US008015904B2

(12) **United States Patent**
Kapolnek et al.

(10) **Patent No.: US 8,015,904 B2**
(45) **Date of Patent: Sep. 13, 2011**

(54) **DIE HOLDER ASSEMBLY FOR ROTARY CUTTING SYSTEM**

(75) Inventors: **Paul G. Kapolnek**, Chicago, IL (US); **Timothy G. Kapolnek**, Stickney, IL (US); **David J. Kapolnek**, Park Ridge, IL (US); **Michael K. Musgrave**, Chicago, IL (US); **Diane Peters**, Des Plaines, IL (US); **Kent M. Troxel**, Highland, IN (US)

(73) Assignee: **Western Printing Machinery Company**, Schiller Park, IL (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 559 days.

(21) Appl. No.: **11/246,008**

(22) Filed: **Oct. 7, 2005**

(65) **Prior Publication Data**

US 2006/0096431 A1 May 11, 2006

Related U.S. Application Data

(60) Provisional application No. 60/616,998, filed on Oct. 8, 2004.

(51) **Int. Cl.**
B26D 1/62 (2006.01)

(52) **U.S. Cl.** **83/343**; 83/698.41

(58) **Field of Classification Search** .. 83/698.41–698.61, 83/529, 343, 346, 670

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

487,894	A *	12/1892	Shields	83/681
1,411,774	A	4/1922	Engel	
1,861,456	A *	6/1932	Shaw et al.	83/669
2,034,161	A	3/1936	Thiel	
2,100,847	A *	11/1937	Halstead	83/143
2,801,694	A *	8/1957	Schneider et al.	83/675
3,030,841	A *	4/1962	Haas	83/672
3,128,663	A *	4/1964	Dovey	83/669
3,188,900	A *	6/1965	Mauro	83/663
3,589,230	A *	6/1971	Neuman	83/669
3,752,042	A *	8/1973	Castille	493/471
3,857,314	A *	12/1974	Gregoire	83/346
3,926,084	A *	12/1975	Blazer	83/698.41
3,935,774	A	2/1976	Craddy	83/355
4,014,234	A	3/1977	Spengler	83/162

(Continued)

FOREIGN PATENT DOCUMENTS

GB 1044313 9/1966

(Continued)

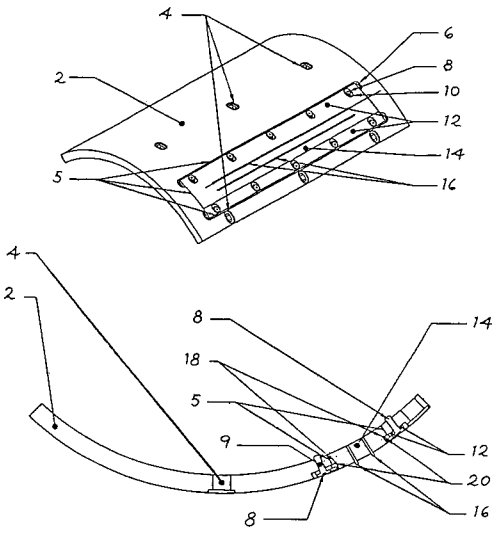
Primary Examiner — Kenneth E. Peterson

(74) *Attorney, Agent, or Firm* — Brinks Hofer Gilson & Lione

(57) **ABSTRACT**

The present invention provides a die holder with one or more pre-located recessed areas or voids into which cutting dies can be quickly and easily inserted and secured. The die holder mounts quickly to the cylinder, and can be quickly removed for alternative operations. The die holder can be made according to the operator needs for different types, sizes and positions of dies. Unused voids can be filled with 'blank' blocks to achieve a consistent or uniform surface height for the full 360 degree area of the die cylinder. The present invention further provides a removable scrap control apparatus that is not attached permanently to the die cylinder on which it is used, which permits the use of a multiple blade die or a plurality of single blade dies on the same die cylinder without requiring permanent holes, slots or other means to accommodate the scrap control apparatus on the die cylinder or anvil cylinder.

19 Claims, 32 Drawing Sheets



U.S. PATENT DOCUMENTS

4,020,724	A *	5/1977	Quinlan	83/346
4,823,659	A *	4/1989	Falasconi	83/100
5,088,367	A *	2/1992	Cracchiolo et al.	83/345
5,159,868	A *	11/1992	Thomas et al.	83/674
5,226,344	A *	7/1993	Rosemann	83/674
5,394,779	A	3/1995	Meeks	83/332
5,570,620	A *	11/1996	Okonski et al.	83/152
5,782,156	A *	7/1998	Collins	83/331
5,893,314	A *	4/1999	Kapolnek et al.	83/698.41
6,266,992	B1 *	7/2001	Butcher et al.	72/478
7,096,709	B2 *	8/2006	Hutchison et al.	72/482.94
2002/0011140	A1 *	1/2002	Okonski et al.	83/698.41

