US 20060213143A1

(19) **United States**

(12) **Patent Application Publication**

McIntyre

(10) **Pub. No.: US 2006/0213143 A1**

(43) **Pub. Date: Sep. 28, 2006**

(54) **SHINGLES AND METHODS OF PRODUCING SHINGLES**

(76) Inventor: **Dan McIntyre**, Dallas, TX (US)

Correspondence Address:
KNOBBE MARTENS OLSON & BEAR LLP
2040 MAIN STREET
FOURTEENTH FLOOR
IRVINE, CA 92614 (US)

(21) Appl. No.: **11/088,450**

(22) Filed: **Mar. 24, 2005**

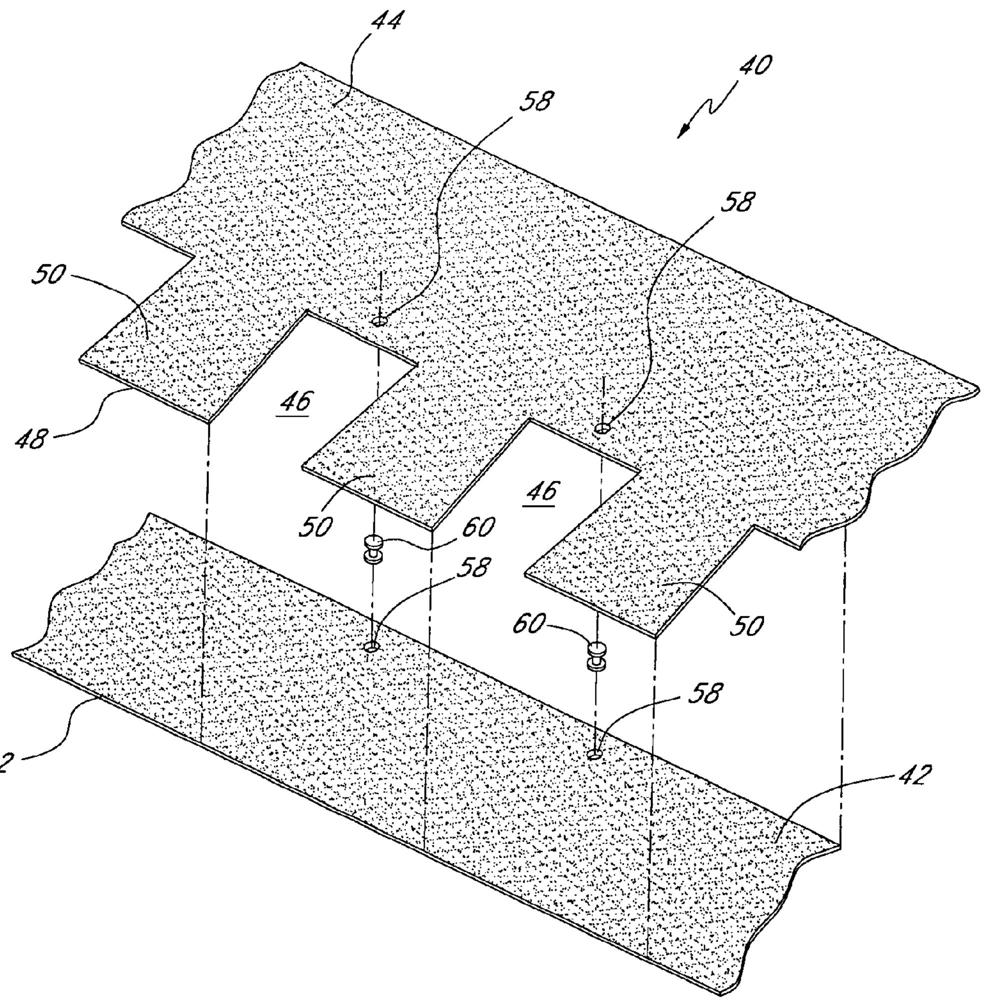
Publication Classification

(51) **Int. Cl.**
E04D 1/00 (2006.01)

(52) **U.S. Cl.** **52/554**

(57) **ABSTRACT**

The present specification describes shingles having first and second discrete portions. A fastening member, such as a rivet, secures the first and second portions to one another. The rivet resists separation of the portions over time after the shingles have been installed on a rooftop. The present specification also describes methods of producing shingles having at least one fastening member to secure first and second shingle portions to one another. In one method, apparatus is provided to puncture a continuous strip of shingles at regular intervals, and then insert a fastening member into the apertures created during the puncturing step. The puncturing and injecting apparatus described includes drums, which the shingle strip may pass over or under.



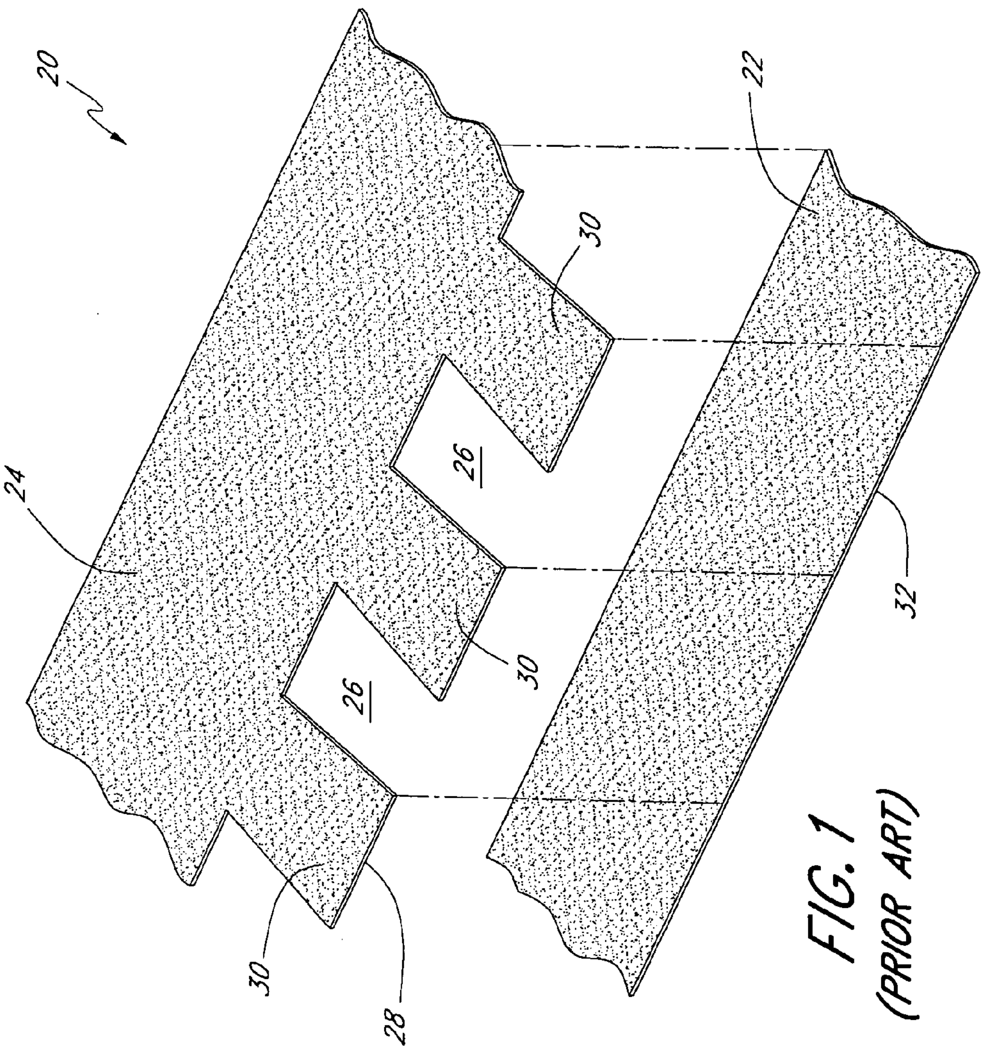


FIG. 1
(PRIOR ART)

