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[54] **UNDERLAYMENT FASTENING DEVICE**

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[73] Assignee: **The United States of America as represented by the Secretary of Agriculture**

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[58] **Field of Search** 81/21, 19, 22, 46; 151/41.73; 85/21

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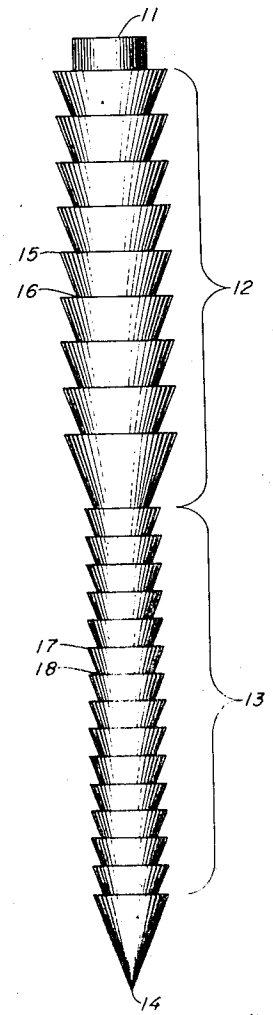
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[57] **ABSTRACT**

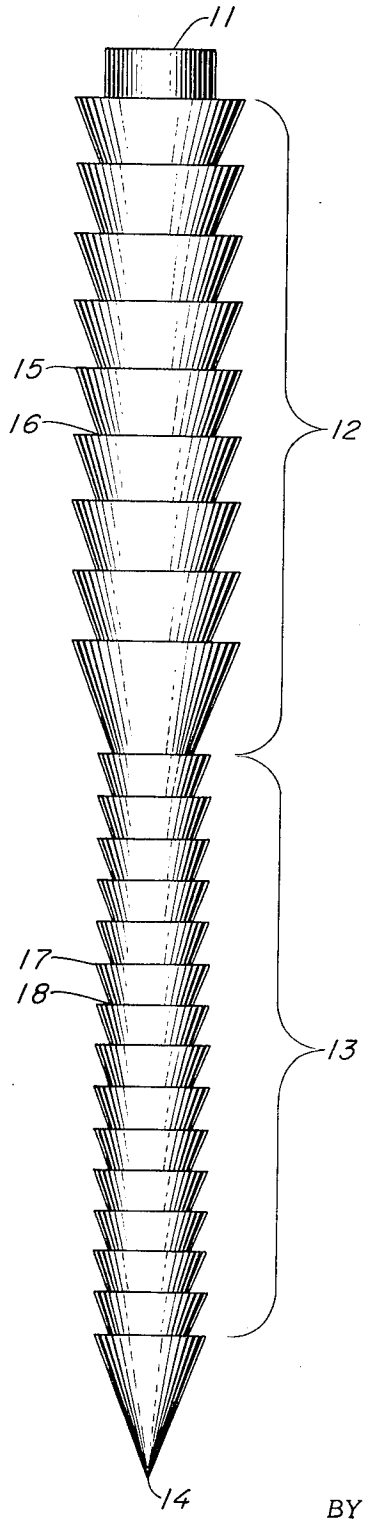
A nail-like device to securely fasten plywood underlayment to plywood subflooring without the accompanying nail popping and dimpling problems that often occur when nails of conventional design are used. The device is comprised of a shaft divided along its length into two sections of different diameters with each section having a plurality of annular grooves. The upper section of the shaft, which is normally embedded in the underlayment, has a larger diameter and coarser annular grooves than the lower section, which is normally embedded in the subflooring. The driving head at the top of the shaft is completely embeddable. These elements cooperate to prevent the device from withdrawing from the underlayment or otherwise causing surface irregularities which would be visible through a thin resilient tile floor.

1 Claim, 1 Drawing Figure



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UNDERLAYMENT FASTENING DEVICE

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BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to driven fasteners with particular reference to floor installation and attaching underlayment to subflooring prior to installing resilient tile finish flooring.

2. Description of the Prior Art

Flat-headed smooth-shank nails, with or without cement coating, are commonly used for fastening underlayment to subflooring. Such nails have adequate withdrawal resistance providing the wood does not undergo dimensional changes; however, if these changes occur, the nails lose withdrawal resistance and may be forced out of the wood. As wood absorbs moisture, it expands and applies stresses to the shank and underside of the nail head which cause the nail to be forced upward. As the wood subsequently loses moisture and shrinks, the nail head is left protruding above the surface of the wood. The nail also loses substantial withdrawal resistance because the wood no longer exerts as much pressure to the shank of the nail. These effects are often cumulative, i.e., nail withdrawal resistance progressively decreases and nail popping progressively increases as the wood floors undergo repeated cycles of swelling and shrinking.