FOREIGN PATENT DOCUMENTS

GB	2 247 205	2/1992
GB	2 337 224	11/1999

* cited by examiner

Figure I

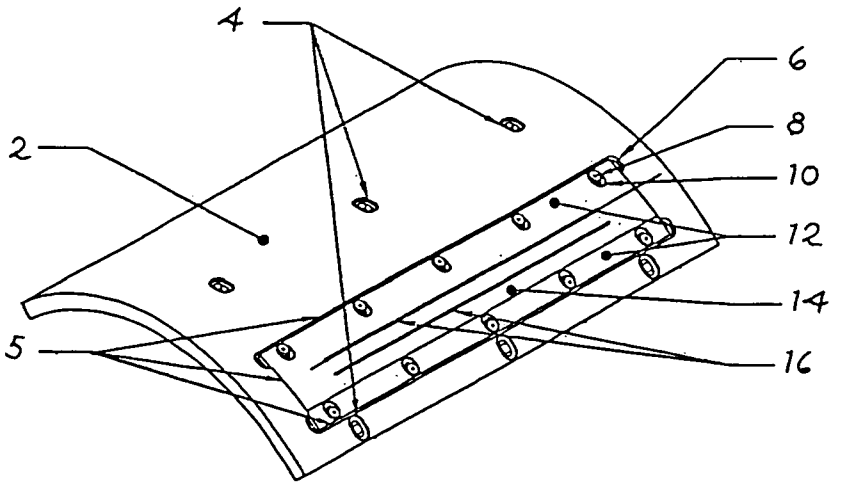


Figure 2

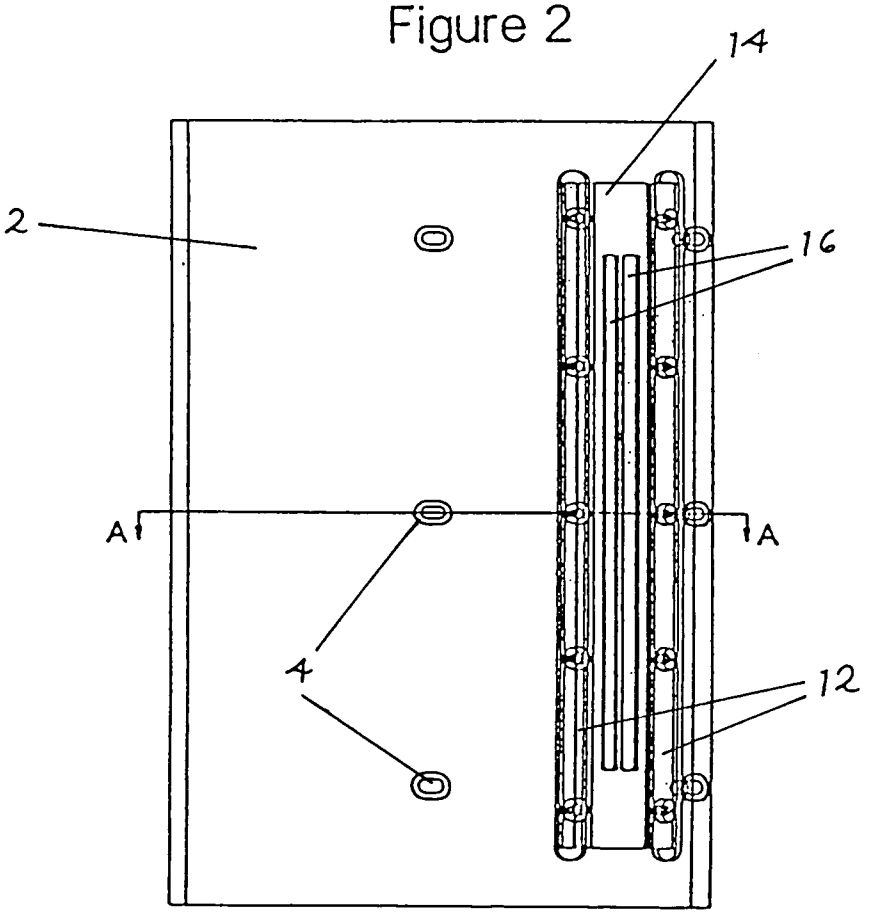


Figure 3

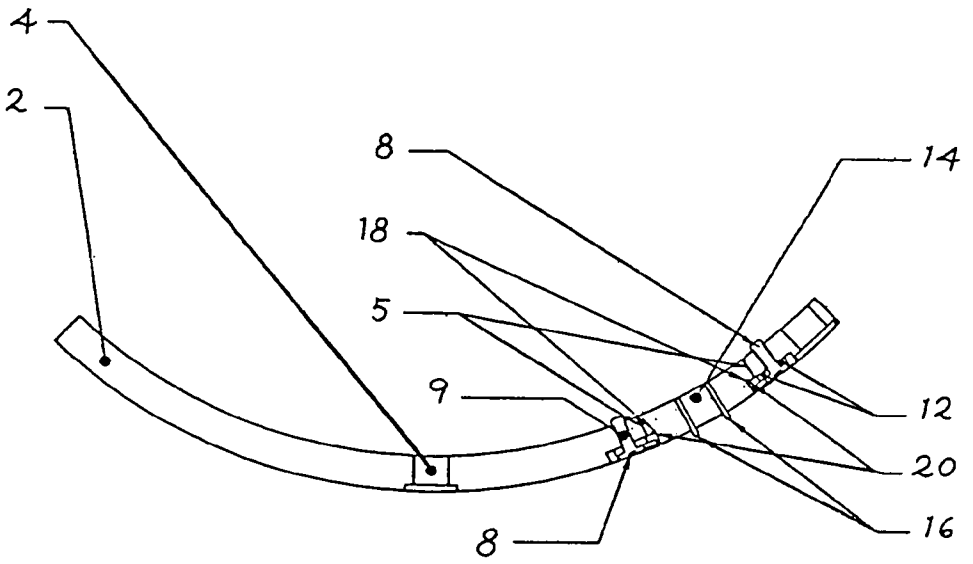


Figure 4

Figure 5

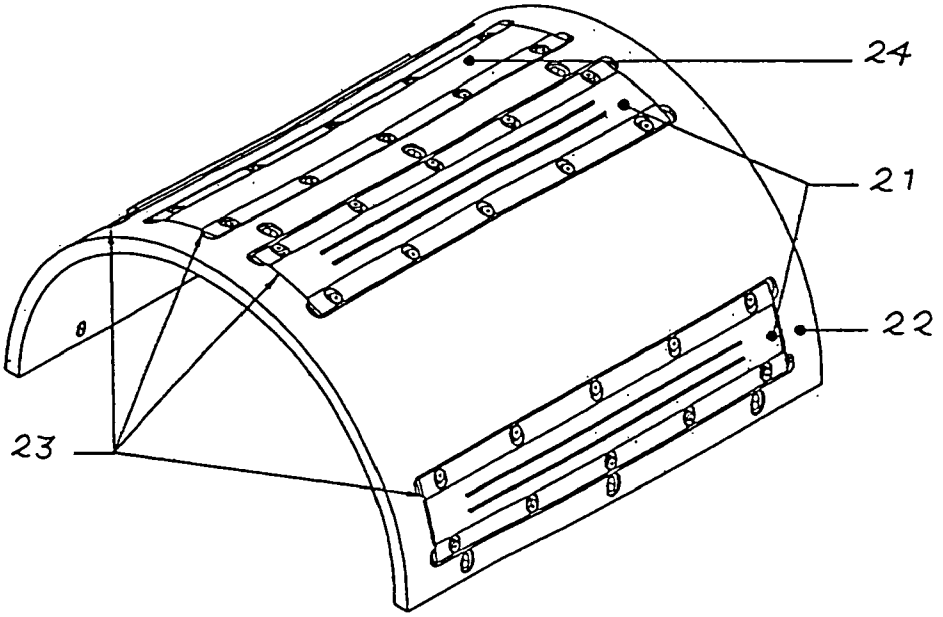


Figure 6

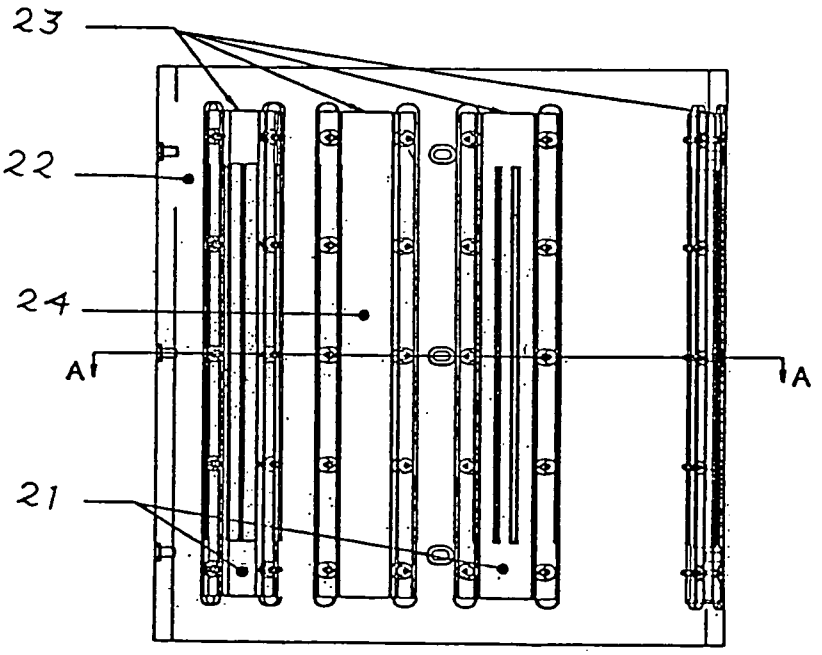


Figure 7

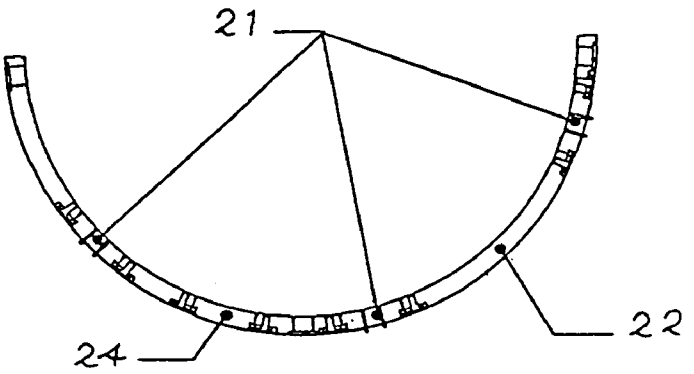


Figure 8

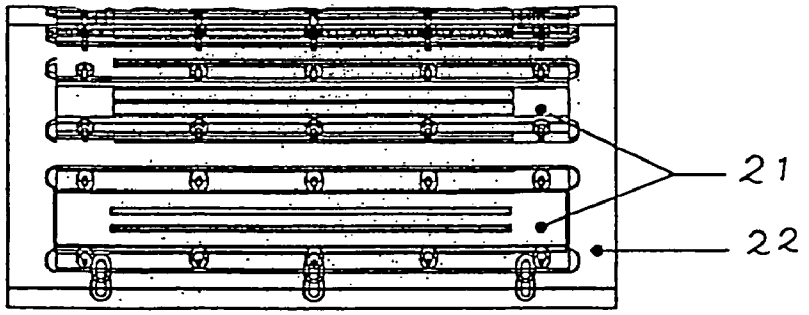


Figure 9

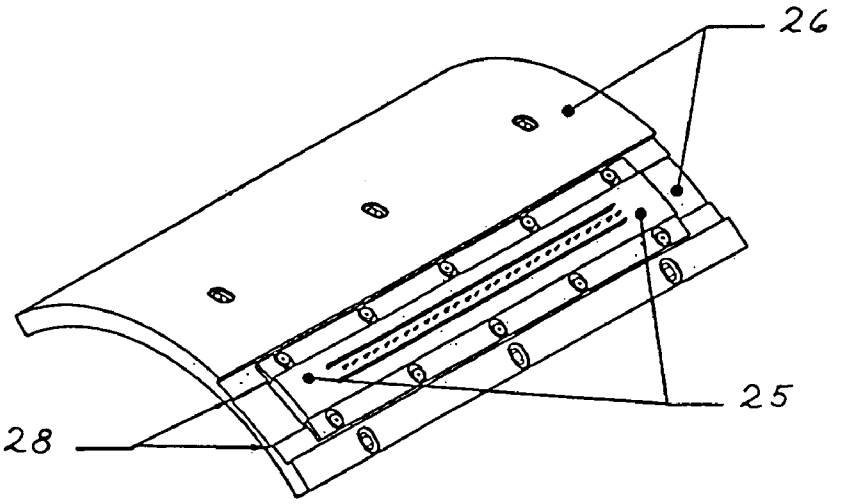


Figure 10

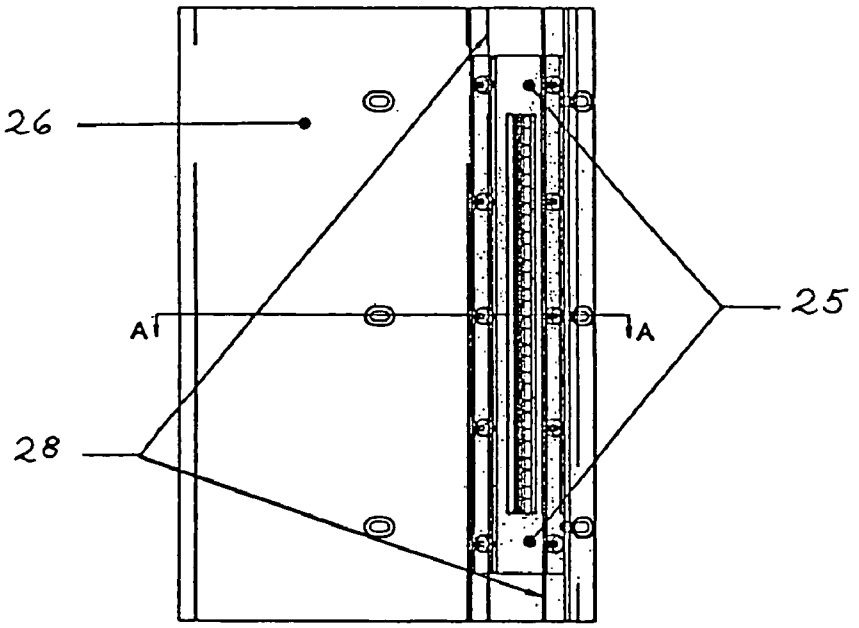


Figure 11

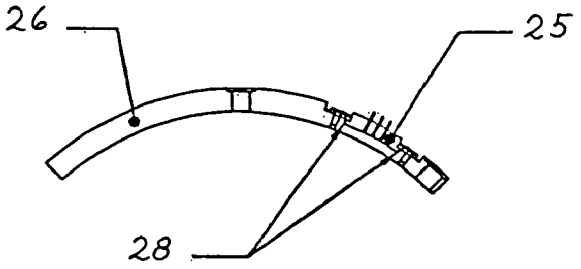


Figure 12

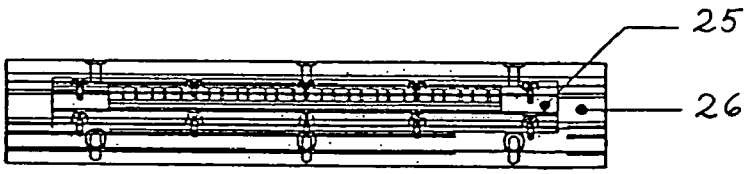


Figure 13

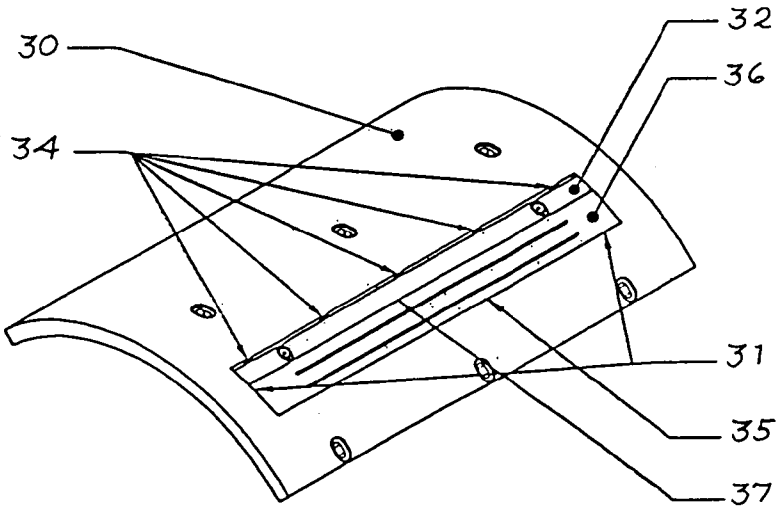


Figure 14

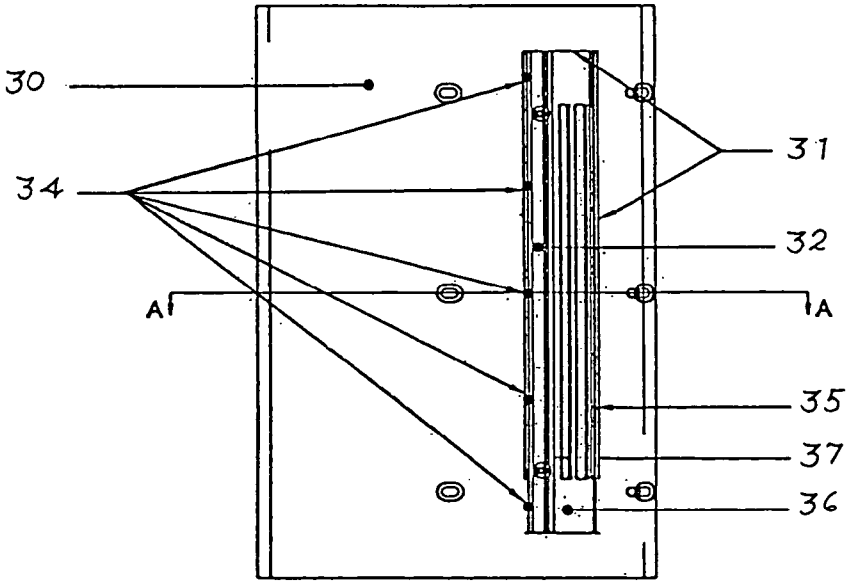


Figure 15

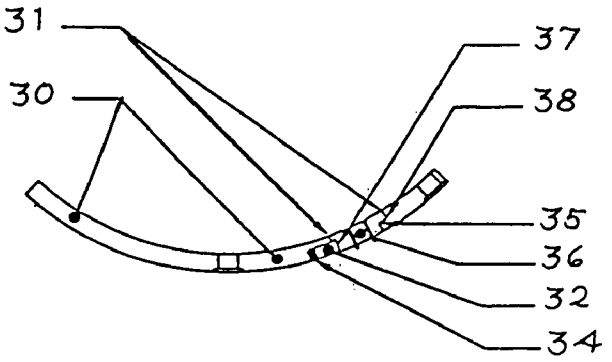


Figure 16

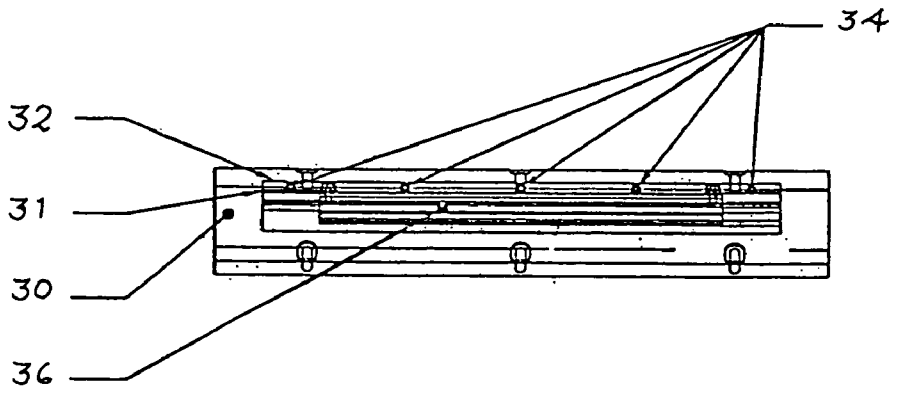


Figure 17

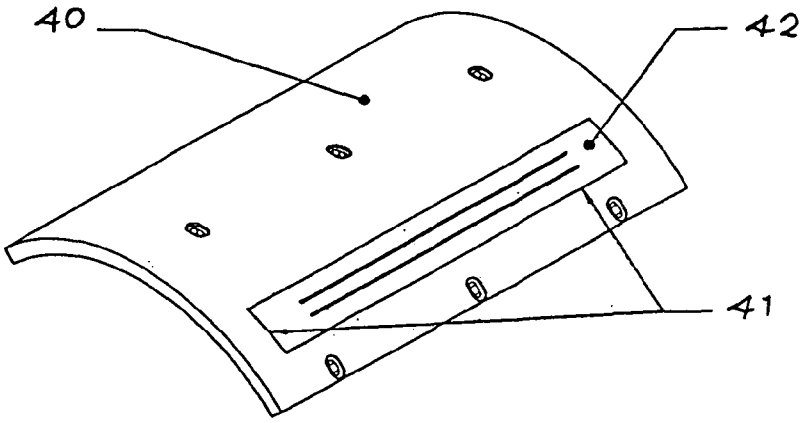


Figure 18

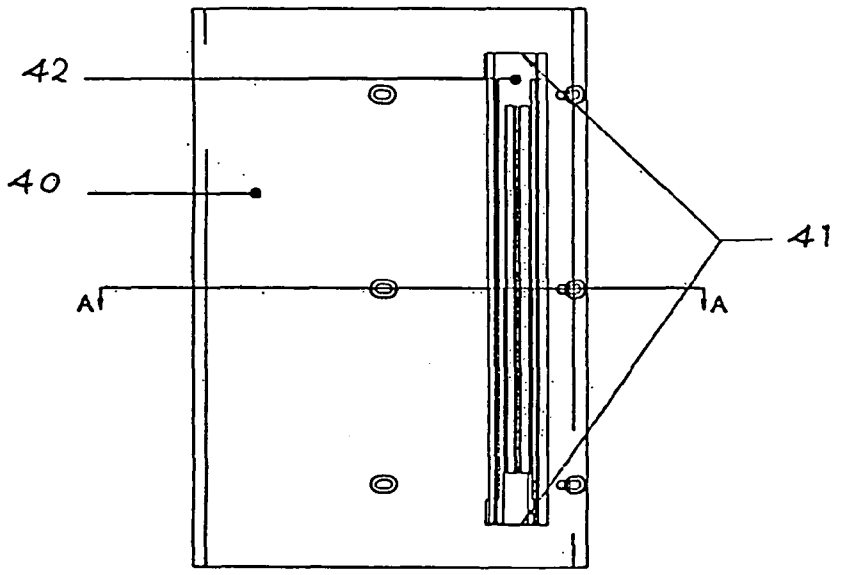


Figure 19

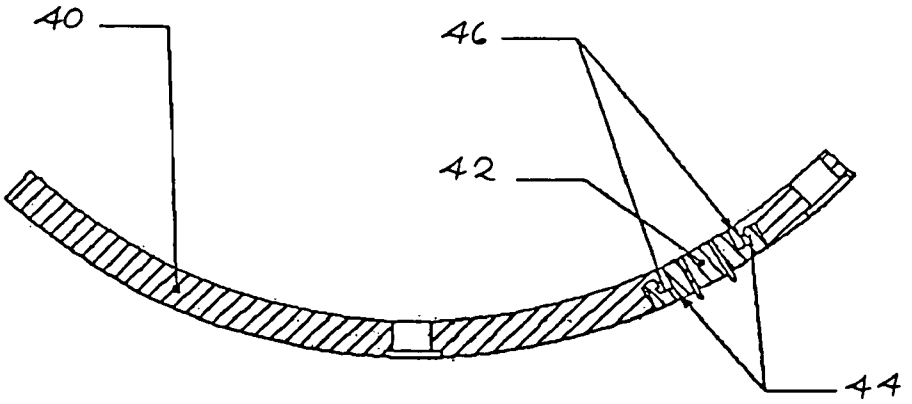


Figure 20

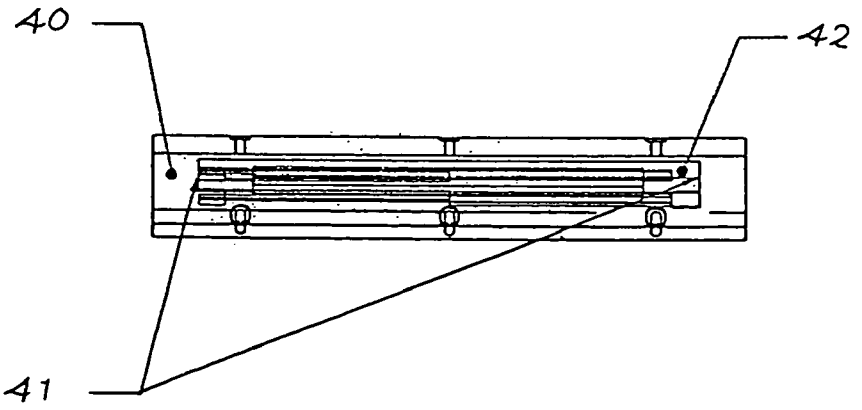


Figure 2I

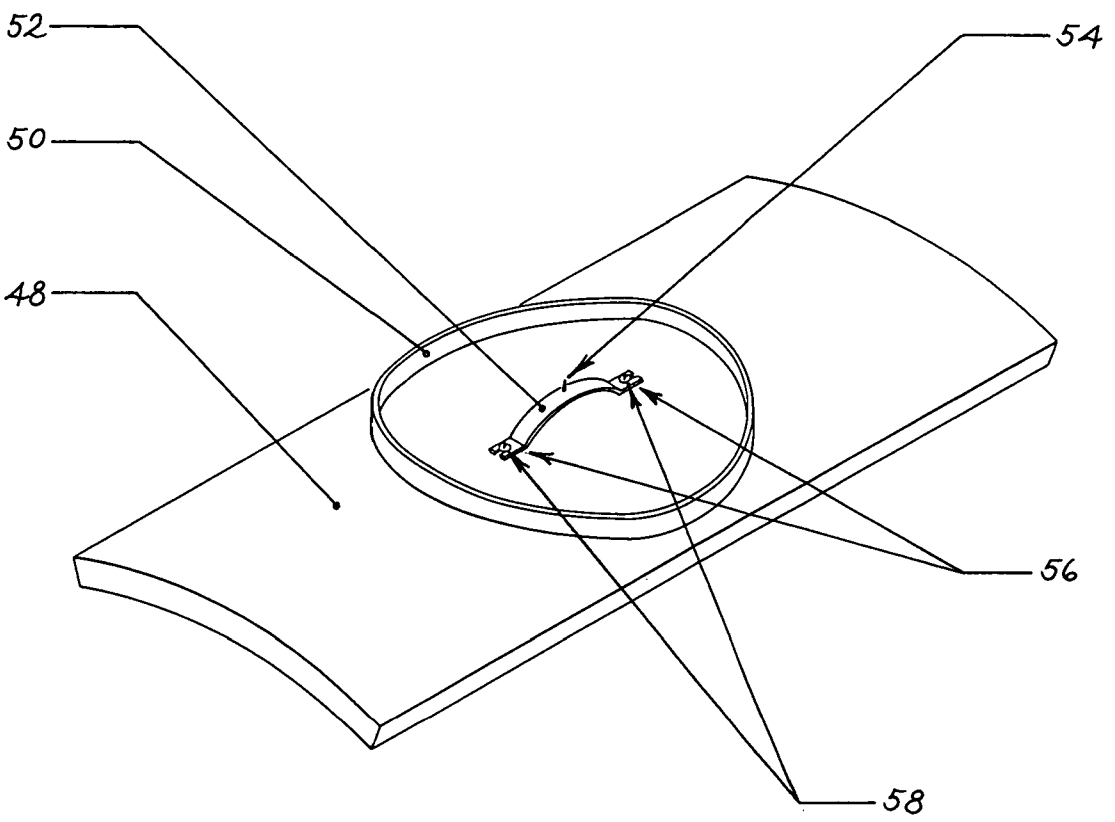


Figure 22

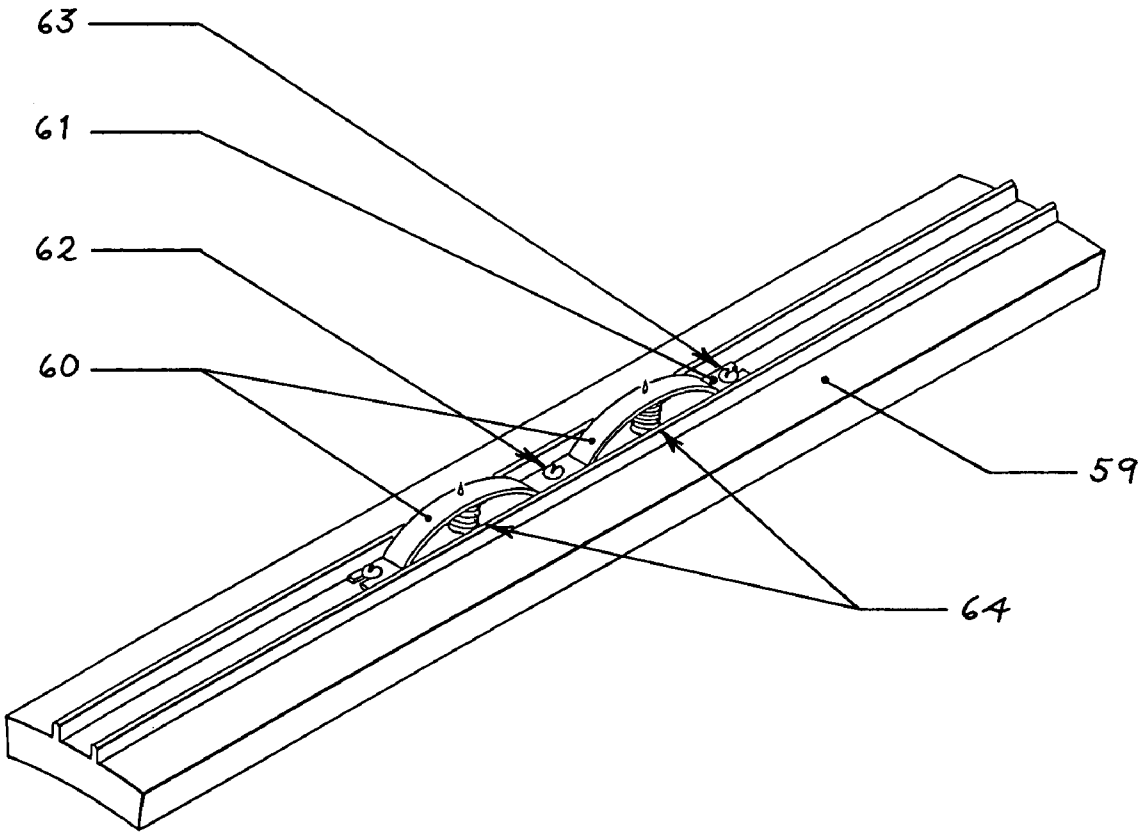


Figure 23

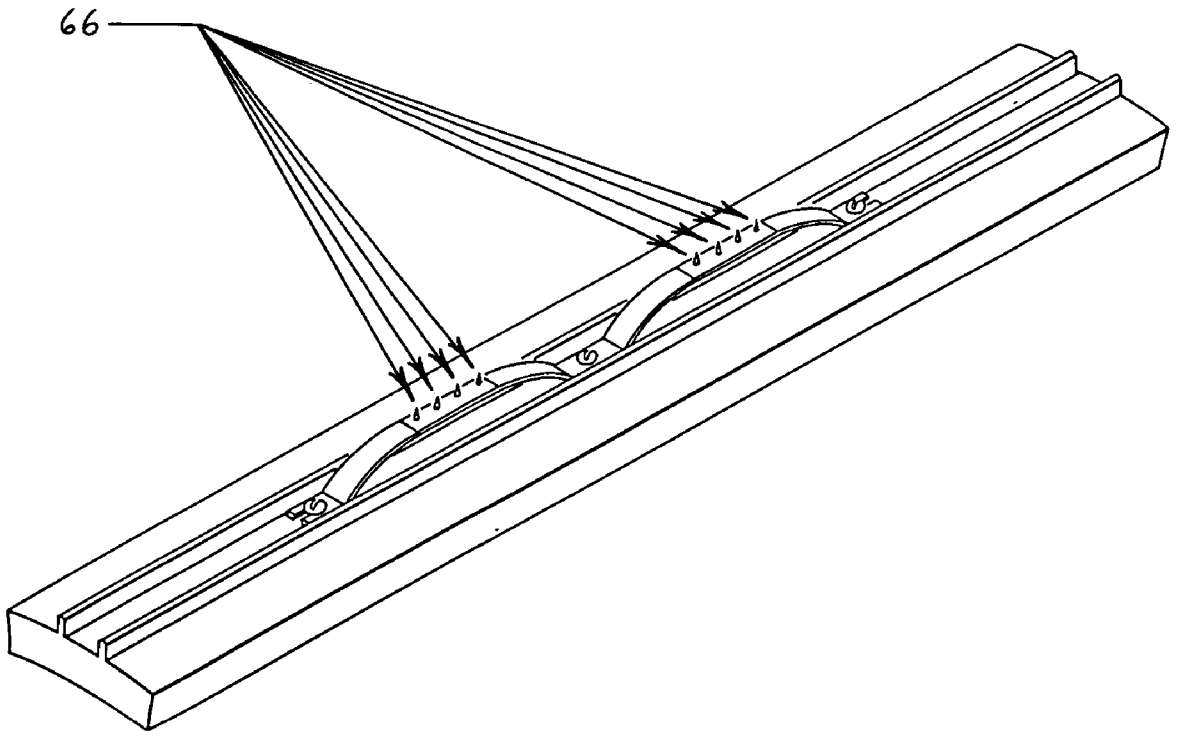


Figure 24

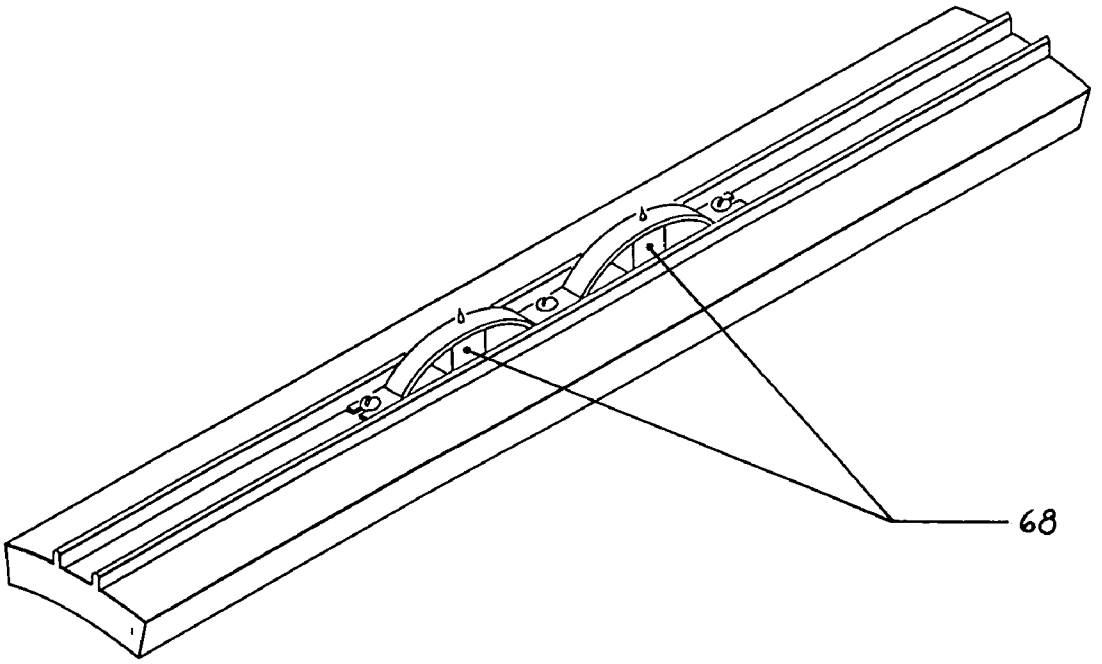


Figure 25

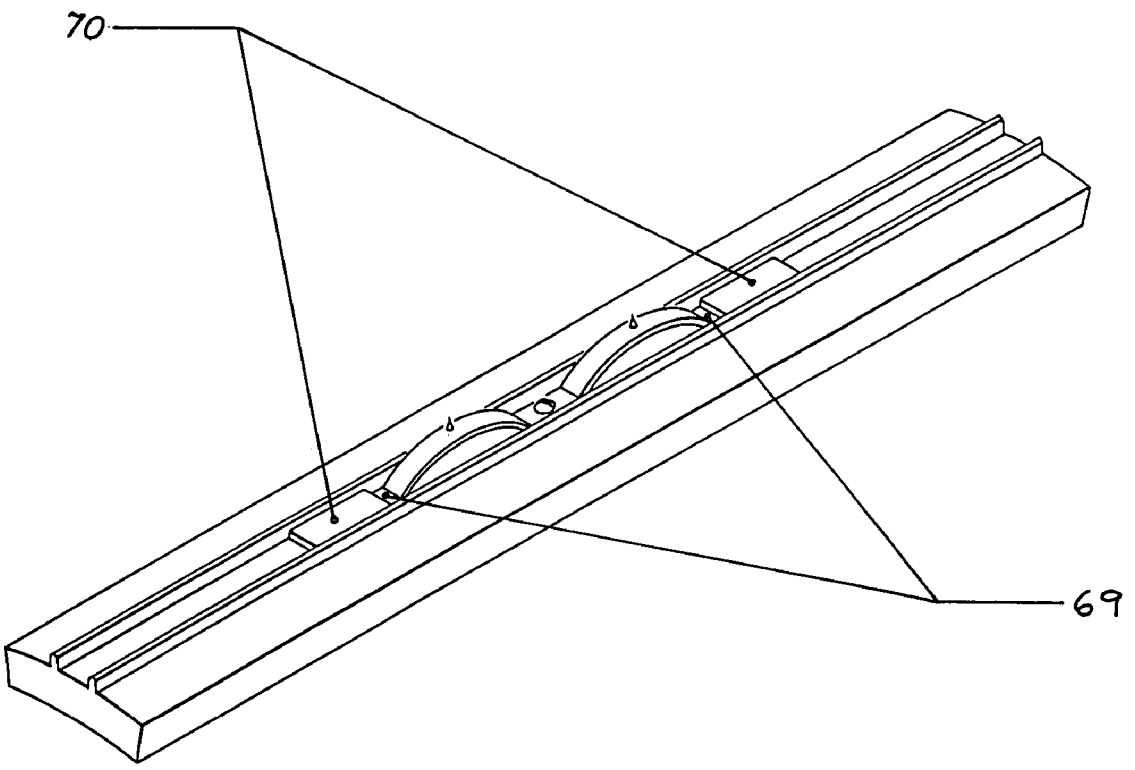


Figure 26

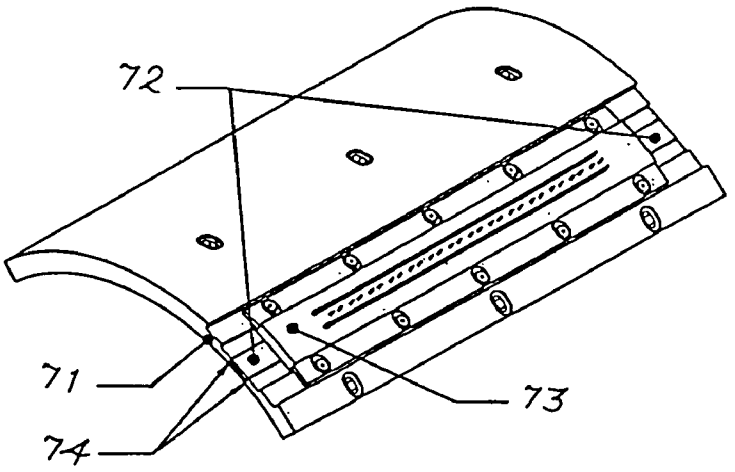


Figure 27

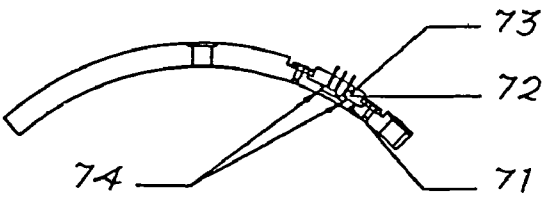


Figure 28

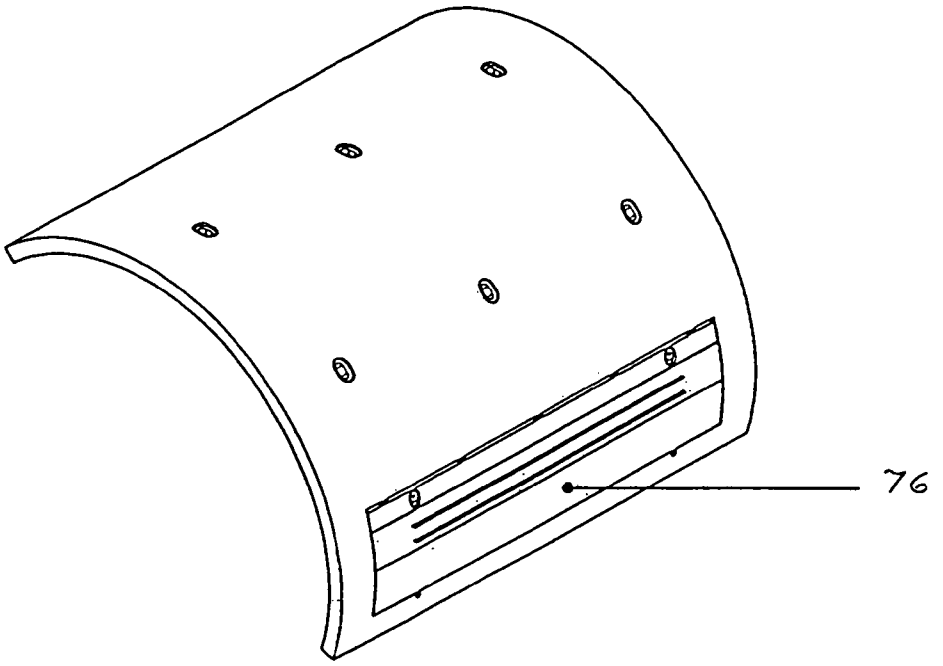


Figure 29

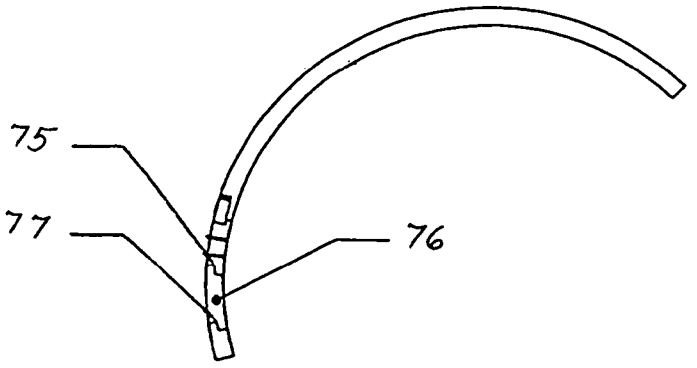


Figure 30

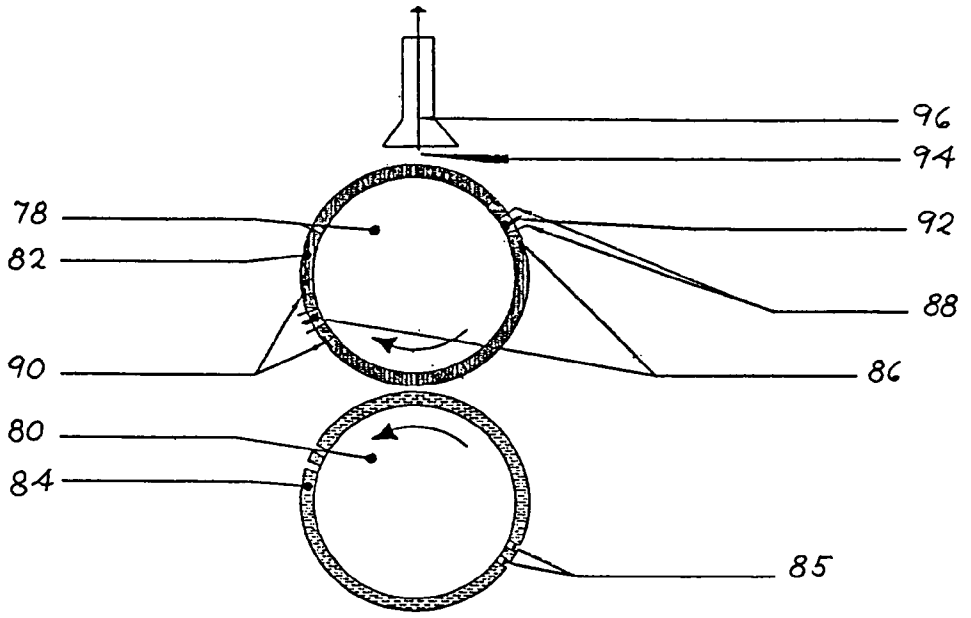


Figure 31

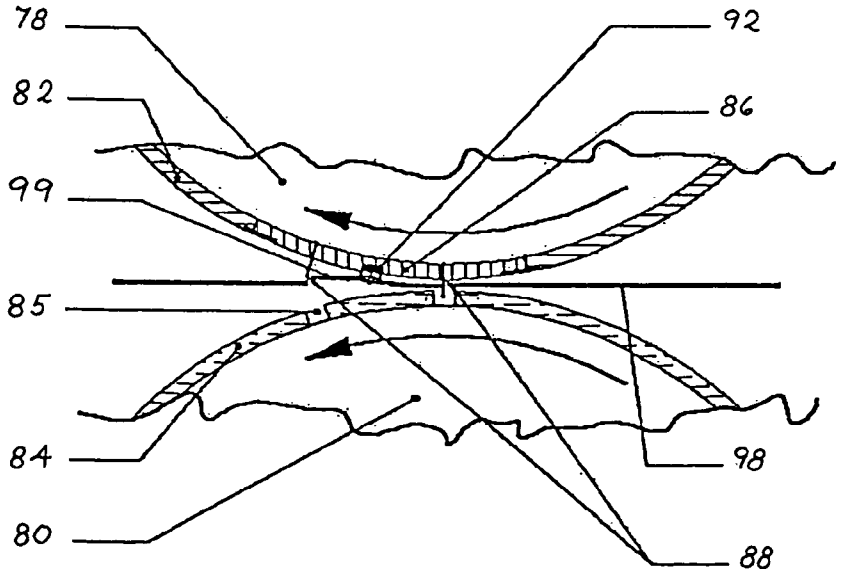


Figure 32

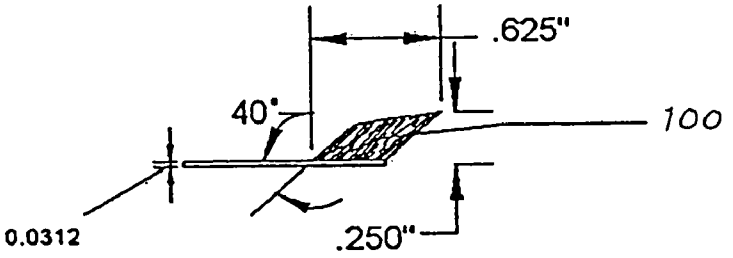