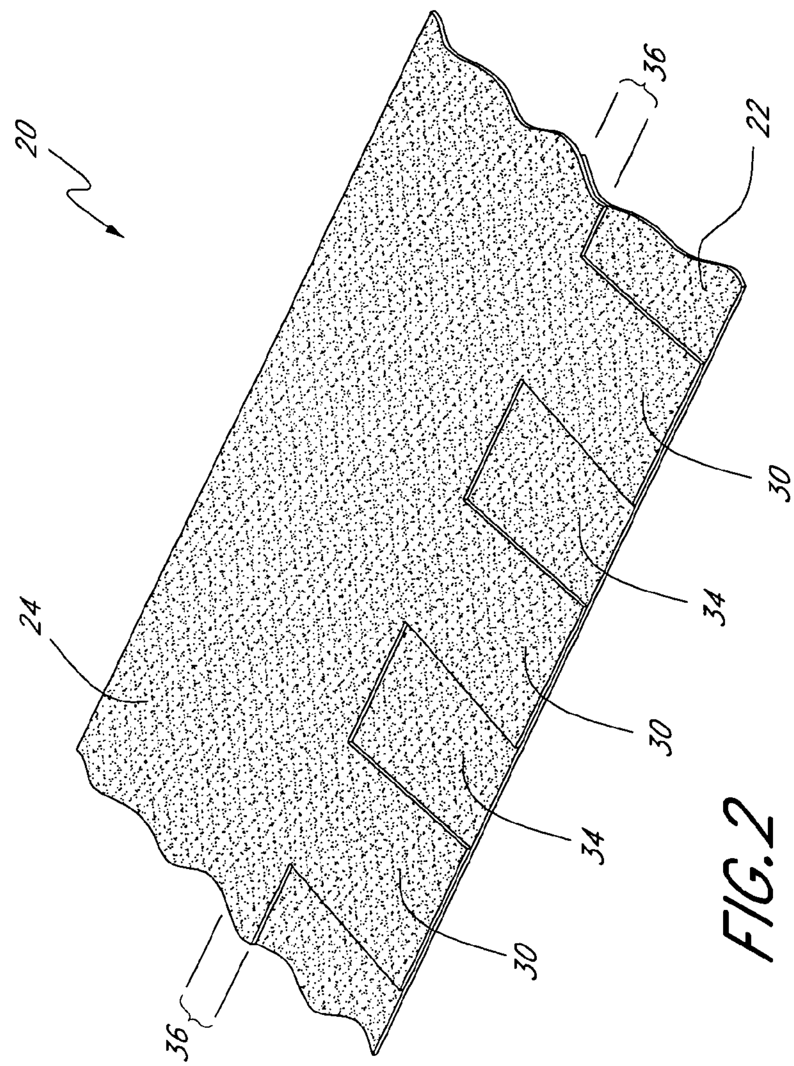


FIG. 2
(PRIOR ART)

