife enters slot **318,** the cutting edge thereof will be oriented substantially in the same direction as the direction in which the radially outward portion of the knife is moving with respect to web **106.** In this respect, the perforating action of knife **306** is similar to the perforating action of knives **182** and **300,** described above.

After knife **306** moves into the slot, lugs **312** will be engaged by cams **314.** The cams pivot the lugs, and therefore knife **306,** rearwardly with respect to the direction of rotation of knife roller **308.** This action permits slot **318** to be made narrow enough for the knife to perform an effective perforation while maintaining the surfaces of the knife and slot rollers in contact with each other. After the knife has been withdrawn from the slot and lugs **312** have disengaged cams **314,** the biasing spring will again pivot knife **306** forwardly. To insure that knife roller **308** and slot roller **316** rotate in synchronism with each other, the rollers preferably are operatively connected together by gears, as described above in connection with the first and second perforating mechanism embodiments.

The foregoing constitutes a detailed description of the dispenser and perforating mechanism of the invention, the latter being adapted to be used in the former, although not being restricted to use solely therein. Moreover, it is recognized that various modifications of both the dispenser and perforating mechanism of the invention may occur to those skilled in the art. Therefore the scope of the invention is to be limited solely by the scope of the appended claims.

We claim:

1. In a dispenser for flexible sheet material including, a chassis adapted to be attached to a wall, means operatively connected to said chassis for rotatably supporting a roll of flexible sheet material, means operatively connected to said chassis for guiding a web of flexible sheet material from said roll to a position to be grasped by a user so that the user may pull the web out of the dispenser, and a mechanism operatively connected to said chassis for perforating said web at intervals therealong to divide the web into individual sheets, the improvement wherein said perforating mechanism comprises, a rotatably mounted roller, a rotatably mounted knife positioned adjacent said roller and having a radially outward portion defining a cutting edge for perforating the web as the web passes between the roller and the knife, said roller being operatively connected to said knife for synchronous rotation therewith and having a slot therein for receiving said radially outward knife portion as the knife rotates past the roller, and means associated with said knife for orienting said cutting edge substantially in the direction in which said radially outward knife portion moves with respect to the web during the entrance of said portion into said slot so that when the portion enters the slot, the cutting edge will effectively perforate the web; and wherein said dispenser further comprises a mechanism associated with said perforating mechanism for stopping the rotation of said knife and said roller and thus arresting the movement of the web after a predetermined length of the web has been withdrawn from the dispenser, and a variable timing means associated with said stop mechanism for controlling the period of time during which the stop mechanism is effective to stop the rotation of the knife and the roller.

2. In a dispenser for flexible sheet material including, a chassis adapted to be attached to a wall, means operatively connected to said chassis for rotatably supporting a roll of flexible sheet material, means operatively connected to said chassis for guiding a web of flexible sheet material from said roll to a position to be grasped by a

user so that the user may pull the web out of the dispenser, and a mechanism operatively connected to said chassis for perforating said web at intervals therealong to divide the web into individual sheets; the improvement wherein said perforating mechanism comprises, a rotatably mounted roller, a rotatably mounted knife positioned adjacent said roller and having a radially outward portion defining a cutting edge for perforating the web as the web passes between the roller and the knife, said roller being operatively connected to said knife for synchronous rotation therewith and having a slot therein for receiving said radially outward knife portion as the knife rotates past the roller, and means associated with said knife for orienting said cutting edge substantially in the direction in which said radially outward knife portion moves with respect to the web during the entrance of said portion into said slot so that when the portion enters the slot, the cutting edge will effectively perforate the web; and wherein said dispenser further comprises a mechanism associated with said perforating mechanism for stopping the rotation of said knife and said roller and thus arresting the movement of the web after a predetermined length of the web has been withdrawn from the dispenser; and wherein said perforating mechanism further comprises a second rotatably mounted roller operatively connected to said first-mentioned roller for synchronous rotation therewith, said knife being mounted on said second roller; and wherein said stop mechanism comprises a camming pin operatively connected to said second roller for rotation therewith, a stop lever pivotally connected to said chassis and having a cam follower and a stop lug integrally affixed thereto, said cam follower being positioned in the rotational path of said camming pin, and said stop lug being movable into the rotational path of said camming pin upon the engagement of said pin with said follower for stopping the rotation of the pin and said second roller, and thereby stopping the rotation of said knife and said first roller, so that after said predetermined length of the web has been withdrawn from the dispenser a user may tear an individual sheet of the web from the portion thereof remaining within the dispenser along the perforations last-produced in the web by said cutting edge, and means connected to said stop lever for moving said stop lug out of the rotational path of said camming pin so that after said individual sheet has been torn from said remaining web portion an additional predetermined length of the web may be withdrawn from the dispenser.