Figure 33

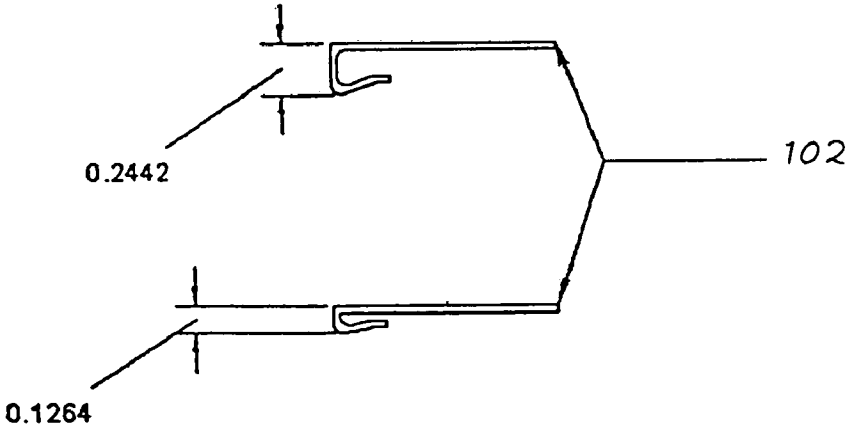


Figure 34

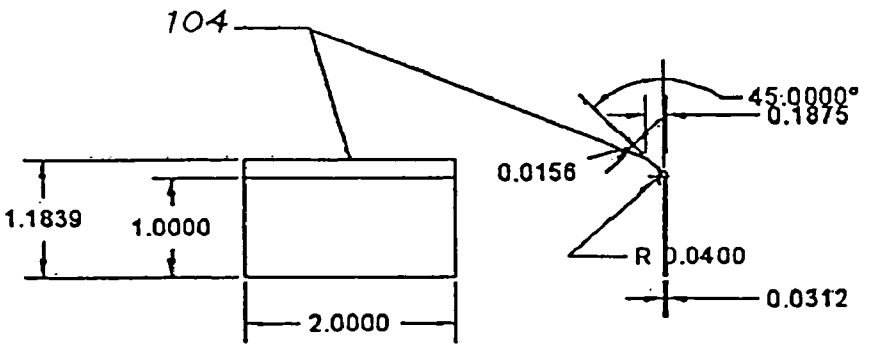


Figure 35

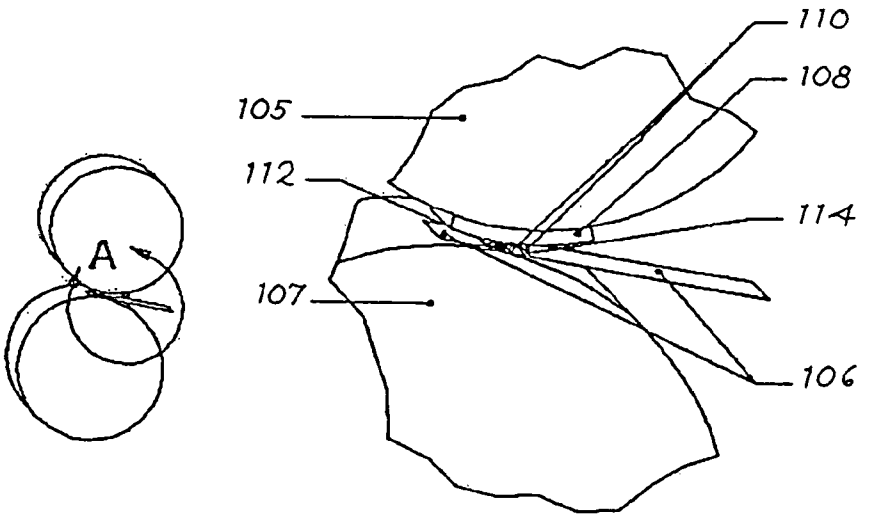


Figure 36

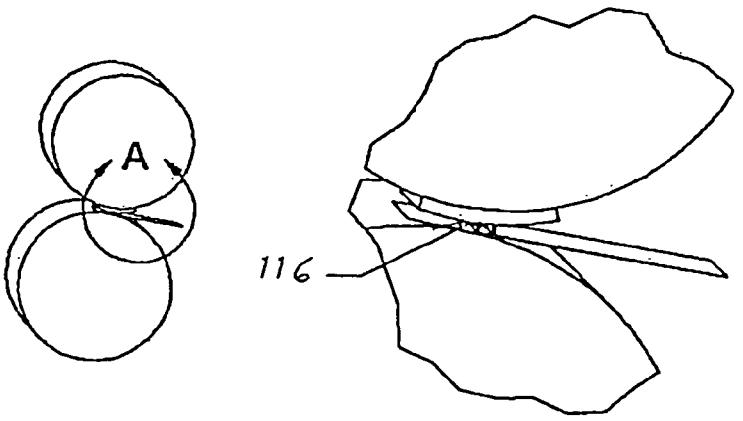


Figure 37

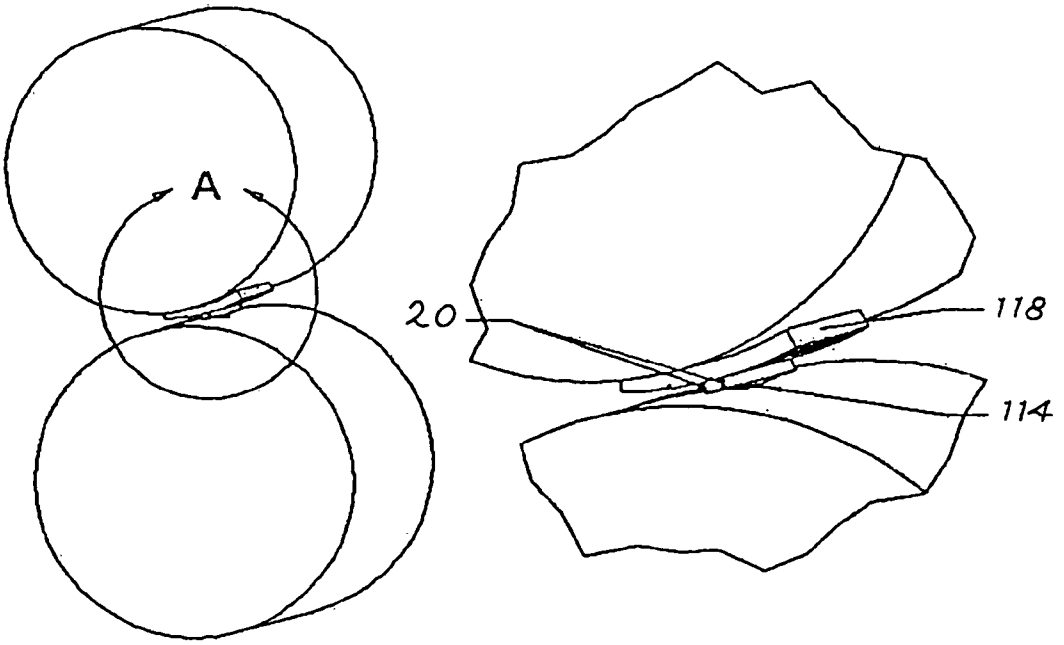


Figure 38

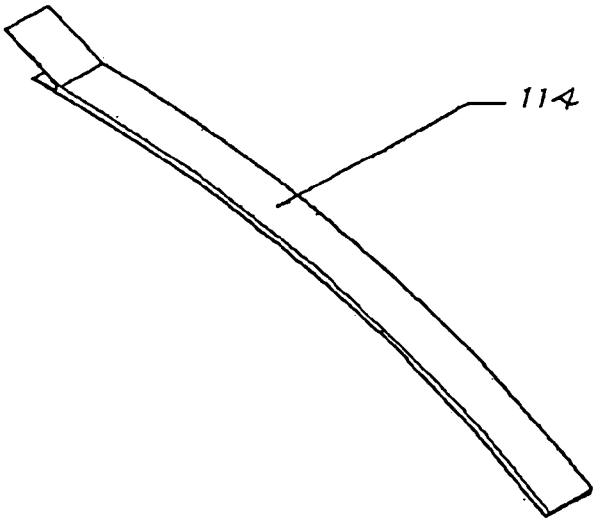


Figure 39

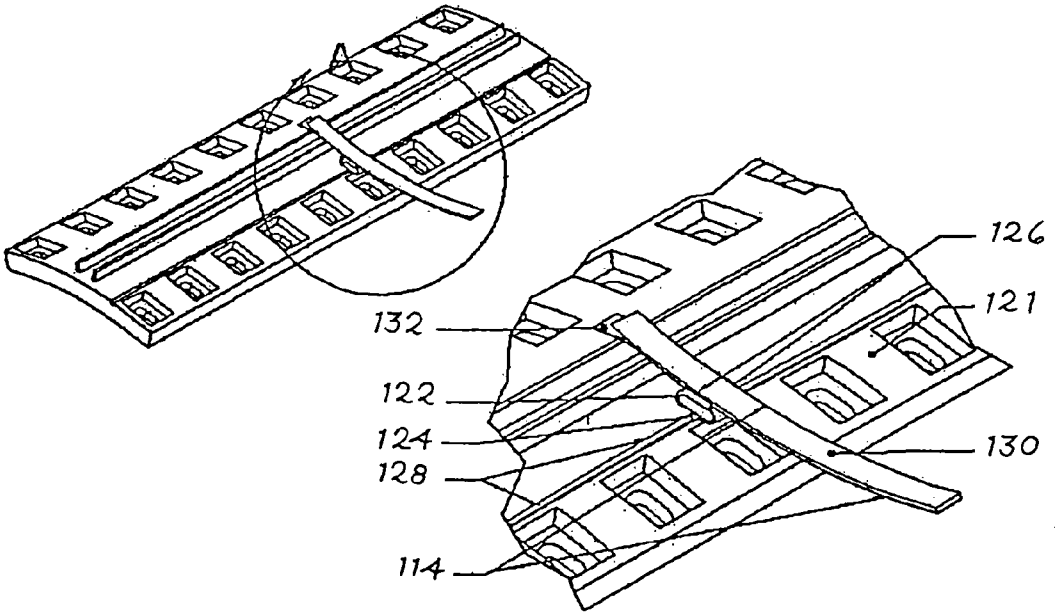


Figure 40

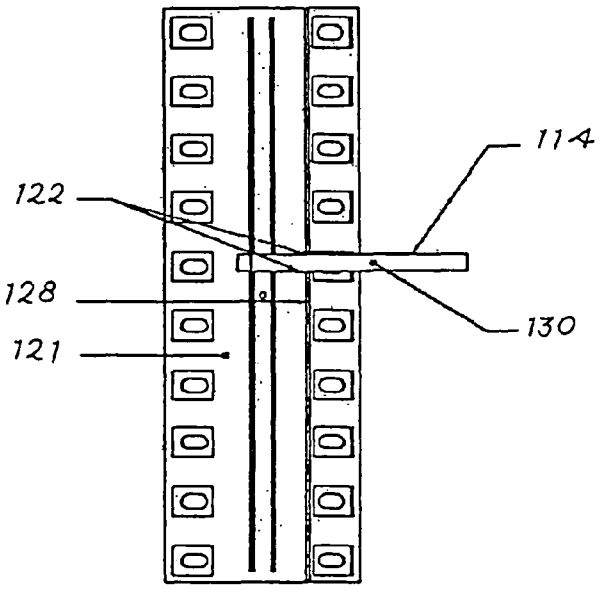


Figure 41

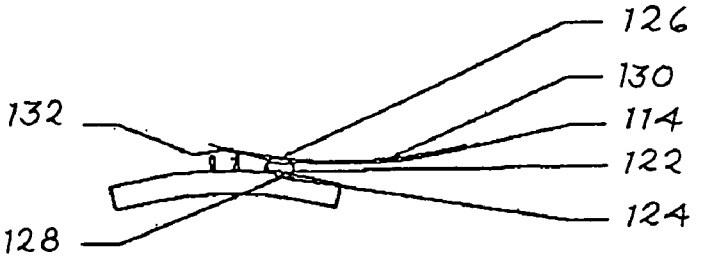


Figure 42

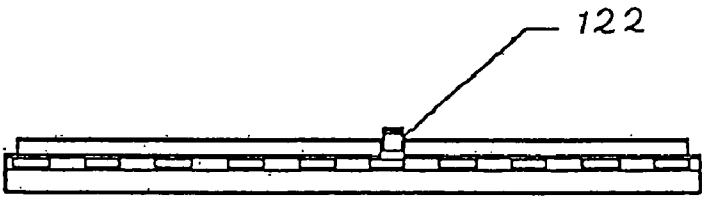


Figure 43

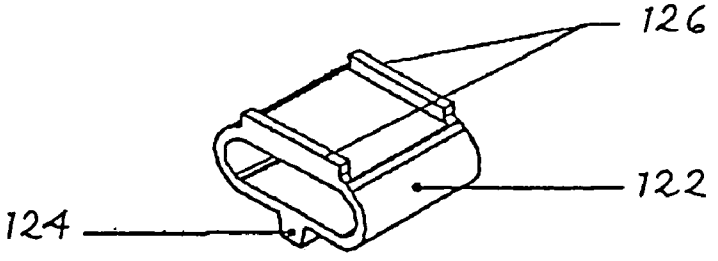


Figure 44

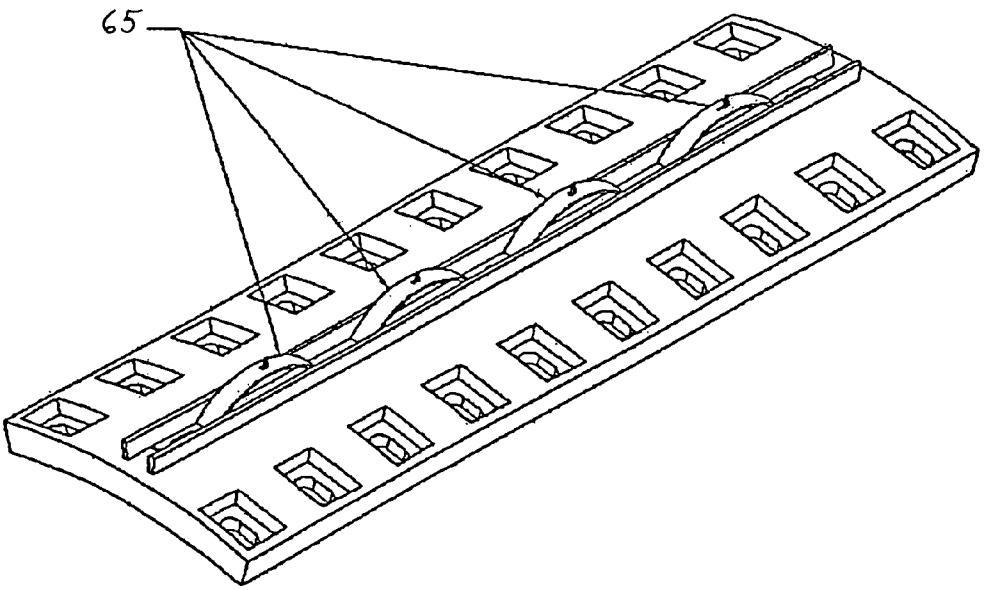


Figure 45

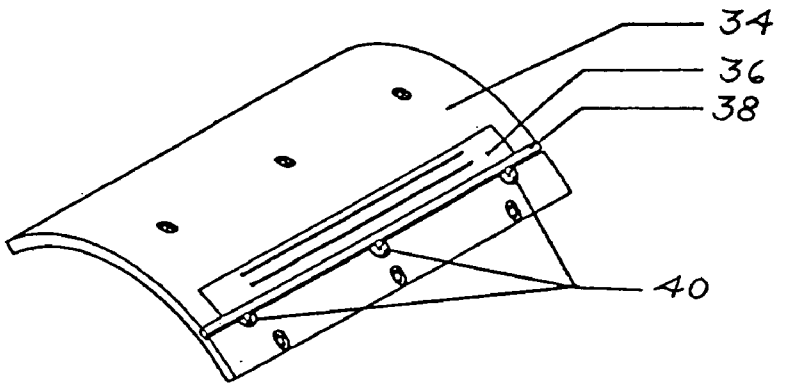


Figure 46

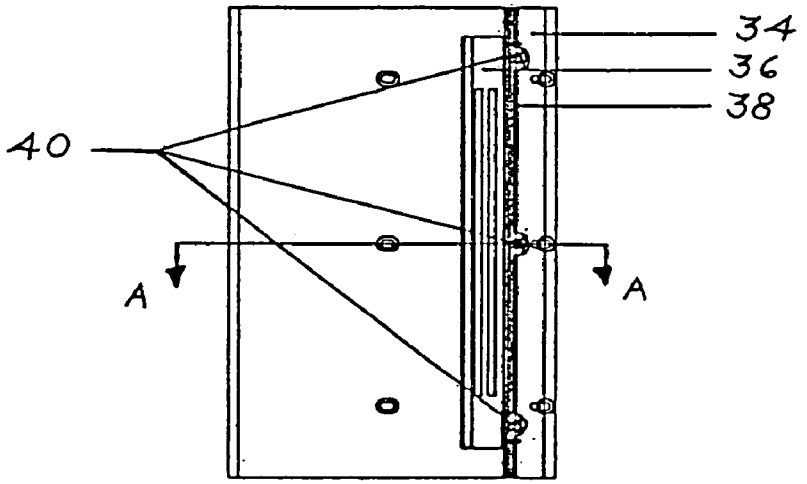


Figure 47

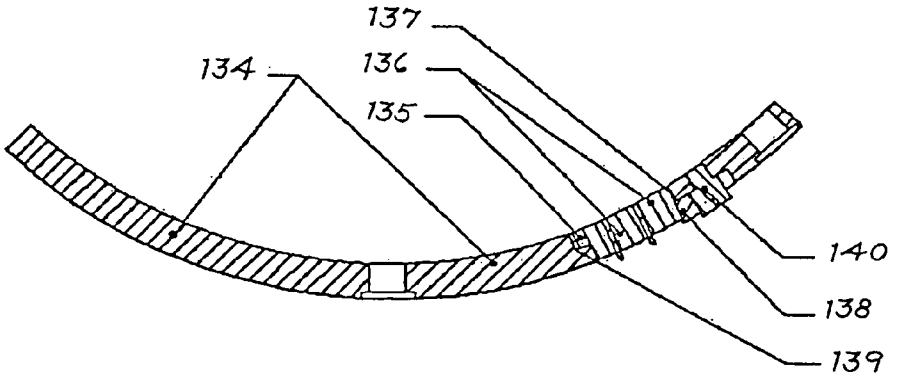


Figure 48

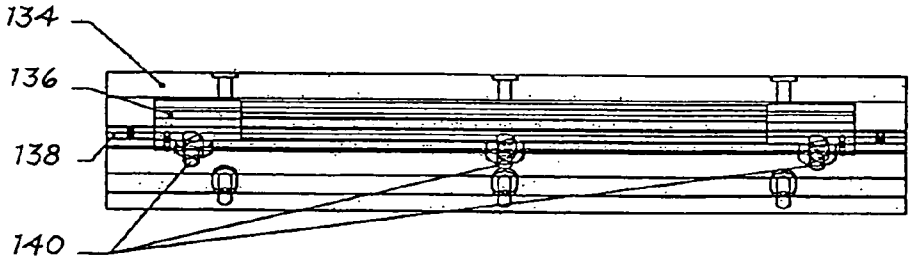


Figure 49

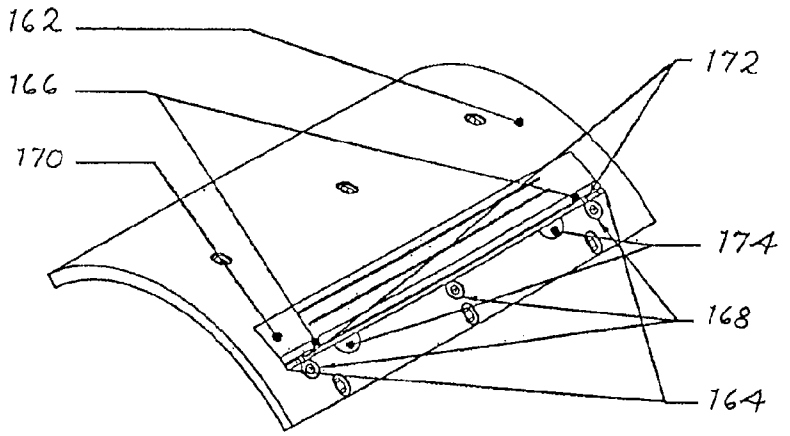


Figure 50

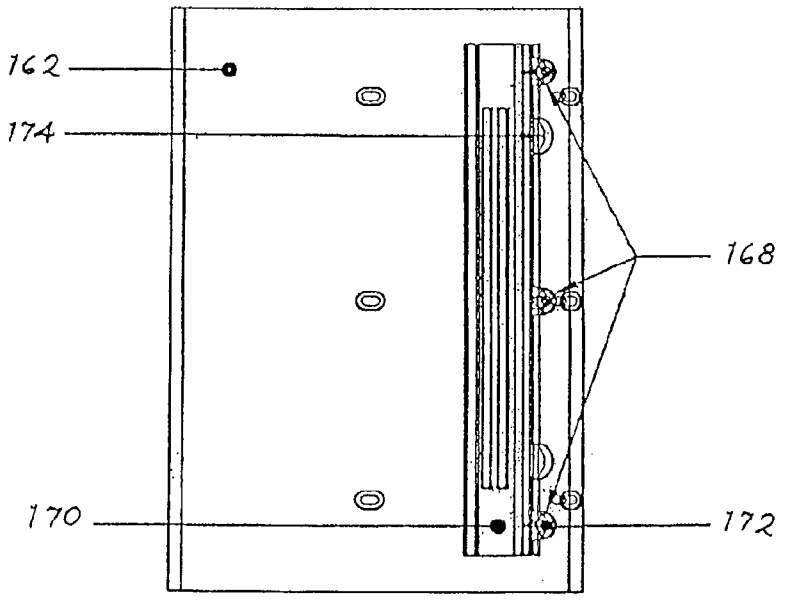


Figure 51

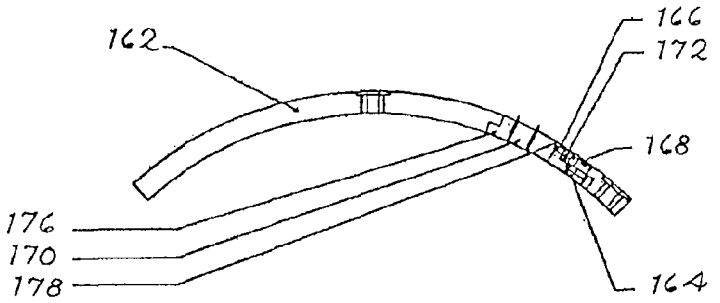


Figure 52

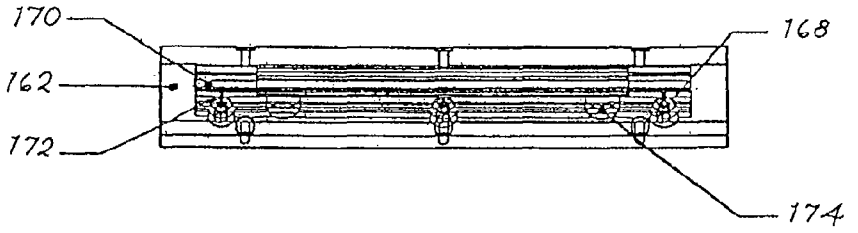


Figure 53

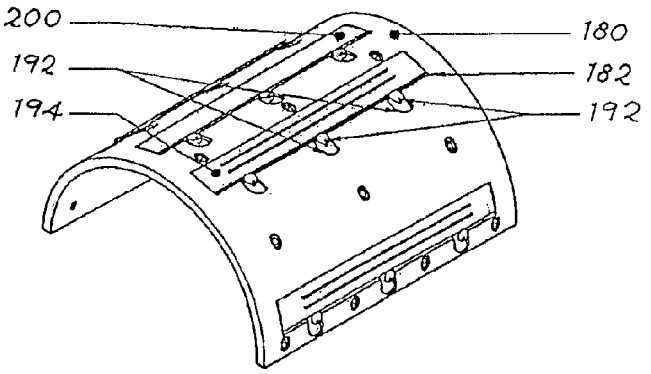


Figure 54

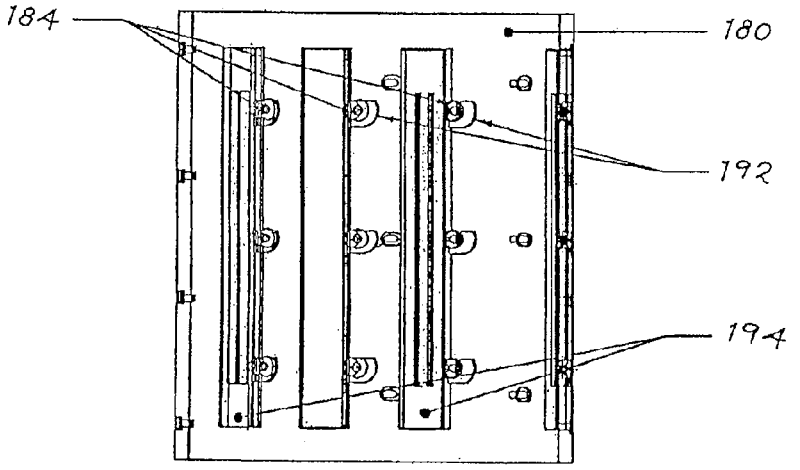


Figure 55

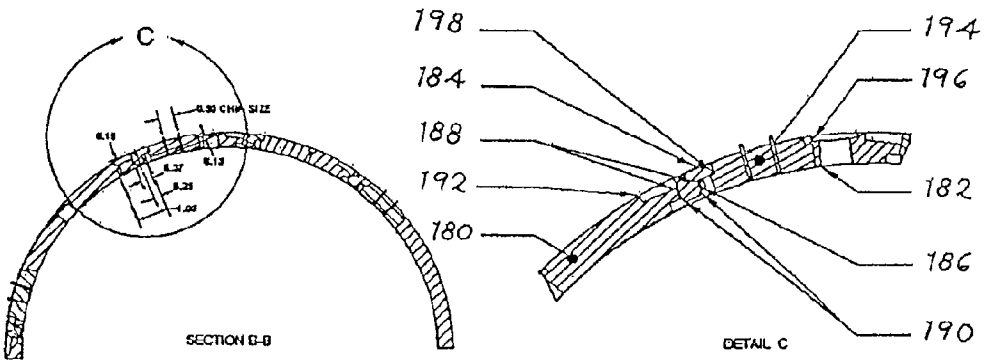


Figure 56

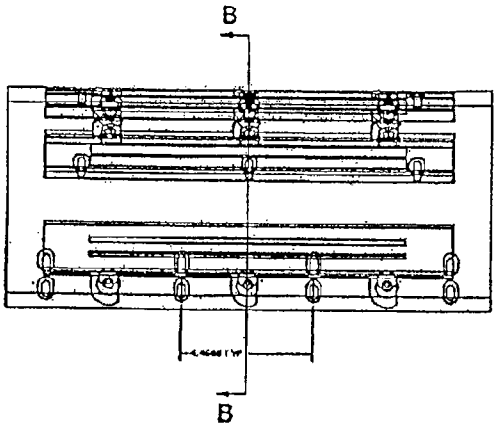
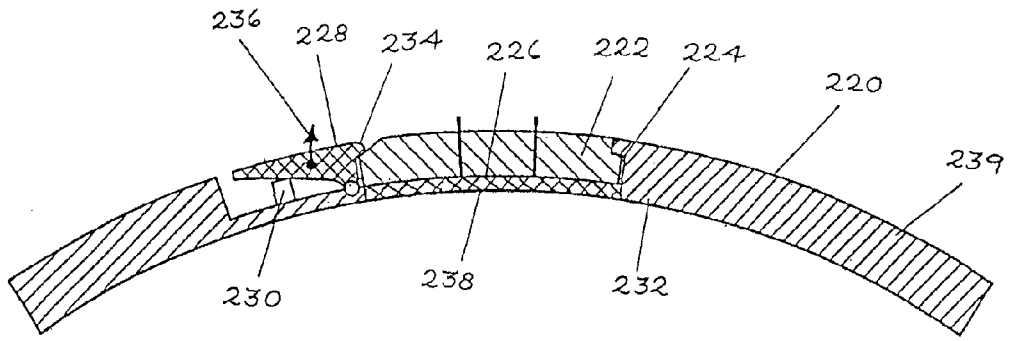
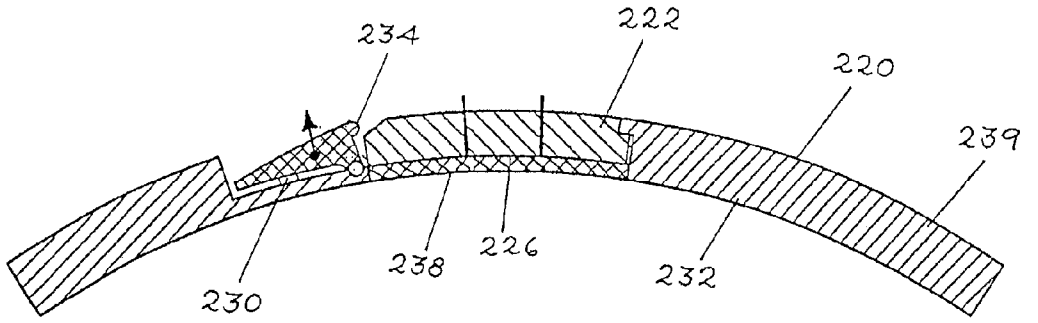


Figure 57



LOCKED POSITION

Figure 58



UNLOCKED POSITION

Figure 59

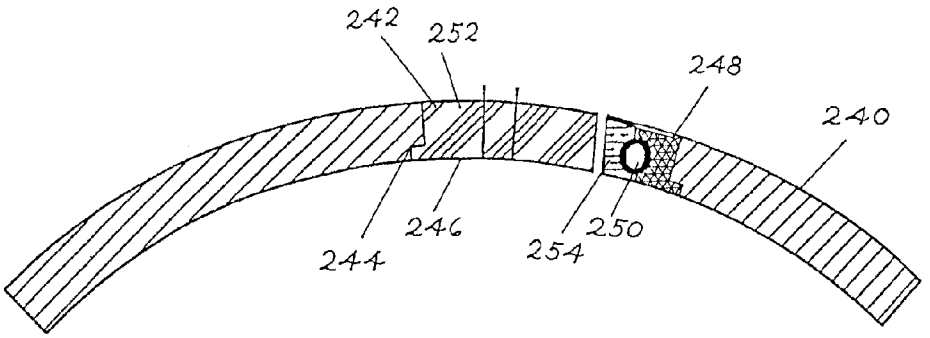
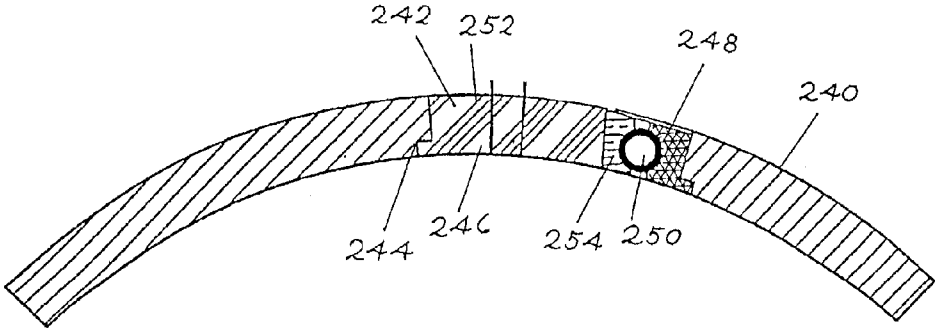


Figure 60



DIE HOLDER ASSEMBLY FOR ROTARY CUTTING SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a non-provisional application which claims the priority of U.S. Provisional Application Ser. No. 60/616,998, filed Oct. 8, 2004, the contents of which are hereby incorporated by reference.