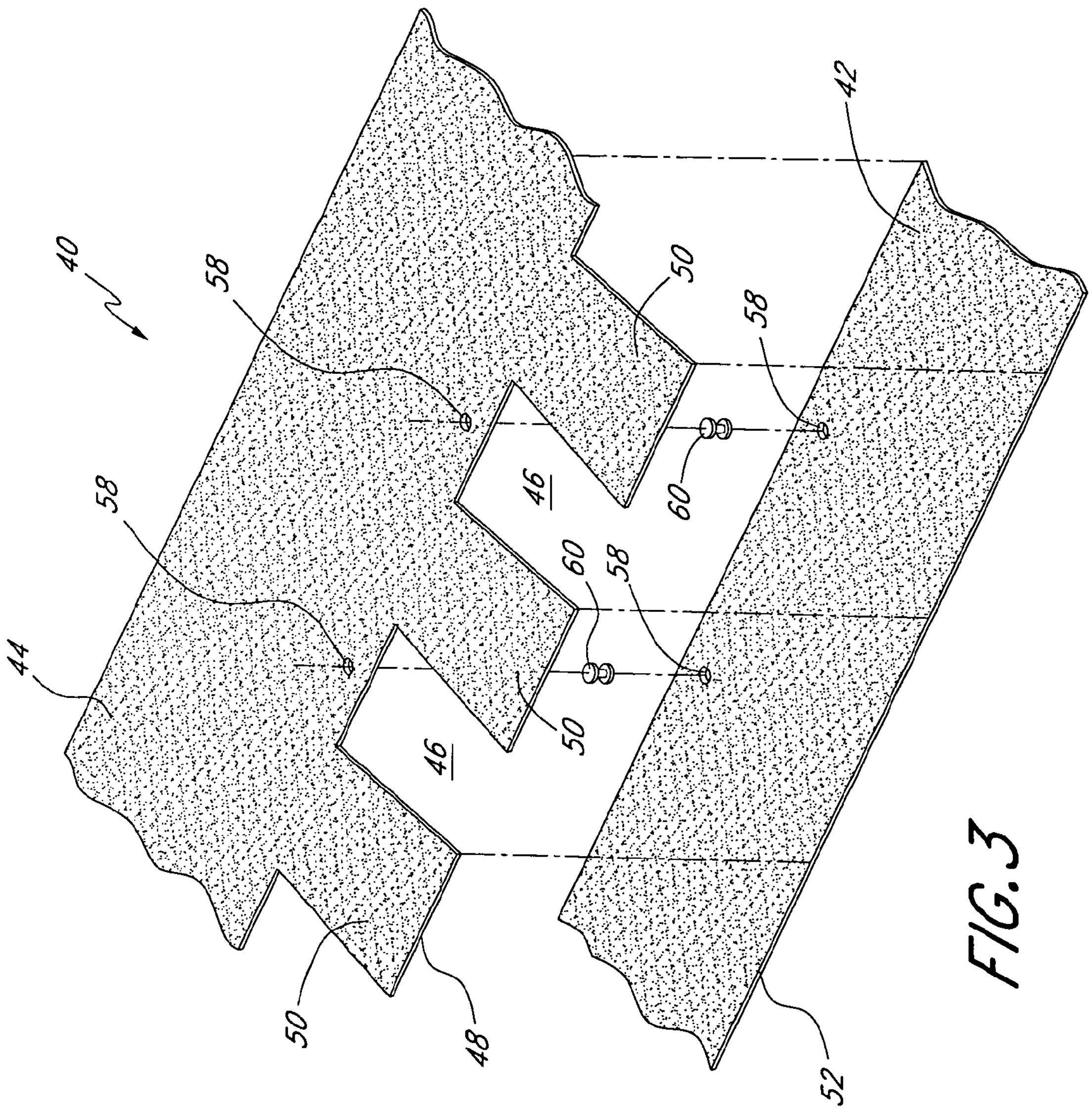


FIG. 3

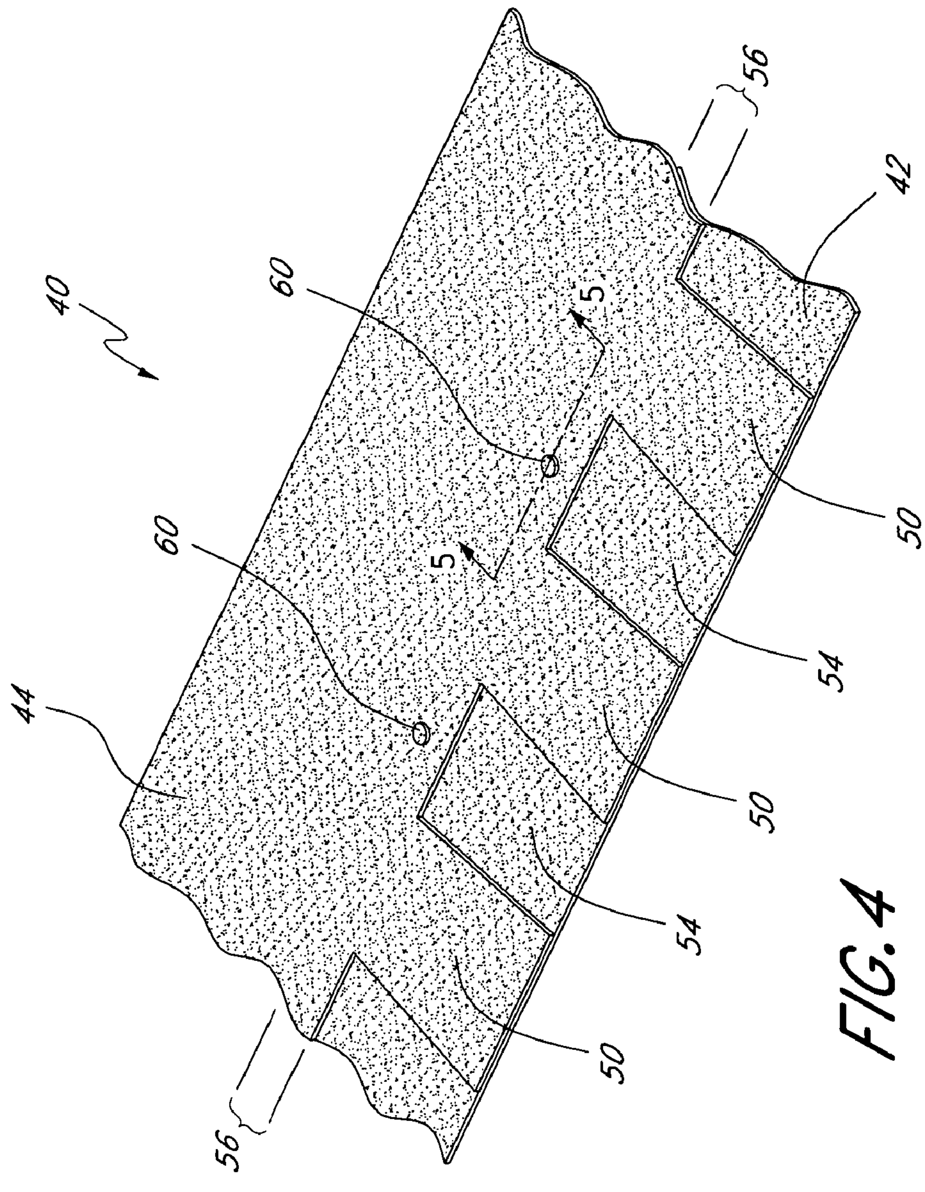


FIG. 4

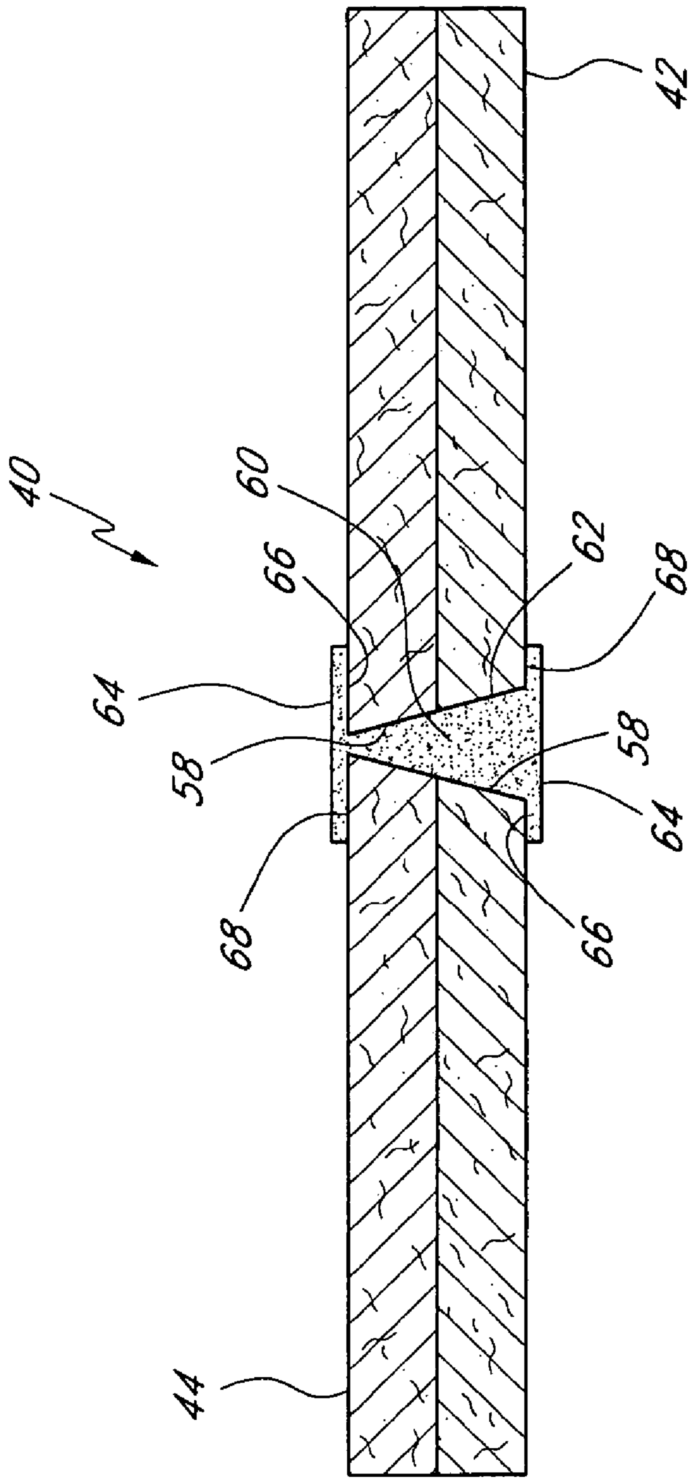


FIG. 5

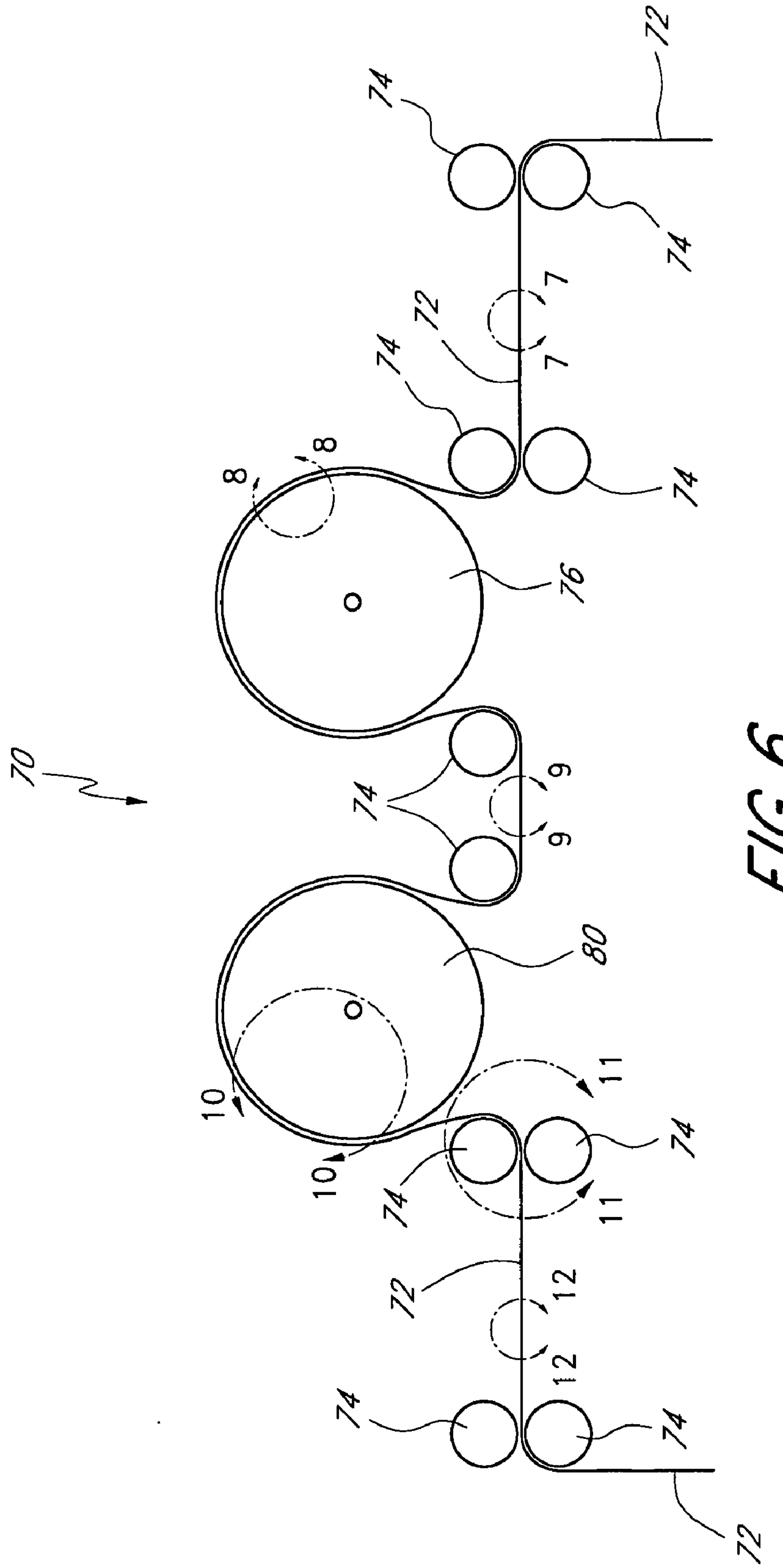


FIG. 6

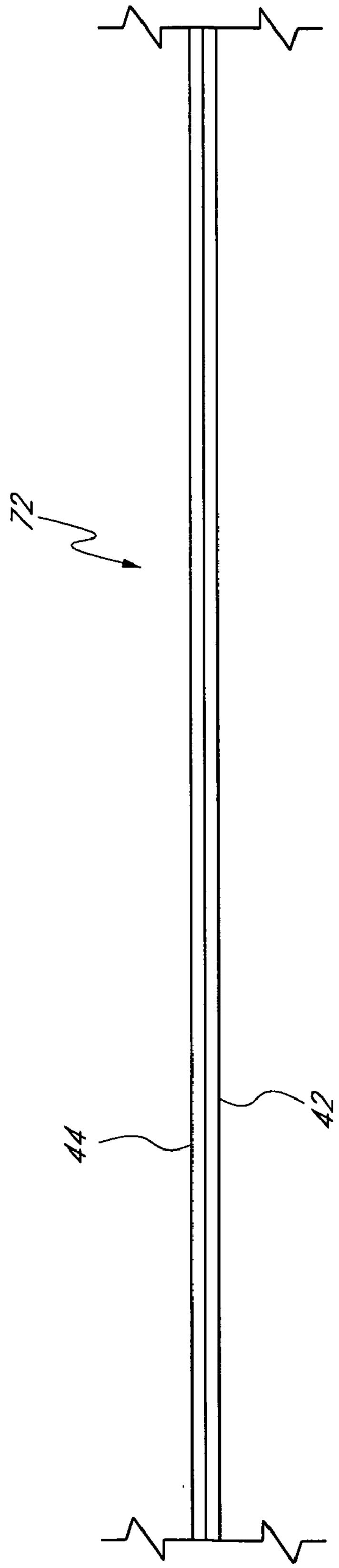


FIG. 7

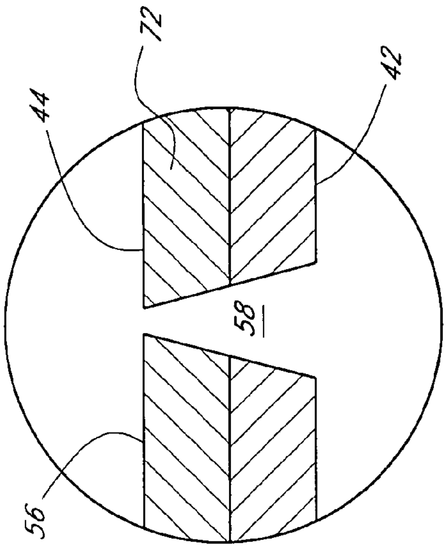


FIG.9

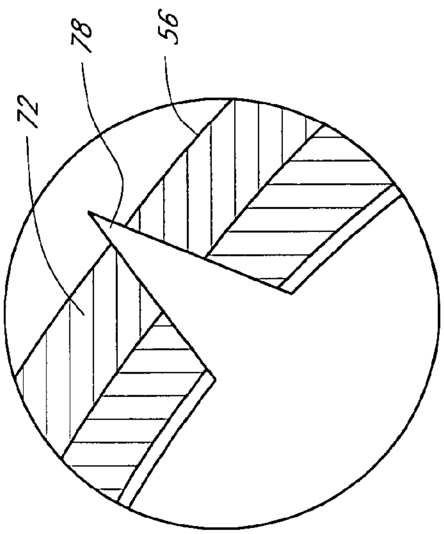


FIG.8

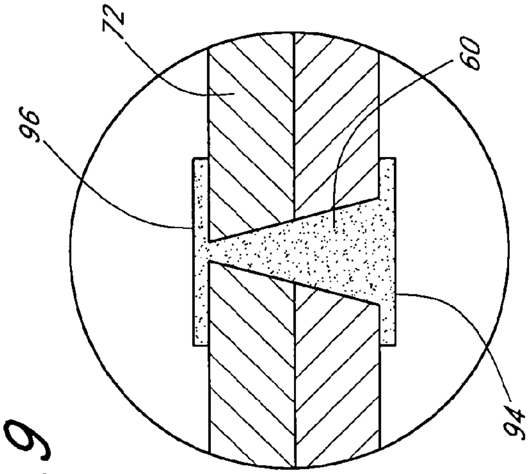


FIG.12

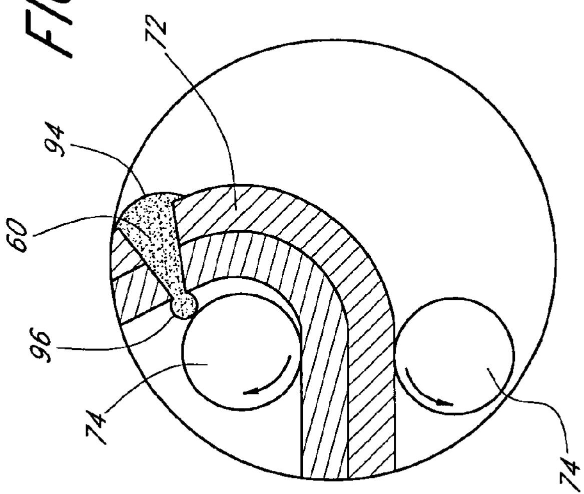


FIG.11

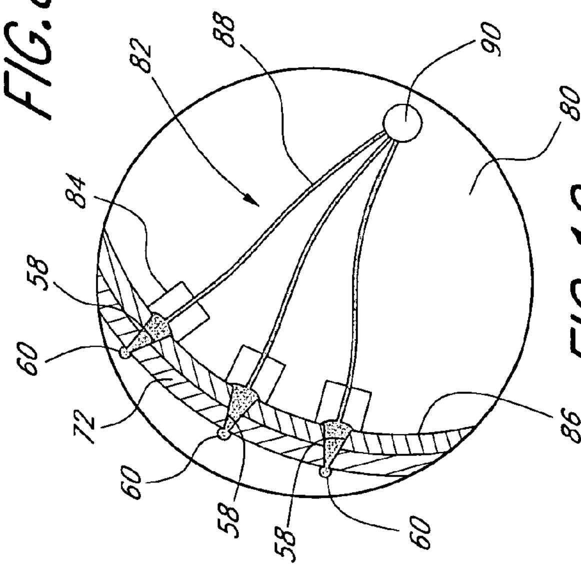


FIG.10

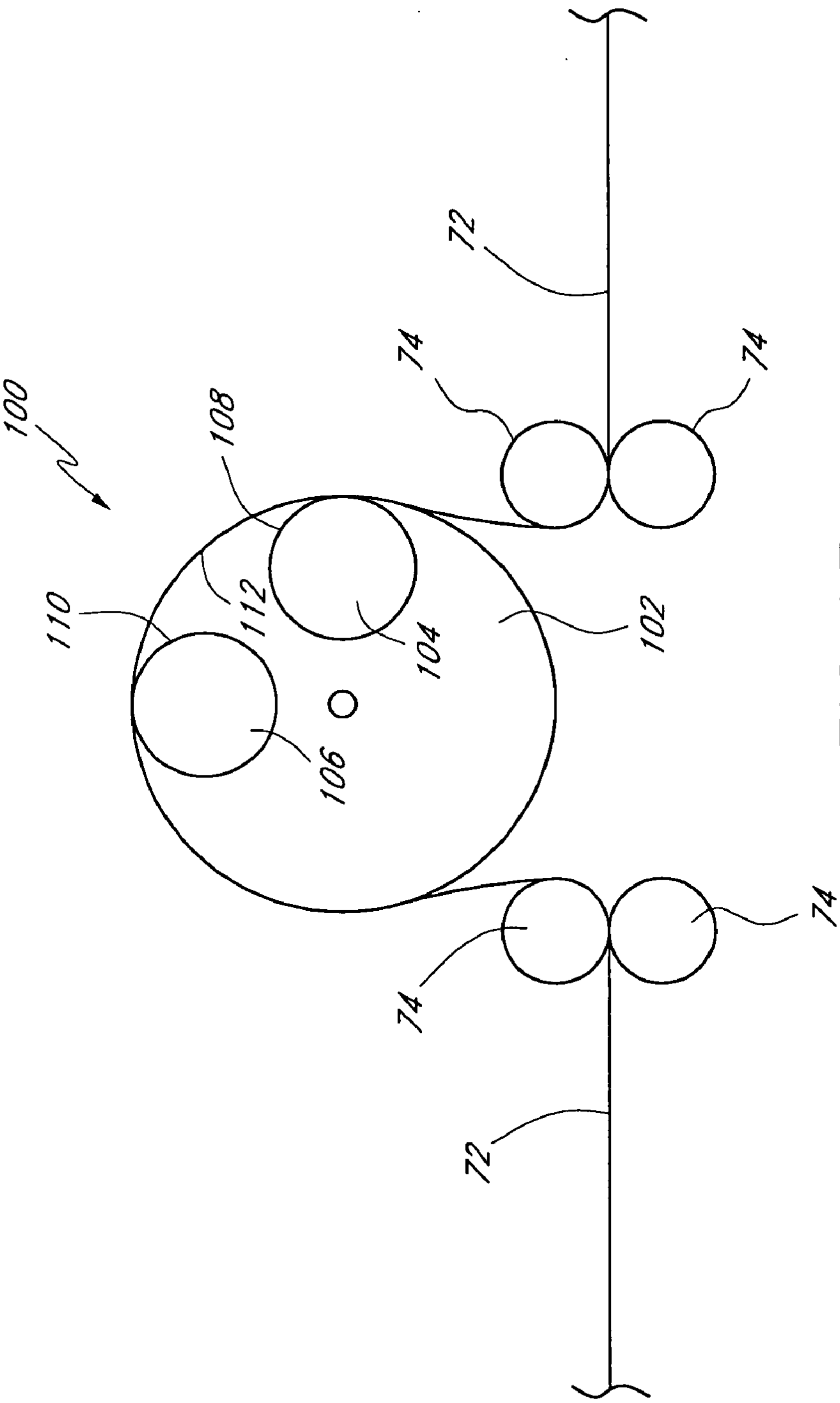


FIG. 13

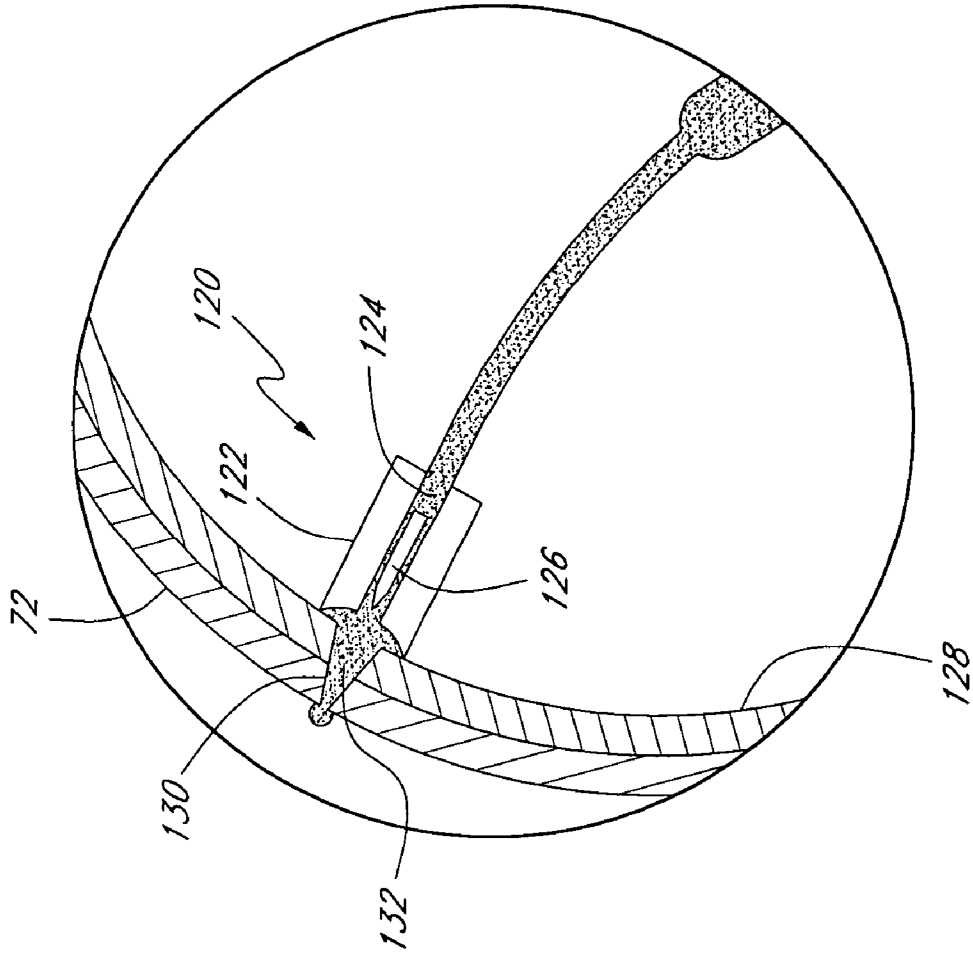


FIG. 14

SHINGLES AND METHODS OF PRODUCING SHINGLES

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to devices for covering rooftops, and to methods of producing such devices.

[0003] 2. Description of the Related Art

[0004] **FIGS. 1 and 2** illustrate one type of roofing shingle **20** that is commonly used today. The shingle **20** includes a first portion **22** (commonly referred to in the industry as a "tab") and a second portion **24** (commonly referred to in the industry as a "dragon's tooth" or "tooth"). The first portion **22** is substantially rectangular, and forms a lower layer of the shingle **20**. The second portion **24** is shaped substantially as a rectangle having a plurality of cutouts **26** (**FIG. 1**) along a lower edge **28** thereof. The cutouts **26** define a plurality of flaps **30** located between adjacent cutouts **26**. The flaps **30** and cutouts **26** are of approximately equal width, and each is shaped substantially as a trapezoid, with the flaps **30** being widest along their lower edges **28**. Approximately the lower half of the second portion **24** overlaps the first portion **22**, such that the lower edge **28** (**FIG. 1**) of the second portion **24** aligns with a lower edge **32** (**FIG. 1**) of the first portion **22**, as shown in **FIG. 2**. Trapezoidally shaped segments **34** of the first portion **22** are visible through the cutouts **26**, with the flaps **30** covering the first portion **22** between adjacent cutouts **26**. Above the cutouts **26**, the tab **22** and tooth **24** define a rectangular region **36** (**FIG. 2**) in which the tooth **24** completely overlaps the tab **22**.