The flat-headed annular-grooved nails, which are considered the most effective commercial nail for attaching underlayment to subflooring, have partially eliminated the aforementioned problems. These nails have much greater withdrawal resistance than the smooth-shank nails, and they lose little withdrawal resistance with repeated dimensional changes of the wood. However, the annular-grooved nails have not eliminated nail popping altogether.

Conventional annular-grooved nails are subject to popping in several ways:

1. The nail may be withdrawn by swelling underlayment which exerts an upward pressure on the shaft and the underside of the nail head. The wood can also shrink away from the nail exposing the head and leaving a nail pop equal to one-half the total shrinkage of the underlayment piece.
2. When underlayment and flooring shrink a gap develops between the two pieces of flooring so that, in effect, the underlayment remains suspended above the subflooring by that portion of the nail embedded in the underlayment. Any downward force applied to the underlayment, typically from a load on the flooring, that exceeds the withdrawal resistance of the nail in the underlayment can cause the nail to slip in that layer and produce a nail pop equal to the original gap distance between the two layers.
3. Another factor which contributes to nail popping when conventional annular-grooved nails are used is the effect of wood fiber damage in the underlayment as the nail is driven through. The annular grooves of the nail act as a rasp in the hole in the underlayment such that when the nail is in place it is less effective at gripping the damaged fibers. The nail tends to have a lower withdrawal resistance from the underlayment than from the subflooring because the latter is exposed to less of this rasping action.

A nail pop more than 0.005 inch will readily telegraph through a finish flooring of thin resilient tile. Though this defect is usually not indicative of severe structural weakness it is unsightly and often necessitates call-backs for repair, or in severe cases, replacement of the finish flooring.

Dimpling can be as objectionable as nail popping in resilient tile flooring. Dimpling is an indentation in the finish flooring created by a flat-headed nail being recessed below the upper surface plane of the underlayment. Conventional underlayment nails can cause dimpling in two ways:

1. Dimpling may occur with conventional flat-headed annular-grooved nails because of their somewhat greater withdrawal resistance from the two layers. They can remain fixed and restrain the wood beneath the nail head, while surrounding wood swells normally with moisture uptake.
2. Dimpling may also occur during installation of underlayment when large flat-headed nails are simply crushed below the surface of the underlayment.

SUMMARY OF THE INVENTION

In general, the principal improvement of this invention resides in an underlayment fastening device with a combination of three features which cooperate to prevent nail popping an dimpling. These features are: a completely embeddable head, annular grooving, and a differential diameter shank.

The shank of the device has two different sections of annular grooving. The upper shank, which is the section normally embedded in the underlayment, has a large diameter and coarse grooves for maximum withdrawal resistance in the underlayment. The lower section of the shank, which is normally embedded in the subflooring, also has annular grooves, but the diameters of the shank and the grooves are smaller than those in the upper section, such that, the withdrawal resistance of the nail from the subfloor is less than from the underlayment. The driving head at the top of the upper shank has a smaller diameter than the crown diameter of the grooves on that portion of the nail.

The embeddable head, annular grooving and differential diameter shank act together to give this invention a resistance to nail popping and dimpling which cannot be obtained by a device incorporating only one or two of these features. The operation of the device is illustrated under the following conditions which, as described in the previous section, often lead to nail popping of conventional underlayment nails:

1. The device resists withdrawing during cycles of wood swelling and shrinking.

As the wood swells, the fastener tends to remain firmly fixed because there is no large flat head against which the expanding wood can act to force the fastener upward. The driving head of this device is smaller than the crown diameter of the largest grooves.

The annular grooves impart high withdrawal resistance so that the fastener is not forced upward by pressure of the swelling wood against the shank.

When underlayment and subfloor swell, some slippage must occur between the fastener and wood. This may occur in two ways, or a combination of the two, neither of which will cause the fastener to project above the surface of the underlayment. The fastener has greater pull-through resistance in the upper section of the shank than direct withdrawal resistance of the lower section of the shank. Thus, as the wood members swell, some slippage occurs in the subfloor while the fastener tends to remain fixed in the underlayment. However, if the fastener tends to remain fixed in the subfloor, but slips in the underlayment, the driving head simply countersinks further below the surface from its initial position. Then as the wood subsequently shrinks, the driving head tends to return to its initial position below the surface of the underlayment. With repeated swelling and shrinking cycles, the fastening device tends to countersink itself slightly deeper.