TECHNICAL FIELD

This invention relates generally to rotary cutters for cutting web or sheet material, and more particularly to an improved means of quickly and securely attaching rotary cutting dies and knives (dies) to, and removing them from rotary, cutting machines, as well as an improved apparatus for removing scrap that is cut from the web material.

BACKGROUND

Conventional methods of attaching dies to cutting machines require the step of positioning dies individually on the die cylinder, and then using several fastening screws to secure each die to the die cylinder. The type and style of die used must be compatible with the cutting machine for proper operation. Attaching and removing conventional dies is a time consuming process, and incorporating into the dies the hardware necessary to mount conventional dies adds to the expense of manufacturing these dies.

For effective operation, conventional methods also require attaching layers of rubber between each of the mounted dies to provide a consistent surface height around the circumference of the die cylinder.

Current systems also use various mechanisms built in to the rotary cutting machine, such as holes or slots in the anvil cylinder, to remove scrap from the web material being cut. As needed, pins are inserted into and removed from holes in the die cylinder. This adds to the time required to prepare a cutting machine for operation.

BRIEF SUMMARY

The present invention provides a die holder with one or more pre-located voids into which cutting dies can be quickly and easily inserted and secured. The die holder mounts quickly to the cylinder, and can be quickly removed for alternative operations. The die holder can be made according to the operator needs for different types, sizes and positions of dies. Multiple die holders do not require a die locating system. Unused voids can be filled with 'blank' blocks to achieve a consistent or uniform surface height for the full 360 degree area of the die cylinder. Accordingly, there is no need to add rubber or bridging blocks to fill any gaps between each of the dies.

The die holder according to the present invention is superior to current methods of mounting dies on rotary cutting machines for a variety of reasons. It provides a way to more quickly and securely attach rotary cutting dies to, and remove them from, rotary cutting machines. It may be used for various styles of dies and various styles of rotary cutting machines. It may be used as an adaptor for using various dies on otherwise incompatible machines, including those of different styles and manufacturers. And it allows for the use of simpler and less costly to manufacture dies. For example, it eliminates the need for special machine mounting features, such as reinforced holes, that are required on conventionally mounted dies, as well as reducing the thickness of die base material required.

The present invention also provides a die holder with a base extending circumferentially around the cylinder, thereby bridging the gaps between dies and providing a consistent surface height around the 360 degree surface of the cylinder in order to reduce or eliminate the normal need for adding rubber or bridging blocks to the cylinder. The die holder can be configured to accommodate multiple, pre-positioned dies to simplify knife positioning and further reduce set up time. Blank (no blade) dies can be used in place of cutting dies where cutting is not needed in a die holder configured to accommodate multiple dies.