[0005] Each of the portions **22**, **24** may comprise, for example, a fiberglass membrane that is coated with asphalt tar and sprinkled with sand. During the manufacturing process, adhesive (not shown) is applied to a back surface of the tooth **24** and/or to a front surface of the tab **22**. The adhesive is applied over the asphalt tar and sand. The tooth **24** is positioned over the tab **22** such that the lower edge **32** of the tab **22** aligns with the lower edge **28** of the tooth **24**, as shown in **FIG. 2**. The adhesive, which is commonly an asphalt-based glue such as SBS rubber, secures the tooth **24** and tab **22** to one another. The adhesive may be applied in the overlapping rectangular region **36**, as well as in the areas where the flaps **30** overlap the tab **22**.

[0006] Many consumers prefer two-piece shingles, because they provide a pleasing appearance that is similar to wood shingles. However, one problem common to two-piece shingles is separation of the tooth **24** from the tab **22**. Such separation is most common in geographic areas that have warmer climates. The warmer temperatures cause the asphalt tar to become soft, thereby enabling the tab **22** to slide downward away from the tooth **24** under the influence of gravity on a slanted roof. Even when relatively strong adhesives are used to secure the tooth **24** and tab **22** to one another, softening of the asphalt tar still may allow for separation, because the adhesive only secures the sand on the tooth **24** to the sand on the tab **22**. Accordingly, softening of the asphalt tar enables the sand to separate from the fiberglass membranes of the tooth **24** and tab **22**. This separation can occur regardless of how strong the adhesive is. When such separation occurs, it can lead to shingle failure and a leaky roof.

[0007] Fastening members, such as nails and staples, are most commonly used to secure shingles to roof surfaces. With two-piece shingles, such as those illustrated in **FIGS. 1 and 2**, the fastening members are preferably driven through the overlapping region **36** of each shingle **20**. The fastening members thus reinforce the adhesive and restrain separation of the tooth **24** from the tab **22**. Unfortunately, laborers who install shingles frequently fail to drive the fastening members through the overlapping region **36** of each shingle **20**. These laborers are sometimes low-skilled and/or under time pressure to complete a job. They may drive the fastening members through the tooth **24** only. Thus, the fastening members do not penetrate the tab **22**. As the asphalt tar softens, the tab **22** can disadvantageously slide down the roof away from the tooth **24**, leading to roof failure. Accordingly, many two-piece shingles that are produced today do not last as long as their manufacturers and consumers would like. A two-piece shingle that is better able to restrain separation of the tab from the tooth, even in very warm climates, would be of substantial benefit to shingle manufacturers, homeowners and other consumers of roofing shingles.