2. When flooring members swell and subsequently shrink, a gap forms between the underlayment and subfloor because of slippage around the fastener. This gap can be closed by an external downward force, usually a heavy load, on the underlayment. With conventional nails, closure of this gap can cause the nail to slip in the underlayment such that the nail head protrudes from the underlayment surface. However, this fastening device with its coarse annular grooves and large upper shank diameter, resists slippage in the underlayment. Instead, as the gap closes, the smaller diameter shank with lesser pull-through resistance, will be the first to slip. Thus the device is more firmly embedded in the underlayment to eliminate nail popping.
3. The dual diameter shank reduces the wood fiber damage in the underlayment as the fastening device is driven. The smaller diameter lower shank does not rasp the underlayment where the upper shaft will be embedded, rather it creates a smaller hole which is subsequently widened by the larger upper shank. This insures a greater withdrawal resistance in the underlayment reducing the chance of nail popping.

The inventive device also acts to prevent dimpling in the surface of the underlayment. This action of the device is illustrated under the following conditions:

1. As the wood swells the smaller diameter driving head does not compress the surrounding surface of the underlayment to cause a dimple, rather the entire surface is allowed to swell evenly. The net effect of this expansion is to simply increase the depth of the driving head below the surface of the underlayment. The large and coarsely grooved upper shank imparts adequate pull-through resistance to keep the nail firmly embedded in this layer without significant slippage.
2. Since the small diameter driving head countersinks below the surface of the underlayment, there is no large head which must be crushed below the surface of the underlayment. The entry hole made by the device is too small in diameter to cause dimpling of the floor covering.

Accordingly, an object of this invention is an underlayment fastening device which will not cause nail popping or dimpling during installation, during swelling and shrinking of the wood, or as external forces are applied to the floor. A further object of this invention is to provide a means of securely attaching underlayment to a subfloor with high withdrawal resistance and adequate pull-through resistance of the fastening device.

BRIEF DESCRIPTION OF THE DRAWING

The accompanying drawing is a side view of the fastening device.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

More specifically, referring to the drawing, the fastening device is a shaft with two different diameter sections along its length, each consisting of a plurality of uniform annular grooves. The upper end of the shaft is truncated perpendicular to the longitudinal axis of the shaft to form a driving head **11**. The opposite end of the shaft is tapered to form a point **14**. Driving head **11** and point **14** allow the device to be driven into wood by use of a hammer or other suitable means to produce a downward force on the shaft. Driving head **11** projects above and is equal in diameter to base diameter **16** of section **12** of the shaft. When the device is installed driving head **11** and upper section **12** are completely embedded in the underlayment, or top layer of wood being fastened. A typical annular groove on upper section **12** has a larger diameter crown **15** and base **16** than crown **17** and base **18**, respectively, of a typical groove along lower section **13** of the shaft. When the device is installed lower section **13** is embedded in the sub-flooring or bottom layer of wood being fastened. The larger diameter grooves on upper section **12** cause the fastening device to have greater resistance to slippage within the underlayment or top layer than it has in the subfloor or bottom layer.

Typical dimensions of 1¼-inches-long version of this device for attaching five-eighths-inch-thick underlayment to one-half-inch-thick subflooring are:

Driving Head	
Diameter	0.100 inches
Projection above first groove	0.045 inches
Upper Section (9 grooves)	
Crown diameter	0.150 inches
Base diameter	0.100 inches
Groove spacing (base-to-base)	0.060 inches
Lower Section (15 grooves)	
Crown diameter	0.100 inches
Base diameter	0.070 inches
Groove spacing (base-to-base)	0.036 inches
Point	
Projection below last groove	0.125 inches

It is understood by the inventors that the scope of this invention is not limited by the specific geometry shown, but that different dimensions, spacing and shapes of annular grooves may be used to accomplish the functions herein described.

Having thus disclosed our invention we claim:

1. A nail-like device for fastening underlayment to subflooring, which avoids later nail popping and dimpling problems, comprising in combination:
   a. a solid shaft divided into upper and lower sections along its length, said upper section having a larger diameter than said lower section and a length sufficient to embed said upper section it the thickness of said underlayment, and said lower section of a

length sufficient to embed it in the thickness of said subflooring,

b. a plurality of annular grooves along the length of, and uniformly proportional in size to the diameters of each of said sections; each of said grooves being formed by a base the same diameter as the shaft section on which it is located, and a crown, the diameter of which is larger than the base diameter on that section,

c. said base and crown diameters on the upper section necessarily being larger than the base and crown diameters on the lower section, such that greater withdrawal resistance is found in the upper section which is embedded in said underlayment than in the lower section which is embedded in said subflooring, thereby limiting possible slippage to said lower section as said underlayment and subflooring alternately shrink and swell during variable moisture periods,

d. the upper end of said upper shaft section being truncated perpendicular to the longitudinal axis of said shaft to form a completely embeddable driving head having a diameter no greater than the maximum diameter of said shaft,

e. the lower end of said lower shaft section being tapered to form a point, and

f. said crowns on each section comprising a flat surface extending generally perpendicular to the axis of said shaft and facing said driving head, the surface of each said groove extending from the crown to the base defining the frustum of a cone.

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