The die holder according to the present invention increases the cutting life of the die, reduces the sound level of the cutting process, and is lighter weight than a comparable conventional die.

The present invention further provides a removable scrap control apparatus that is not attached permanently to the die cylinder on which it is used, which permits the use of a multiple blade die or a plurality of single blade dies on the same die cylinder without requiring permanent holes, slots or other means to accommodate the scrap control apparatus on the die cylinder or anvil cylinder. Nor does the scrap control apparatus require pins in the cylinder.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a prospective view of a die holder with sliding lock bars and inserted die.

FIG. **2** is a top view of die holder with sliding lock bars and inserted die.

FIG. **3** is a cross sectional view of die holder with sliding lock bars and inserted die taken along line A-A of FIG. **2**.

FIG. **4** is a side view of die holder with sliding lock bars and inserted die.

FIG. **5** is a prospective view of an extended, half circumference die holder with sliding lock bars and inserted dies.

FIG. **6** is a top view of extended, half circumference die holder with sliding lock bars and inserted dies.

FIG. **7** is a cross sectional view of extended, half circumference die holder with sliding lock bars and inserted dies taken along line A-A of FIG. **6**.

FIG. **8** is a side view of extended, half circumference die holder with sliding lock bars and inserted dies.

FIG. **9** is a prospective view of a die holder adaptor with sliding lock bars and inserted die.