SUMMARY OF THE INVENTION

[0008] The preferred embodiments of the present shingles and methods of producing shingles have several features, no single one of which is solely responsible for their desirable attributes. Without limiting the scope of these shingles and methods as expressed by the claims that follow, their more prominent features will now be discussed briefly. After considering this discussion, and particularly after reading the section entitled "Detailed Description of the Preferred Embodiments," one will understand how the features of the preferred embodiments provide advantages, which include a very high resistance to separation of the tab and tooth portions of the shingle, and an ability to manufacture shingles at very high line speeds.

[0009] One embodiment of the present shingles and methods of producing shingles comprises a shingle adapted to be secured to a rooftop to prevent moisture from penetrating the rooftop. The shingle comprises a first relatively larger portion, and a second relatively smaller portion partially overlapping the first portion, thereby defining an overlapping region. At least one aperture extends through both portions in the overlapping region, and a fastening member extends through the at least one aperture.

[0010] Another embodiment of the present shingles and methods of producing shingles comprises apparatus for producing shingles. The apparatus comprises a strip of shingles, a first drum including puncturing apparatus and a second drum including injecting apparatus. The second drum is spaced from the first drum and positioned such that longitudinal axes of the drums are substantially parallel. The drums are adapted to receive the strip along outer surfaces thereof.

[0011] Another embodiment of the present shingles and methods of producing shingles comprises a method of producing shingles. The method comprises the step of providing at least one shingle having a tab portion, a tooth portion and an overlapping region in which the tab portion and tooth portion overlap. The method comprises the steps of puncturing at least one shingle in the overlapping region to thereby produce an aperture, and inserting a fastening member into the aperture to thereby secure the tab portion to the tooth portion.