3. A dispenser as recited in claim **2,** further comprising a variable timing means connected to said stop lever for controlling the length of time of the stop lug remaining in the rotational path of the camming pin.

4. A dispenser as recited in claim **3,** wherein said timing means comprises a pair of resilient vacuum cups, one of said cups being attached to said stop lever and the other of said cups being attached to said chassis, said cups being engageable in vacuum-gripping relationship when said stop lug is positioned in the rotational path of said camming pin, and valve means associated with one of said cups for regulating the flow of air between the cups when the cups are in vacuum-gripping relationship.

5. A dispenser as recited in claim **2,** wherein the position of said camming pin is adjustable with respect to said second roller so that said knife and said first roller may be stopped while said last-produced perforations are either inside or outside the dispenser.

6. A dispenser as recited in claim **5,** further comprising means operable when said knife and said first roller are stopped with said last-produced perforations inside the dispenser for rotating the knife and the first roller automatically after said stop lug has moved out of the rotational path of said camming pin so that the leading edge of the web will be moved outside the dispenser to a position to be grasped by a user.

7. A dispenser as recited in claim **4,** wherein said one cup is made of a relatively hard resilient material and said other cup is made of a relatively soft resilient material to thereby minimize the compression force required to engage the cups in vacuum-gripping relationship.

8. In a dispenser for flexible sheet material including, a chassis adapted to be attached to a wall, means operatively connected to the chassis for rotatably supporting a roll of flexible sheet material, means operatively connected to the chassis for guiding a web of flexible sheet material from said roll to a position to be grasped by a user so that the user may pull the web out of the dispenser, a mechanism operatively connected to the chassis for perforating said web at intervals therealong to divide the web into individual sheets, said perforating mechanism including a rotatably mounted roller, a rotatably mounted knife positioned adjacent said roller and having a radially outward portion defining a cutting edge for perforating the web as the web passes between the roller and the knife, said roller being operatively connected to said knife for synchronous rotation therewith and having a slot therein for receiving said radially outward knife portion as the knife rotates past the roller, a stop mechanism associated with said perforating mechanism for stopping the rotation of said knife and said roller and thus arresting the movement of the web after a predetermined length of the web has been withdrawn from the dispenser, and a variable timing means associated with said stop mechanism for controlling the period of time during which stop mechanism is effective to stop the rotation of the knife and the roller; the improvement wherein said timing means comprises a pair of resilient vacuum cups, one of said cups being attached to said stop mechanism and the other of said cups being attached to said chassis, said cups being engageable in vacuum-gripping relationship when said stop mechanism stops the rotation of the knife and the roller, said one cup being made of a relatively hard resilient material and said other cup being made of relatively soft resilient material to thereby minimize the compression force required to engage the cups in said vacuum-gripping relationship, and valve means associated with said one cup for regulating the flow of air between the cups when the cups are in vacuum-gripping relationship.

9. A dispenser as recited in claim **8,** wherein said stop mechanism is adjustable with respect to said perforating mechanism so that said knife and said roller may be stopped while the perforations last-produced in the web by said cutting edge are either inside or outside the dispenser.

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