FIG. **10** is a top view of die holder adaptor with sliding lock bars and inserted die.

FIG. **11** is an end view of die holder adaptor with sliding lock bars and inserted die taken along line A-A of FIG. **10**.

FIG. **12** is a side view of die holder adaptor with sliding lock bars and inserted die.

FIG. **13** is a prospective view of a die holder with a tuck-in side, a spring-enforced locking bar side and an inserted die.

FIG. **14** is a top view of die holder with tuck-in side, spring-enforced locking bar side and inserted die.

FIG. **15** is a cross sectional view of die holder with tuck-in side, spring-enforced bar locking bar side and inserted die taken along line A-A of FIG. **214**

FIG. **16** is a side view of a die holder with a tuck-in side, a spring-enforced locking bar side and an inserted die.

FIG. **17** is a prospective view of a die holder with snap-in die design and an inserted die.

FIG. **18** is a top view of a die holder with snap-in die design and inserted die.

FIG. **19** is a cross sectional view of a die holder with snap-in die design and inserted die taken along line A-A of FIG. **18**.

FIG. **20** is a side view of a die holder with snap-in die design and inserted die.

FIG. **21** is a configured shape cut-out die with a flexible bowed stripper band.

FIG. **22** is a double knife die with a flexible double-bowed stripper band.

FIG. **23** is a double knife die with a multiple point, flexible, double-bowed stripper band.

FIG. **24** is a double knife die with a rubber reinforced, flexible, double-bowed stripper band.

FIG. **25** is a double knife die with a flexible double-bowed stripper band, and slip-in end pockets.

FIG. **26** is a perspective view of a die holder adaptor with a blade backer strip.

FIG. **27** is an end view of die holder adaptor with blade backer strip.

FIG. **28** is a perspective view of a die holder with a tuck-in die and a spacer bar.

FIG. **29** is an end view of die holder with a tuck-in die and a spacer bar.

FIG. **30** is a side view of die holders and dies with scrap removal mechanisms. These are shown mounted on a die cylinder, with an anvil cylinder and a scrap removal chute.

FIG. **31** is a side view of die holders and dies with scrap removal mechanisms. These are shown mounted on a die cylinder, cutting a web of material against an anvil cylinder.

FIG. **32** is a side view of a stripper brush.

FIG. **33** is a side view of two styles of stripper clips.

FIG. **34** is a top view and a side view of a stripper flap.

FIG. **35** is a partial perspective view of a stripper brush and stripper finger mounted to an anvil cylinder, and a cutting die mounted to a die cylinder with web material passing between the die cylinder and anvil cylinder.

FIG. **36** is a partial perspective view of a stripper flap and stripper finger mounted to an anvil cylinder, and a cutting die mounted to a die cylinder with web material passing between the die cylinder and anvil cylinder.

FIG. **37** is a partial perspective view of a stripper finger mounted to an anvil cylinder and an opposing die mounted to a die cylinder.

FIG. **38** is a perspective view of a stripper finger.

FIG. **39** is a perspective view of a stripper finger attached to a mounting tool which is attached to a die.

FIG. **40** is a top view of stripper finger attached to a mounting tool which is attached to a die.

FIG. **41** is an end view of stripper finger attached to a mounting tool which is attached to a die.

FIG. **42** is a side view of stripper finger attached to a mounting tool which is attached to a die.

FIG. **43** is a perspective view of a stripper finger mounting tool.

FIG. **44** is a perspective view of a double knife die with a multiple-bowed stripper band.

FIG. **45** is a perspective view of a die holder and die with a tuck-in side and a quick lock bar mechanism.

FIG. **46** is a top view of a die holder and die with a tuck-in side and a quick lock bar mechanism.

FIG. **47** is a cross sectional view of a die holder and die with a tuck-in side and a quick lock bar mechanism taken along line A-A of FIG. **46**.

FIG. **48** is a side view of a die holder and die with a tuck-in side and a quick lock bar mechanism.

FIG. **49** is a perspective view of a cam lock die holder and die with free spinning cam and Z lock bar.

FIG. **50** is a top view of a cam lock die holder and die with free spinning cam and Z lock bar.

FIG. **51** is an end view of a cam lock die holder and die with free spinning cam and Z lock bar.

FIG. **52** is a side view of a cam lock die holder and die with free spinning cam and Z lock bar.

FIG. **53** is a perspective view of a cam lock die holder and dies with free spinning cam locks.

FIG. **54** is a top view of a cam lock die holder and dies with free spinning cam locks.

FIG. **55** is a cross sectional view of a cam lock die holder and dies with free spinning cam locks.

FIG. **56** is a side view of a cam lock die holder and dies with free spinning cam locks.

FIG. **57** is a cross sectional view of a centrifugal lock die holder and cutting die with a centrifugal lock in the locked position.

FIG. **58** is a cross sectional view of a centrifugal lock die holder and cutting die with a centrifugal lock in the unlocked position.

FIG. **59** is a cross sectional view of a bladder lock die holder and cutting die with a bladder lock in the unlocked position.

FIG. **60** is a cross sectional view of a bladder lock die holder and cutting die with a bladder lock in the locked position.

DETAILED DESCRIPTION OF THE DRAWINGS AND THE PRESENTLY PREFERRED EMBODIMENTS

Referring to FIG. **30**, there is shown a die cylinder **78**, with an anvil cylinder **80**, a stripper comb **94**, and a scrap removal chute **96**. The web material (not shown) passes between the nip formed between the two cylinders. Die holders **82**, dies **86**, and scrap removal mechanisms **92** are shown mounted on a die cylinder **78**. A resilient material **84** is covering the anvil cylinder except for the gaps **85** corresponding to the die blades **92** on die cylinder **78**. FIG. **31** shows an enlarged partial side sectional view of die holder **82**, die **86** and scrap removal mechanism **92**, which are mounted on die cylinder **78**. A web of material **98** is cut by die blades **88**. The web material scrap **99** is impaled by scrap removal mechanism **92**.

FIGS. **1**, **2**, **3** and **4** show a perspective, top, cross sectional and side view, respectively, of a cutting die with a base **14** and blades **16**. The die is inserted into a cutout **5** of a base of die holder **2**, and secured with locking bars **12** and fasteners **8**. Locking bars **12** are set in indentations **6** of base of die holder **2**. Fasteners **8** extend through openings **10** in the locking bar and openings **9** in the base of die holder **2**. Fasteners through holes **4** in the base **2** of the die holder are used to mount the base **2** to die cylinder **78**. A locking bar lip **20** fits into a notch **18** in the die base edge to secure the position of locking bar **12** and die base **14**.

FIGS. **5**, **6**, **7** and **8** show a perspective, top, cross sectional and side view, respectively, of cutting dies **21**, similar to the cutting die shown in FIGS. **1-4**, that are inserted into multiple cutouts **23** of a base of a die holder **22** that extends around half of the circumference of cylinder **78**. A blank **24** is inserted in one cutout in place of a cutting die **21**.

FIGS. **9**, **10**, **11** and **12** show a perspective, top, end and side view, respectively, of a cutting and perforating die, similar to the cutting dies shown in FIGS. **1-8**, which is mounted to a base of a die holder adaptor **26**. Contours **28** in the base of the die holder adaptor are configured to fit the shape of the base of a die **25**.

FIGS. **13**, **14**, **15** and **16** show a perspective, top, cross sectional and side view, respectively, of a tuck-in style die **36** that is inserted into a cutout **31** of a base of a die holder **30**. An edge **35** of die **36** tucks into an indentation **38** in a base of die holder **30**. Another edge **37** of die **36** is secured by a locking bar **32**, which is pushed into place and reinforced by springs **34**.

FIG. **28** shows a perspective view and FIG. **29** shows an end view of a spacer **76** and a tuck-in style die, similar to the style in FIGS. **13-16**. Spacer **76** fits securely between a contour edge **75** of the die and a contour edge **77** of the die holder.

FIGS. **45**, **46**, **47** and **48** show a perspective, top, cross sectional and side view, respectively, of another tuck-in style die **136** in a die holder **134**. An edge **135** of die **136** is tucked into an indentation **139** in die holder **134**. Another edge **137** of die **136** is secured by a locking bar **138** which is secured by a locking screw **140**.

FIGS. **17**, **18**, **19** and **20** show a perspective, top, cross sectional and side view, respectively, of a snap-in style die **42** that is inserted into a cutout **41** of a base of a die holder **40**. Contoured edges **44** of die **42** fit securely into and around contoured edges **46** of die holder **40**.

FIG. **26** shows a perspective view and FIG. **27** shows an end view of a cutting die **73** with a blade backer strip **72** fit into an indentation **74** of the base of a die holder adaptor **71**.

FIG. **21** shows a perspective view of a contour cutting die with a base **48**, a blade **50**, and a flexible, pointed, bowed stripper band **52** arcing away from the die base. A point **54** is at the peak of the arc. Slotted ends **56** of stripper band **52** fit securely under and around fasteners **58**.

FIG. **22** shows a perspective view of a cutting die **59** with a flexible, pointed, double bowed stripper band **60**. The middle section of the band is secured to die **59** with a fastener **62**. Slotted ends **61** of stripper band **60** fit securely under and around fasteners **63**. Spring supports **64** are under the arcs of stripper band **60**.

FIG. **44** is a perspective view of a double knife die with a multiple-bowed stripper band **65**.

FIG. **23** shows a perspective view of a cutting die with a flexible, pointed, multiple bowed stripper band with multiple points **66** at the peaks of the arcs of the stripper band.

FIG. **24** shows a perspective view of a cutting die with a flexible, pointed, multiple bowed stripper band with rubber supports **68** under the arcs of the stripper band.

FIG. **25** shows a perspective view of a cutting die with a flexible, pointed, multiple bowed stripper band. Ends **69** of the stripper band fit securely into fastener pockets **70** molded into the die.

FIG. **35** shows a perspective view of a stripper brush **112** and a stripper finger **114** mounted to an anvil cylinder **107**, and a cutting die **108** mounted to a die cylinder **105** with the web material **106** passing between the die cylinder and the anvil cylinder. Brush **112** and finger **114** are positioned to capture the "scrap" web material from between (and cut with) the die blades **110**. A stripper brush **100** (FIG. **32**), flap **104** (FIG. **34**), flap **116** (FIG. **36**), and clip **102** (FIG. **33**) may be used in place of brush **112** in alternative embodiments.

FIGS. **39**, **40**, **41** and **42** show a perspective, top, end and side view, respectively, of stripper finger **114** (FIG. **38**) attached to a mounting tool **122** that is attached to a die **121**. On the die side of mounting tool **122** is a protrusion **124** inserted into a channel **128** in die **121**. On the other side of mounting tool **122** is a clasp **126** to hold finger **114**. Finger **114** has an appendage **132** for stripping material.

FIGS. **49**, **50**, **51** and **52** show a perspective, top, end and side view of a cam lock die holder **162** and die **170** with free spinning cam **168** and Z lock bar **166**. Die **170** is positioned in a die holder opening **164**. One edge **176** is tucked under holder **162** in opening **164** and the opposite edge **178** is secured by a locking bar **166** which is held in position by a plurality of cams **168**. A plurality of thumb notches **174** are in holder **162** along edge of opening **164**. A plurality of posts **172** pass through locking bar **166** from die holder **162**.

FIGS. **53**, **54**, **55** and **56** show a perspective, top, cross sectional and side view of a cam lock die holder **180**, a spacer **200** and dies **194** with free spinning locking cams **184**. Die **194** is positioned in a die holder opening **182**. One edge **196** is tucked under holder **180** in opening **182** and the opposite edge **198** is secured by a plurality of locking cams **184**. A cam shaft **186** is inside of a metal sleeve **188** and held by a retention ring **190**. The head of cam **184** is countersunk in a cavity **192**.

As shown in FIGS. **30** and **31**, the invention is used on rotary cutting machines having a die cylinder **78** and an anvil cylinder **80**. A die holder **82** and die **86** are attached to die cylinder **78**. A scrap removal mechanism **92** is attached to die **86**. A web of material **98** passes between die cylinder **78** and anvil cylinder **80**, and is cut by die blades **88**. A scrap removal mechanism **92** impales web material scrap **99** against a resilient material **84** covering the anvil cylinder, and carries scrap **99** away from web **98**. A stripper brush or comb **94** and vacuum chute **96** may be mounted near the path of the rotating scrap removal mechanism **92** to aid in removing scrap **99** from the scrap removal mechanism **92** as it passes by the stripper brush or comb **94** and vacuum chute **96**.

In one embodiment, the die holder is made of a polyurea elastomer having a hardness of 60±5 (Shore D). However, other materials may be used.

In one embodiment, the locking bar is made of steel. However, other materials may be used.

To install the style of cutting dies shown in FIGS. **1-8**, a user attaches die holder base **2** as they would normally attach a die to a die cylinder **78**. The user then loosens fasteners **8** enough to slide the locking bars **12** away from cutout **5**. The user then positions die **14** into cutout **5**, and slides locking bars **12** over the edges of die base **14**. The user fits locking bar lip **20** into notch **18** in the die base edge, then tightens fasteners, clamping locking bar **12** against die base **14**, and securing die **14** and die holder **2** to die cylinder **78**.

To eliminate or reduce the need for rubber that is otherwise added by the user, two half circumference die holders **22** (FIGS. **5-8**) are attached to the die cylinder **78**, circumventing the cylinder. The die holders **22** may remain attached to the die cylinder **78** when dies **21** are replaced. The multiple cutouts **23** of the base of a die holder **22** are predetermined at the time die holder **22** is made to accommodate the desired and/or most likely used die positions. With die holders **22** in place, the user is able to quickly insert and secure dies **21** to the proper location on the cylinder **78** according to the job requirements. Blank dies **24** are inserted into cutouts **23** where cutting dies **21** are not required.

A die holder adaptor **26** (FIGS. **9-12**) may be used to attach dies **25** to an otherwise incompatible die cylinder **78**. The die holder adaptor **26** is sized to fit the die cylinder **78** on a rotary cutting machine. Contours **28** in the base of the die holder adaptor are configured or adapted to fit the shape of the base of the dies **25**. The user attaches die holder adaptor **26** to the die cylinder **78** with fasteners as they would normally attach a die, then inserts and secures dies **25** into the die holder adaptor.

To install a tuck-in style die **36** (FIGS. **13-16**), the user attaches a die holder **30** to a die cylinder **78** with fasteners as they would normally attach a die. The user inserts an edge **35** of die **36** into an indentation **38** in the base of a die holder **30**,

pulls back a locking bar **32** to allow the other edge **37** of die **36** to be placed into cutout **31**, positions die **36** in cutout **31**, and then positions and secures locking bar **32** over die edge **37**.

A spacer **76** (FIGS. **28**, **29**) may be used to fill in extra space and secure the die **36** when die **36** is substantially smaller than the cutout **31**. In one embodiment, the die is made of a polyurea elastomer having a hardness of 60±5 (Shore D). The user installs spacer **76** between the contour edge **75** of the die and the contour edge **77** of the die holder in the same way that the user installs tuck-in die **36** as described above.