[0012] Another embodiment of the present shingles and methods of producing shingles comprises apparatus for producing shingles. The apparatus comprises a strip of shingles, an outer drum, a first drum and a second drum. The first drum includes puncturing apparatus, and the second drum includes injecting apparatus. The second drum is spaced from the first drum and positioned such that longitudinal axes of the drums are substantially parallel. The outer drum is adapted to contact the strip along an outer surface thereof. The first drum is adapted to puncture the strip as it passes by the outer drum. The second drum is adapted to inject a fastening member into the strip as it passes by the outer drum.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The preferred embodiments of the present shingles and methods of producing shingles, illustrating their features, will now be discussed in detail. These embodiments depict the novel and non-obvious shingles and methods shown in the accompanying drawings, which are for illustrative purposes only. These drawings include the following figures, in which like numerals indicate like parts:

[0014] **FIG. 1** is a top perspective, exploded view of a prior art shingle;

[0015] **FIG. 2** is a top perspective view of the shingle of **FIG. 1**;

[0016] **FIG. 3** is a top perspective, exploded view of one embodiment of the present shingles;

[0017] **FIG. 4** is a top perspective view of the shingle of **FIG. 3**;

[0018] **FIG. 5** is a cross-sectional view of the shingle of **FIG. 4**, taken along the line **5-5**;

[0019] **FIG. 6** is a side elevational view of one embodiment of apparatus for producing the shingle of **FIG. 3**;

[0020] **FIG. 7** is a detail side elevational view of a strip of shingles that are arranged end-to-end, taken along the line **7-7** in **FIG. 6**;

[0021] **FIG. 8** is a detail view of the apparatus of **FIG. 6**, taken along the line **8-8**;

[0022] **FIG. 9** is a detail side elevational view of the apparatus of **FIG. 6**, taken along the line **9-9**;

[0023] **FIG. 10** is a detail side elevational view of the apparatus of **FIG. 6**, taken along the line **10-10**;

[0024] **FIG. 11** is a detail side elevational view of the apparatus of **FIG. 6**, taken along the line **11-11**;

[0025] **FIG. 12** is a detail side elevational view of the apparatus of **FIG. 6**, taken along the line **12-12**;

[0026] **FIG. 13** is a side elevational view of another embodiment of apparatus for producing the shingle of **FIG. 3**; and

[0027] **FIG. 14** is a detail side elevational view of an alternative embodiment of apparatus for performing puncturing and injecting steps.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0028] **FIGS. 3-5** illustrate one embodiment of the present shingles **40**. Like the prior art shingle **20** above, the present shingle **40** includes a first portion **42** (a "tab") and a second portion **44** (a "tooth"). In the illustrated embodiment, the first portion **42** is substantially rectangular, and forms a lower layer of the shingle **40**. The second portion **44** is shaped substantially as a rectangle having a plurality of cutouts **46** (**FIG. 3**) along a lower edge **48** thereof. The cutouts **46** define a plurality of flaps **50** located between adjacent cutouts **46**. In the illustrated embodiment, the flaps **50** and cutouts **46** are of approximately equal width, and each is shaped substantially as a trapezoid, with the flaps **50** being widest along their lower edges **48**. Those of skill in the art will appreciate that the cutouts **46** and flaps **50** need not be of approximately equal size, and that either or both could be shaped differently from a trapezoid.

[0029] In the illustrated embodiment, approximately the lower half of the second portion **44** overlaps the first portion **42**, such that a lower edge **52** (**FIG. 3**) of the first portion **42** aligns with the lower edge **48** (**FIG. 3**) of the second portion **44**, as illustrated in **FIG. 4**. Trapezoidally shaped segments **54** of the first portion **42** are visible through the cutouts **46**, with the flaps **50** covering the first portion **42** between adjacent cutouts **46**. The shape of the segments **54** is dependent upon the shape of the cutouts **46**, and need not be trapezoidal. The cutouts **46** and segments **54** could, for example, be rectangular or any other shape. Above the cutouts **46**, the tab **42** and tooth **44** define a rectangular region **56** (**FIG. 4**) in which the tooth **44** completely overlaps the tab **42**.

[0030] For clarity, the figures herein illustrate only a segment of the width of the shingle **40**. Side edges of the shingle **40** are represented by wavy lines that indicate that the shingle **40** may extend beyond the wavy lines. In one embodiment, side edges of the shingle **40** are substantially straight. In one embodiment, the shingle **40** has a width that is substantially greater than its height. For example, in one embodiment the shingle **40** may measure approximately twelve inches by approximately thirty-nine inches.

[0031] Each of the first and second portions **42**, **44** may comprise, for example, a membrane that is coated with a sticky substance and sprinkled with a particulate material. The sticky substance and particulate material coat at least a substantial portion of a front surface of each membrane. In one embodiment the membrane may comprise fiberglass, the sticky substance may comprise asphalt tar, and the particulate material may comprise sand.

[0032] With reference to **FIGS. 3 and 4**, in the rectangular overlapping region **56** of each, the tooth **44** and the tab **42** each include at least one aperture **58**. The aperture(s) **58** on the tooth **44** align with the aperture(s) **58** on the tab **42**, and each receives a fastening member **60** that secures the tooth **44** and tab **42** to one another. In the illustrated embodiment, the fastening member **60** comprises a rivet **60**. However, those of skill in the art will appreciate that the fastening member **60** could embody alternative shapes that may or may not resemble a rivet.

[0033] With reference to **FIG. 5**, which illustrates a detailed cross-sectional view of one rivet **60** and its respective aperture **58**, the rivet **60** includes a central shaft portion **62** and spaced end cap portions **64**. In the illustrated embodiment, the shaft portion **62** is substantially conical, and matches the cross-sectional shape of the aperture **58**. Also, in the illustrated embodiment, the end cap portions **64** are substantially disk-shaped. The conical shape of the aperture **58** and shaft portion **62**, and the disk shape of the end cap portions **64** is a result of the manufacturing process, which is described in more detail below. Those of skill in the art will appreciate that alternative manufacturing methods may produce apertures, shaft portions and end cap portions having different shapes. Moreover, the number of apertures **58** and rivets **60** in a single shingle **40**, and the spacing therebetween, can vary widely depending upon the intended application of that shingle **40**.

[0034] The diameter of each end cap portion **64** is greater than the diameter of the aperture **58** at either end thereof. Inner surfaces **66** of each end cap portion **64** abut outward facing surfaces **68** of the tooth **44** and tab **42**. Interengagement of the end cap portions **64** and the outward facing surfaces **68** inhibits separation of the tooth **44** and tab **42** from one another.

[0035] In the illustrated embodiment, the rivet **60** is constructed of a plastic, a nylon, a polyester or a polymer material. Those of skill in the art will appreciate that other materials could be used instead. However, the selected material is preferably compatible with the manufacturing environment and with the environment in which the rivet **60** will ultimately be deployed (such as atop a roof). Thus, factors such as the ambient temperature, the composition of the surrounding medium and any adjacent shingle materials, the presence of certain solvents and production speeds may be considered. Examples of other possible materials for the rivet **60** include polypropylene, metals (such as aluminum), metal alloys, other alloys, fiberglass or injectable adhesives.

[0036] **FIG. 6** illustrates one embodiment of apparatus **70** and methods for producing the present shingles **40**. The apparatus **70** may be self contained, or it may be just one aspect of a larger apparatus (not shown) for producing shingles **40**. In either case, at the right-hand side of **FIG. 6**, a continuous strip **72** of shingles **40** enters the apparatus **70**. In one embodiment, the strip **72** may comprise shingles **40** that are oriented top-to-bottom. In another embodiment, the strip **72** may comprise shingles **40** that are oriented end-to-end, as illustrated in **FIG. 7**. In this embodiment, the shingles **40** are configured such that from left to right the viewer sees one continuous tooth **44** layered upon one continuous tab **42**. Of course, if the viewer were positioned on the opposite side of the strip, he or she would see the evenly spaced gaps between the flaps **50** (**FIG. 4**). The thickness of the strip **72** in **FIG. 7** has been exaggerated for illustrative effect. The strip **72** is cut at a later step of the process to form individual shingles **40**.

[0037] In the configuration of **FIG. 7**, the width of the strip **72** (measured into the plane of the **FIG. 7**) may correspond to the height of a single shingle **40**. Alternatively, the width of the strip **72** may include multiple uncut shingle strips **72** that are positioned next to one another along an axis that extends perpendicular to the plane of the paper. In such wider configurations, the strip **72** may be cut longitudinally at a later step of the process to form several thinner strips **72** of shingles **40**. Alternatively, the width of the strip **72** may include multiple independent shingle strips **72** that are positioned next to one another along an axis that extends perpendicular to the plane of the paper.

[0038] With reference to **FIG. 6**, the strip **72** may pass over or under several rollers **74**, or through several pairs of rollers **74**. Some of these rollers **74** may be driven, and some may be passive. Some of them may be pinch rollers **74** that provide locomotive force to drive the strip **72** through the apparatus **70**. For example, the pinch rollers **74** may be pairs of driven rollers **74** that squeeze the strip **72** from opposite surfaces. As the rollers **74** spin, they pull the strip **72** through a gap located in between the rollers **74**.