To install a snap-in style die **42** (FIGS. **17-20**), the user attaches a die holder **40** to a die cylinder **78** with fasteners as they would normally attach a die. The user inserts die **42** into a cutout **41** of the base of die holder **40**. Contoured edges **44** of the base of die **42** fit securely into and around the contoured edges **46** of the base of the die holder **40**.

A blade backer strip **72** (FIGS. **26**, **27**) is used in a die holder adaptor **71** to distribute the force exerted through the blades of a die **73** to die holder adaptor **71**. In one embodiment, the blade backer strip **72** is made of steel. The user attaches die holder adaptor **71** to the die cylinder **78** with fasteners as they would normally attach a die, inserts blade backer strip **72** into an indentation **74** in the base of die holder adaptor **71**, and then inserts and secures die **73** into die holder adaptor **71**.

To install a tuck-in style die **136** (FIGS. **45-48**), the user attaches a die holder **134** to die cylinder **78** as they would normally attach a die. The user inserts an edge **135** of die **136** into an indentation **139** in the base of a die holder **134**, pulls back a locking bar **138** to allow the other edge **137** of die **136** to be placed into holder **134**, positions die **136** in holder **134**, then positions locking bar **138** over die edge **137** and secures it with a plurality of locking screws **140**.

To install a cam lock die **170** (FIGS. **49-52**), the user positions a die holder **162** with a locator bar (not shown) and secures the die holder **162** to a die cylinder with a plurality of fasteners as they would normally attach a die. The user inserts a die **170** into a die holder opening **164**, tucking one edge **176** under holder **162**. The user secures die **170** with locking bar **166** by turning a plurality of cams **168** that slide locking bar **166** over a die edge **178**. A plurality of thumb notches **174** in holder **162** allow easy insertion and removal of die **170**. A plurality of posts **172** passing through locking bar **166** from die holder **162** add stability and security to the die locking system.

To install a cam lock die **194** (FIGS. **53-56**), the user positions and secures a die holder **180** as they would with die holder **162**. The user inserts a die **194** into a die holder opening **182**, tucking one edge **196** under holder **180**. The user secures die **194** by turning a plurality of cams **184** that slide over a die edge **198**.

FIGS. **57** and **58** show cross sectional views of a centrifugal lock die holder **220** for securing cutting die **222** to a rotary cutting cylinder (not shown). The die holder **220** comprises a an indentation **224** along one side of the recess **226** into which one edge of the base **232** of the cutting die **222** is laterally inserted and secured. The opposite edge of the base **232** of the cutting die **222** is secured by a centrifugal lock **228** that is rotatably attached to the base of the die holder. The centrifugal lock **228** is rotatable between a first position (shown in FIG. **57**) wherein the cutting die **222** is secured to the die holder, and a second position (shown in FIG. **58**) wherein the cutting die **222** can be removed from (or inserted into) the recess **226** of the die holder **220**.

In the particular embodiment illustrated, the centrifugal lock **228** includes a retaining lip **234** that engages with and upper portion of the cutting die **222** when in the first position so as to retain the cutting die **222** within the recess **226**. A spring **230** is disposed between centrifugal lock **228** and the base **232** of the die holder so as to bias the centrifugal lock **228** in the first position. In addition, the centrifugal lock **228** has a center of mass **236** that is offset from the axis of rotation so that centrifugal forces acting on the centrifugal lock **228**, as a result of rotation the rotary cutting cylinder, bias the centrifugal lock **228** in the first position. In particular, and with specific reference to FIG. **57**, the center of mass **236** is disposed so that the outwardly directed centrifugal force causes the centrifugal lock to rotate clockwise towards the first or closed position. Thus, the faster the rotation of the rotary cutting cylinder, the larger the closing force of the centrifugal lock **228**.

The base **232** of the die holder **220** comprises a plurality of portions manufactured from different materials or having different physical properties. For example, and as illustrated in FIGS. **57** and **58**, the base **232** comprises a first portion **238** below the recessed area **266** manufactured from a first material, and a second portion **239** adjacent to the recessed area **226** manufactured from a second material. The first material may comprise an impact absorbing material such as plastic or rubber that is adapted to absorb the force transmitted to the base **232** by the cutting die **222**. The second material may comprise a more rigid material such as aluminum to provide overall rigidity to die holder **220**. The inclusion of an impact absorbent material in the first portion **238** of the base **232** below the cutting die **222** eliminates the need for a separate impact absorbing layer (e.g., rubber) between the die holder **220** and the rotary cutting cylinder. In an alternative design, the first portion **238** below the recessed area **266** comprises a multi-layer material having an impact absorbent material layered on top of (over) a more rigid material. For example, the entire base **232** may comprise a uniform material such as aluminum with a rubber pad disposed on top of the first portion of the **238** along the bottom of the recessed area **266**. It should also be understood that the use of different materials for different portions of the die holder base, as described above, can be utilized in any of the previously described embodiments.

FIGS. **59** and **60** show perspective views of a bladder lock die holder **240** for securing cutting die **242** to a rotary cutting cylinder (not shown). The die holder **240** comprises a an indentation **244** along one side of the recess **246** into which one edge of the base **252** of the cutting die **242** is laterally inserted and secured. The opposite edge of the base **252** of the cutting die **242** is secured by a bladder lock **248** that is secured attached to the base of the die holder. The bladder lock **248** is movable between a first position (shown in FIG. **60**) wherein the cutting die **242** is secured to the die holder, and a second position (shown in FIG. **59**) wherein the cutting die **242** can be removed from (or inserted into) the recess **246** of the die holder **240**. The bladder lock **248** is moved or actuated by a change in fluid pressure within a chamber **250** inside the bladder lock **248**. In particular, a fluid is injected into the chamber **250** so as to move an edge **254** of the bladder lock **248** towards and into engagement with the cutting die **242**. The cutting die **242** is released by removing or reducing the fluid pressure within the chamber **250** of the bladder lock **248**. In the embodiment illustrated, the chamber **250** comprises an air bladder that is filled with air. The pressure of the air within the chamber **250** is increased to move the bladder lock **248** from the second position to the first position, and is reduced to move the bladder lock **248** from the first position to the second position.

Various scrap removal mechanisms may also be incorporated into the die. With reference to FIG. **21**, a flexible,

pointed, bowed stripper band **52** is installed onto a base **48** of a contour cutting die by positioning the slotted ends **56** of stripper band **52** under and around fasteners **58**. The user secures the ends **56** by tightening the fasteners **58**. The point **54** on the band **52** should be directed away from the base **48** in order to impale scrap **99** and carry it to the stripper comb **94** and scrap removal chute **96**. The band **52** pushes scrap **99** away from die blade **50** in order to separate scrap **99** from the web of material **99**. The band **52** can be removed by loosening fasteners **58** and pushing ends **56** inward to slide from under the fasteners **58**.

One embodiment of the stripper band is made of steel. The points are cut and bent up from the strip.

With reference to FIG. **22**, a flexible, pointed, multiple bowed stripper band **60** is installed in a cutting die **59** in a similar way to band **52**. The user positions the slotted ends **61** of stripper band **60** under and around fasteners **63**, and secures the ends **61** by tightening the fasteners **63**. The user then secures the middle section of the band to die **59** with a fastener **62**. The band **60** can be removed by loosening fasteners **63**, removing fastener **62**, and then pushing ends **61** inward to slide from under the fasteners **63**. The user may insert springs **64** or rubber **68** (FIG. **24**) under the arcs of stripper band **60** for additional support.

FIG. **25** shows a different embodiment wherein the user inserts the ends **69** of the stripper band into fastener pockets **70** molded into the die to secure the ends **69**.

In different style scrap removal system (FIGS. **32-43**), a stripper finger **114** is used in conjunction with a stripper brush **112** to remove and carry "scrap" from a web material **106**. Brush **112** and finger **114** are positioned to capture the scrap web material from between the die blades **110**.

Finger **114** is positioned and attached to an anvil cylinder **107** with the use of a mounting tool **122**. Finger **114** is held by a clasp **126** to mounting tool **122**. Mounting tool **122** is attached by a protrusion **124** to a channel **128** in a die **121**. An adhesive is used to attach an anvil cylinder side of finger **114** to anvil cylinder **107**. A die cylinder **105** and anvil cylinder **107** are rotated until side of finger **114** adheres to anvil cylinder **107**. Mounting tool **122** is removed before cutting operation begins. Brush **112** is positioned and attached to cylinder **107** in order to form a pocket with an appendage **132** on finger **114** around a die blade **110** to carry "scrap" from a web material **106**. A stripper brush **100** (FIG. **32**), flap **104** (FIG. **34**), flap **116** (FIG. **36**), and clip **102** (FIG. **33**) may be used in place of brush **112** in alternative embodiments.

It should be understood that variations and alternative methods of embodying the present invention are contemplated. For example, various materials, such as steel, aluminum, plastic or epoxy, may be used to make the die base. Various materials, such as plastic, rubber, wood, steel or aluminum, may be used to make the die holder and blade backer strip. Various materials, such as plastic, wood, steel or aluminum, may be used to make the locking bar. Various materials, such as plastic, steel or other metals may be used to make the stripper band. And various materials, such as urethane may be used to reinforce the stripper band.

The locking bar can be drawn toward the die with magnets rather than pushed toward the die with springs. Various configurations, such as parallel or perpendicular bent points or pin inserts, may be used for the stripper band points. The ends of slotted stripper bands may be secured to the die with fixed posts rather than screw down fasteners. The die holder and die holder adaptor may be used to hold various shapes, sizes, makes and types of dies, including epoxy, steel, and mechanical. And the dies, die holders, die holder adaptors and scrap removal mechanisms may be used on various shapes, sizes, makes and types of rotary cutting machines, including those with the die cylinder under the anvil cylinder.

It is therefore intended that the foregoing detailed description be regarded as illustrative rather than limiting, and that it be understood that it is the following claims, including all equivalents, that are intended to define the spirit and scope of this invention.

The invention claimed is:

1. A die holder system for securing a rotary cutting die to a rotary die cylinder, said die holder system comprising:

a rotary cutting die comprising a cutting blade fixedly mounted to a curved cutting die base, the cutting die base comprising an edge disposed along the perimeter thereof,

a die holder comprising a curved holder base having a lower surface and an upper surface, the lower surface being configured to be mounted on a rotary die cylinder, the upper surface comprising a recessed area configured for receiving the cutting die base of the rotary cutting die, the recessed area having a depth that is equal to a thickness of the cutting die base and equal to a thickness of the curved holder base so that an upper surface of the cutting die base is flush with the upper surface of the die holder base and a lower surface of the die base is mountable against the rotary die cylinder, said cutting blade having a lower edge coincident with the lower surface of the cutting die base,

wherein the die holder further comprises a first mounting system for removably securing the die holder to the rotary die cylinder, and a second mounting system for removably securing the cutting die base of the rotary cutting die to the die holder by engaging the edge of the cutting die base at a plurality of spaced apart locations, the second mounting system being configured so as to not project above the upper surface of the holder base and not project below the lower surface of the holder base, and

wherein said cutting blade is fixed to said cutting die base when said rotary cutting die Is not mounted to said die holder.

2. The die holder system according to claim **1** wherein the upper surface of the holder base comprises a plurality of spaced apart recessed areas configured for receiving a plurality of cutting dies.

3. The die holder system according to claim **1** wherein the first mounting system comprises a plurality of first fasteners configured to secure the holder base to the rotary die cylinder, the plurality of first fasteners being spaced apart from the recessed area and configured so as to not project above the upper surface of the holder base when the die holder is secured to the rotary die cylinder.

4. The die holder system according to claim **1** wherein the second mounting system comprises a plurality of second fasteners configured to secure the cutting die to the die holder.

5. The die holder system according to claim **1** wherein the second mounting system comprises a contoured portion disposed along each of two opposite sides of the recessed area of the holder base, each contoured portion configured to receive and secure the cutting die base of the cutting die to the die holder with a snap-in arrangement.

6. The die holder system according to claim **1** wherein the second mounting system comprises an indentation disposed along a side of the recessed area of the die holder, the indentation configured to laterally receive and secure a first edge of the cutting die base to the die holder at a first location.

7. The die holder system according to claim **6** wherein the second mounting system further comprises a mechanism con-

figured to secure an opposite edge of the cutting die base to the die holder, the opposite edge being at a location opposite the first location with the cutting blade being disposed there between.

8. The die holder system according to claim **7** wherein the mechanism comprises a plurality of second fasteners configured to extend through the cutting die base of the rotary cutting die.

9. The die holder system according to claim **7** wherein the mechanism comprises a plurality of cams rotatably attached to the die holder, the cams being rotatable between a first position and a second position, the first position configured to engage the opposite edge of the cutting die base and secure the cutting die base to the die holder, the second position configured to disengage from the opposite edge of the cutting die base and permit the cutting die base to be removed from the die holder.

10. The die holder system according to claim **9** wherein the plurality of cams each comprise an axis of rotation that is transverse to an axis of rotation of the rotary die cylinder and are configured to laterally engage an indentation in the opposite edge of the cutting die base.

11. The die holder system according to claim **7** wherein the mechanism comprises a centrifugal lock rotatably attached to the die holder, the centrifugal lock being moveable between a first position and a second position, the first position configured to engage and secure the opposite edge of the cutting die base of the cutting die to the die holder, the second position configured to permit the cutting die to be removed from the die holder.

12. The die holder system according to claim **11** wherein the centrifugal lock comprises an axis of rotation that is parallel to an axis of rotation of the rotary die cylinder.

13. The die holder system according to claim **12** wherein the centrifugal lock comprises a center of mass that is offset from its axis of rotation such that centrifugal force acting on the centrifugal lock due to rotation of the rotary die cylinder biases the centrifugal lock in the first position.

14. The die holder system according to claim **11** wherein the centrifugal lock further comprises a spring for biasing the centrifugal lock in the first position.

15. The die holder system according to claim **7** wherein the mechanism comprises a fluid actuated device that is moveable between a first position and a second position upon a change in fluid pressure within the device, the first position configured to engage and secure the opposite edge of the cutting die base of the cutting die to the die holder, the second position configured to permit the cutting die to be removed from the die holder.

16. The die holder system according to claim **15** wherein the fluid actuated device comprises an air bladder that is moveable between the first position and the second position upon a change in air pressure within the air bladder.

17. The die holder system according to claim **1** wherein a first portion of the holder base is disposed below the recessed area, and a second portion of the holder base is disposed adjacent to the recessed area, further wherein the first portion and the second portion comprise different materials.

18. The die holder system according to claim **17** wherein the first portion comprises a first material that is an impact absorbing material, and the second portion comprises a second material that is more rigid than the first material.

19. The die holder system according to claim **17** wherein the first portion comprises a multi-layered material including an impact absorbing material, and the second portion comprises a second material that is more rigid than the first material.

* * * * *