[0039] As the shingle strip **72** passes through the larger apparatus and/or the apparatus **70**, at various stages guides (not shown) may direct the strip **72** so that it follows a desired path. For example, the guides may be positioned to either side of the strip **72** to push it left or right (that is, into our out of the plane of the paper in **FIG. 6**). The guides may be positioned in a trough (not shown) that traces the path of the strip **72** through the larger apparatus and/or the apparatus **70**. The guides may include ceramic surfaces that are highly resistant to wear that may be caused by the passing shingle strip **72**. The guides may desirably create a small amount of friction with the strip **72**, so as not to slow the strip **72** as it passes through the larger apparatus and/or the apparatus **70**.

[0040] With further reference to **FIG. 6**, the strip **72** may pass through two pairs of rollers **74** before being fed onto, and passing over the top of, a first drum **76**, or puncturing drum **76**. In an alternative configuration for the manufacturing apparatus **70**, the shingle strip **72** may pass underneath the drum **76**. Guides (not shown) may ensure that the strip **72** is positioned correctly along a longitudinal axis of the drum **76**.

[0041] The first drum **76** includes a plurality of puncturing apparatus **78** (**FIG. 8**). In one embodiment, the puncturing apparatus **78** are evenly spaced around the circumference of the drum **76**. The puncturing apparatus **78** are thus adapted to puncture the strip **72** at evenly spaced intervals along the length of the strip **72**. In one embodiment, the interval may measure anywhere from 3 inches to 18 inches. However, those of skill in the art will appreciate that other intervals are also feasible, and the intervals stated above are not limiting.

[0042] The drum **76** may also include puncturing apparatus **78** that are evenly spaced from one another in the direction of a longitudinal axis of the drum **76**. The puncturing apparatus **78** are thus adapted to puncture the strip **72**, or multiple strips **72**, at evenly spaced intervals across the width of the drum **76**. Such a drum would allow multiple strips **72** positioned side-by-side to travel over the drum **76** and be punctured at the same time.

[0043] In one embodiment, the puncturing apparatus **78** comprises a plurality of spikes **78**, as illustrated in **FIG. 8**. In the illustrated embodiment, the spikes **78** are substantially conically shaped. However, those of skill in the art will appreciate that the spikes **78** could have a variety of other shapes, such as cylindrical. The spikes **78** may be constructed of a relatively hard and tough material, for example, diamond, carbide, steel, ferrous or nonferrous alloys or ceramics. In still further embodiments, the puncturing apparatus **78** may comprise, for example, a water jet, an air jet, a laser cutter, or any other type of apparatus that is capable of puncturing, piercing or otherwise creating a hole in a shingle **40**.

[0044] In the configuration of **FIG. 7**, the circumferential spacing of the puncturing apparatus **78** is preferably set to whatever rivet spacing is desired. The shingle strip **72** is preferably positioned so that the puncturing apparatus **78** punctures each overlapping region **56** as shown in **FIG. 8**. **FIG. 9** illustrates a close-up view of each overlapping region **56** after it has passed over the first drum **76** and been punctured. After the puncturing step, each overlapping region **56** includes one or more apertures **58** that pass through both the tooth **44** and the tab **42** of each shingle **40**. Those of skill in the art will appreciate that the orientation of the tooth **44** and tab **42** may be reversed.

[0045] After passing over the first drum **76**, the strip **72** may pass under one or more additional rollers **74**, as shown in **FIG. 6**. The rollers **74** may help to maintain tension in the strip **72**. The strip **72** may then be fed onto, and pass over the top of, a second drum **80**, or injecting drum **80**. In an alternative configuration for the manufacturing apparatus **70**, the shingle strip **72** may pass underneath the drum **80**.

[0046] In the illustrated embodiment, the second drum **80** is substantially the same diameter as the first drum **76**. For example, each drum **76**, **80** may have a diameter of **6** feet. However, those of skill in the art will appreciate that the drums **76**, **80** could have different diameters. The drums **76**, **80** may also have substantially equal widths (measured perpendicular to the plane of **FIG. 6**). For example, each drum **76**, **80** may have a width of about twelve inches. However, those of skill in the art will appreciate that the drums **76**, **80** could have different widths.

[0047] The second drum **80** includes a plurality of injecting apparatus **82**, as illustrated in **FIG. 10**. In one embodiment, the injecting apparatus **82** are evenly spaced around the circumference of the drum **80**. The injecting apparatus **82** are thus adapted to inject rivets **60** into the strip **72** at evenly spaced intervals along the length of the strip **72**. The spacing may be the same as that described above with respect to the first drum **76**.

[0048] The second drum **80** may also include injecting apparatus **82** that are evenly spaced from one another in the direction of a longitudinal axis of the drum **80**. The injecting apparatus **82** are thus adapted to inject rivets **60** into the strip **72**, or multiple strips **72**, at evenly spaced intervals along the width of the drum **80**. Such a drum would allow multiple strips **72** positioned side-by-side to travel over the drum **80** and be injected at the same time.

[0049] In one embodiment, the injecting apparatus **82** comprises a plurality of injection nozzles **84**, as illustrated in **FIG. 10**. **FIG. 10** illustrates the configuration of the shingle strip **72** that is illustrated in **FIG. 7**. The injection nozzles **84** may be, for example, pneumatically operated. In the illustrated embodiment, the injection nozzles **84** are positioned such that they abut an inside surface **86** of the drum **80**. Holes (not shown) are preferably provided in the outer surface of the drum **80** at the location of each injection nozzle **84**.

[0050] A fluid conduit **88** extends from each nozzle **84** to a central hub **90**. Liquefied rivet material flows through the central hub **90**, into the fluid conduits **88** and is expelled through the injection nozzles **84** and into the apertures **58** in the strip **72**. In one embodiment, for example, the rivet material may begin as a solid that is placed in an extruder (not shown), melted and pumped through a melt pump (not shown) to the central hub **90**. Pressure may be used to push the rivet material through any piping/conduits between the extruder and the injection nozzles **84**. One or more photoelectric sensors may be used to control the opening and closing of the injection nozzles **84**.

[0051] To properly align the apertures **58** with the injection nozzles **84**, a circumferential spacing of the injection nozzles **84** is preferably equal to a circumferential spacing of the puncturing apparatus **78** (though the drums **76**, **80** need not have equal diameters). The second drum **80** is also preferably positioned such that a distance between the drums **76**, **80** as measured along the path of travel of the strip **72** is a multiple of the circumferential spacing of the puncturing apparatus **78**. Then, tension in the strip **72** ensures that the strip **72** always aligns properly with the second drum **80** so that the rivets **60** are injected into the apertures **58**. A timing belt (not shown) may ensure that the drums **76**, **80** rotate in synchronicity with one another, or with other components of the apparatus, as desired.

[0052] After passing over the second drum **80** (**FIG. 6**), the strip **72** passes through a pair of pinch rollers **74**. With reference to **FIGS. 11 and 12**, prior to passing through the pinch rollers **74** the rivet **60** has a first end **94** shaped substantially as an arcuate dome with a relatively large diameter, and a second end **96** shaped substantially as a ball with a relatively small diameter. The shape of the rivet ends **94**, **96** at this stage is a result of the injection process. The end nearest the nozzle **84** during injection forms the dome shape, and the opposite end forms the ball shape.

[0053] When the shingles **40** are installed atop a roof, the lower portions of shingles **40** in a first row overlap the upper portions of the shingles **40** in a second, adjacent, row. The shingles **40** in the first row may overlap the portions of a shingles **40** in the second row where the rivets **60** are located. Therefore, to provide a more functional and aesthetically pleasing roof, it is advantageous to flatten the ends **94**, **96** of the rivets **60** as much as possible so that they do not cause the overlapping adjacent shingles **40** to protrude upwardly.

[0054] When the rivets **60** pass through the pinch rollers **74** (**FIG. 11**), the rivet **60** material is still soft enough to easily undergo plastic deformation. The rollers **74** thus flatten the rivet ends **94**, **96** into the configurations shown in **FIG. 12**.

[0055] The manufacturing steps described above are advantageously capable of being integrated into a larger manufacturing process in which the production line is moving very quickly. In the illustrated embodiment, the steps of puncturing and riveting are performed on relatively large drums **76**, **80** that rotate at an angular velocity that is proportional to the linear velocity of the shingle strip **72**. Thus, while the steps of puncturing and riveting are performed, the apparatus that is performing those functions remains fixed relative to the shingle strip **72**, providing a relatively large amount of time to perform these steps.

[0056] Whereas prior art shingles **20** glue the sand on the tooth **24** to the sand on the tab **22**, as described above, the rivets **60** of the present shingles **40** advantageously extend through the membranes of the tooth **44** and tab **42**, thereby locking these components together. Separation of the shingle components thus depends solely upon the rivets **60**, rather than upon the asphalt tar, which has a relatively low melting temperature. Testing conducted by the inventor has shown the durability of the present shingles **40** and the ability of the rivets **60** to hold the tooth **44** and tab **42** together. In one test, one of the present shingles **40** was suspended from its tooth **44**, such that the tab **42** hung freely and would have separated from the tooth **44** had it not been for the rivet **60** holding the two portions together. The shingle **40** was then placed in an oven set at about 120° F. The temperature was increased about 10° F. every hour until the tab **42** separated from the tooth **44** and dropped off. The goal was to see if the rivet **60** could hold the two portions together up to a temperature of about 220° F. When the oven temperature reached about 315° F., the test was stopped. The rivet **60** still firmly held the tooth **44** and tab **42** together. By contrast, a prior art shingle **20** with no rivet **60** subjected to the same test failed at about 160° F.

[0057] During testing of the present shingle **40**, large amounts of the sticky substance melted and dropped away. However, because the rivet **60** engaged the more heat-resistant membranes of the shingle **40**, melting of the sticky substance did not affect the grip of the rivet **60** on the tooth **44** or the tab **42**. Because the rivet **60** firmly secures the tooth **44** and the tab **42** to one another, it is unnecessary to penetrate the overlapping region **56** with a fastening member (such as a nail or a staple) when the shingles **40** are installed atop a roof. With prior art shingles **20** it was advantageous to drive the fastening member through the overlapping region **36** and into the roof so that the fastening member would supplement the adhesive and more firmly secure that tooth **24** and tab **22** to one another. However, with the present shingles **40** the fastening member may be driven only through the tooth **24** or the tab **42** without affecting the expected lifespan of the shingle **40**. The rivets **60** alone securely hold the tooth **44** and the tab **42** together without the need for any additional fastening members.

[0058] **FIG. 13** illustrates another embodiment of apparatus **100** and methods for producing the present shingles **40**. Again, the apparatus **100** may be self contained, or it may be just one aspect of a larger apparatus (not shown) for producing shingles **40**. In either case, at the right-hand side of **FIG. 13**, a continuous strip **72** of shingles **40** enters the apparatus. The strip **72** may pass through a pair of rollers **74** before being fed onto, and passing over the top of, an outer drum **102**. After passing over the outer drum **102**, the strip **72** may pass through another pair of rollers **74**. Guides (not shown) may ensure that the strip **72** is positioned correctly along a longitudinal axis of the drum **102**.

[0059] First and second drums **104**, **106** are positioned within the outer drum **102**. In the illustrated embodiment, the first drum **104** is positioned at approximately 3 o'clock on the outer drum **102**, and the second drum **106** is positioned at approximately 12 o'clock on the outer drum **102**. However, those of ordinary skill in the art will appreciate that the first and second drums **104**, **106** could be positioned at other locations within the outer drum **102**, and that the first and second drums **104**, **106** could be positioned outside the outer drum **102**.

[0060] The first drum **104** includes puncturing apparatus (not shown), and is similar in configuration to the first drum **76** described above. The second drum **106** includes injecting apparatus (not shown), and is similar in configuration to the second drum **80** described above. Outer surfaces **108**, **110** of the first and second drums **104**, **106**, respectively, may abut an inner surface **112** of the outer drum **102**. The drums **102**, **104**, **106** preferably rotate at appropriate angular velocities so that as the drums **102**, **104**, **106** all rotate the outer surfaces **108**, **110** of the first and second drums **104**, **106** do not slip with respect to the inner surface **112** of the outer drum **102**.

[0061] The outer drum **102** includes a plurality of holes (not shown) in its surface. In one embodiment, the holes are evenly spaced around the circumference of the drum **102**. The holes align with the puncturing apparatus and the injecting apparatus on the first and second drums **104**, **106**, respectively, as the drums **102**, **104**, **106** rotate. Thus, the puncturing and injecting steps described above with respect to the apparatus **70** and methods illustrated in **FIG. 6** take place at the surface of the outer drum **102** as the strip **72** passes over the drum **102**.

[0062] **FIG. 14** illustrates an alternative embodiment of apparatus **120** for performing puncturing and injecting steps. In the illustrated embodiment, the puncturing and injecting tools comprise a single apparatus **120**. The apparatus **120** includes an injection nozzle **122**. A lumen **124** of the injection nozzle **122** houses a puncturing tool **126** that is selectively retractable. The apparatus **120** may be positioned on the inside of a drum **128**, similarly to the injecting apparatus **82** described above. As the strip **72** passes over the drum **128**, the puncturing tool **126** punctures the strip **72** to produce a hole **130**, and the injection nozzle subsequently injects liquefied rivet **132** material into the hole **130**.

SCOPE OF THE INVENTION

[0063] The above presents a description of the best mode contemplated for carrying out the present shingles and methods of producing shingles, and of the manner and process of making and using them, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which they pertain to make and use these shingles and methods. These shingles and methods are, however, susceptible to modifications and alternate constructions from those discussed above that are fully equivalent. Consequently, these shingles and methods are not limited to the particular embodiments disclosed. On the contrary, these shingles and methods cover all modifications and alternate constructions coming within the spirit and scope of the shingles and methods as generally expressed by the following claims, which particularly point out and distinctly claim the subject matter of the shingles and methods.

What is claimed is:

1. A shingle adapted to be secured to a rooftop to prevent moisture from penetrating the rooftop, comprising:

a first portion;

a second portion partially overlapping the first portion, thereby defining an overlapping region;

at least one aperture extending through both portions in the overlapping region; and

a fastening member extending through the at least one aperture.

2. The shingle of claim 1, wherein the at least one fastening member comprises spaced end portions that abut an upper surface and a lower surface, respectively, of the shingle.

3. The shingle of claim 2, wherein the at least one fastening member comprises a shaft portion that connects the spaced end portions.

4. The shingle of claim 1, wherein the at least one fastening member comprises a plastic, a nylon, a polyester, a polymer material, a polypropylene, a metal, a metal alloy, a non-metal alloy, a fiberglass or an injectable adhesive.

5. The shingle of claim 1, wherein the first and second portions each comprise a membrane with a sticky substance covering at least a significant portion of an upper surface thereof, and a particulate substance covering at least a significant portion of the sticky substance.

6. The shingle of claim 5, wherein the membrane comprises fiberglass.

7. The shingle of claim 5, wherein the sticky substance comprises asphalt tar.

8. The shingle of claim 5, wherein the particulate substance comprises sand.

9. Apparatus for producing shingles, comprising:

a strip of shingles;

a first drum including puncturing apparatus; and

a second drum including injecting apparatus, the second drum being spaced from the first drum and positioned such that longitudinal axes of the drums are substantially parallel;

wherein the drums are adapted to contact the strip along an outer surface or outer surfaces thereof.

10. The apparatus of claim 9, wherein the puncturing apparatus comprises at least one spike, or at least one water jet, or at least one air jet or at least one laser cutter.

11. The apparatus of claim 9, wherein the injecting apparatus comprises at least one nozzle adapted to dispense a liquefied material.

12. The apparatus of claim 9, further comprising a pair of pinch rollers adapted to receive the strip therebetween.

13. A method of producing shingles, the method comprising the steps of:

providing at least one shingle having a tab portion, a tooth portion and an overlapping region in which the tab portion and tooth portion overlap;

puncturing the at least one shingle in the overlapping region to produce an aperture; and

inserting a fastening member into the aperture to secure the tab portion to the tooth portion.

14. The method of claim 13, wherein during the puncturing step the at least one shingle passes over a substantially cylindrical drum.

15. The method of claim 14, wherein the drum includes puncturing apparatus.

16. The method of claim 15, wherein the puncturing apparatus comprises at least one spike, or at least one water jet, or at least one air jet or at least one laser cutter.

17. The method of claim 13, wherein during the inserting step the at least one shingle passes over a substantially cylindrical drum.

18. The method of claim 17, wherein the drum includes injecting apparatus.

19. The method of claim 18, wherein the injecting apparatus comprises at least one nozzle adapted to dispense a liquefied material.

20. The method of claim 18, wherein the injecting apparatus injects a liquefied material into the aperture, and the liquefied material hardens to form a fastening member.

21. The method of claim 20, wherein the liquefied material comprises a plastic, a nylon, a polyester, a polymer material, a polypropylene, a metal, a metal alloy, a non-metal alloy, a fiberglass or an injectable adhesive.

22. The method of claim 13, further comprising the step of flattening end portions of the fastening member.

23. Apparatus for producing shingles, comprising:

a strip of shingles;

an outer drum;

a first drum including puncturing apparatus; and

a second drum including injecting apparatus, the second drum being spaced from the first drum and positioned such that longitudinal axes of the drums are substantially parallel;

wherein the outer drum is adapted to contact the strip along an outer surface thereof, the first drum is adapted to puncture the strip as it passes by the outer drum, and the second drum is adapted to inject a fastening member into the strip as it passes by the outer drum.

* * * * *