

Spiral Flex Tree Fastener

This Sheet Has Been Replaced

Background of the Invention1. Field of The Invention

5       The present invention is directed toward the fastener art and, more particularly, to a fastener of the type generally referred to as a "push-in" or "drive" fastener.

2. Description of the Prior Art

10       "Push-in" or "drive" fasteners of a variety of types and styles are well known in the art. Typically, they are arranged to be driven axially into preformed openings in a work piece and to engage therein by virtue of laterally extending  
15 flexible tabs or wing-like members. The work piece may be a panel of some sort, the fastener being used in the case to secure another panel, or strip of molding or the like, thereto.

20       Fasteners of this variety are often referred to as tree fasteners because the flexible tabs or wing-like members extend outwardly from a shank as branches do from the trunk of a tree.

25       Ongoing problems with such fasteners include the relationship between the installation or insertion forces and the removal forces. Ideally, it would be desirable in many situations to have a design wherein the insertion forces are extremely low and the removal forces extremely high. In many prior art designs, these forces are nearly equal.  
30       Attempts to reduce the forces resisting installation while increasing the forces resisting removal have typically involved changing the shape of the tabs,

their angle of inclination, or their manner of connection to the fastener shank. These changes have generally been of marginal value.

Other problems include the difficulty in  
5 maintaining the fastener centered in a hole, so that it may have less of a tendency to wander out. Further, it has always been difficult to keep the tabs flexed inside the hole to discourage rattle and rotation without including an overdrive feature,  
10 such as a resiliently collapsible head in the shape of an umbrella.

The prior art is replete with tree-type fasteners. For illustration, U.S. Patent No. 4,728,238 shows a one-piece drive fastener having a  
15 head and a shank, the shank including a generally non-circular cross section presently a plurality of generally flat, axially extending surfaces. Each of the flat surfaces on the shank carry a plurality of axially spaced flexible resilient wing elements; the  
20 wings being flexed along the straight line connection with the flat surfaces. Certain wings extending from and positioned in spaced relation along at least one of said surfaces are angularly disposed so as to tilt in the direction of the head and further include means formed integrally with  
25 each of the certain wings to substantially increase the force required for removal of the fastener from a cooperating aperture as compared to the force required to introduce the fastener into the  
30 aperture. Nevertheless, this fastener is not self-centering, and tends to walk out of the holes when shifted back and forth. Forces required for its removal are inconsistent in value.

U.S. Patent No. 4,776,739 shows a one-piece  
35 plastic reusable push-in fastener for insertion into

an aperture in a workpiece comprising a head portion and a shank portion, the shank portion being integrally formed on one side of the head portion with its longitudinal axis extending away from the head portion and having a particular cross section and a transversely extending fin section intermediate the length of the shank on one side thereof whereby the fin section cooperates with the particular shank cross section to inhibit withdrawal of the fastener from a particular workpiece aperture and to centrally locate the longitudinal axis of the shank with the central axis of the aperture by forcing the periphery of the shank cross section against the inner wall of the workpiece aperture. While this fastener is self-centering, it makes minimal contact with the wall of the aperture. As a consequence, the fastener is able to rock in thin panels. The ratio between the forces required for removal and insertion is very low, being close to 1:1.

In short, a tree-type fastener having the ability to remain centered in its hole, as well as the ability to remain flexed in the hole without the use of an overdrive, which is much more difficult to remove than to insert into the hole, has been long-sought in the art. Such a fastener is provided by the present invention.

#### Summary of the Invention

The present invention is a spiral flex tree fastener which may be removably inserted into a hole in a panel, and may have a removal force greater than an insertion force with respect to the hole. The fastener has potential application in many industries, such as, for example, in the automobile

manufacturing industry, where it may be used to attach door panels and interior trim, or as a fastener for brake and fuel line clips.

5 The spiral flex tree fastener has a head and an elongated shank having an axis and extending axially from the head. The elongated shank has a cross section whose maximum extent is substantially equal to the maximum extent of the hole in which the fastener is intended to be inserted. As a  
10 consequence, when the fastener is inserted into such a hole, the elongated shank fits snugly in the hole. This aspect of the present invention provides a decided advantage over many prior-art fasteners.

The elongated shank has a plurality of flexible  
15 fins disposed thereon at an oblique angle with respect to the axis of the shank. Each of the fins has a portion which extends, when measured radially from the axis of the shank, a distance greater than that from the axis to the edge of the intended hole,  
20 so that the fins may flex against the walls of that hole and may spring out inside the panel upon passage through the hole to hold the fastener firmly therein and to inhibit its unintentional removal therefrom.

25 The present invention will now be described in more complete detail with frequent reference being made to the several figures to be identified immediately below.

#### Brief Description of the Drawings

30 Figure 1 is a side plan view of a preferred embodiment of the spiral flex tree fastener of the present invention;

Figure 2 is another side plan view of the preferred embodiment taken as indicated by line 2-2 in Figure 1;

Figure 3 is a cross section of the preferred embodiment taken as indicated by line 3-3 in Figure 1;

Figure 4 is a side plan view of an alternate embodiment of the spiral flex tree fastener of the present invention;

Figure 5 is a cross section of the embodiment shown in Figure 4 taken as indicated by line 5-5 in that figure;

Figure 6 is a side plan view of yet another embodiment of the present invention; and

Figure 7 is a cross section of the embodiment shown in Figure 6 taken as indicated by line 7-7 in that figure.

#### Detailed Description of the Preferred Embodiment

Figure 1 is a side plan view of a preferred embodiment of the spiral flex tree fastener 10 of the present invention. The fastener 10 has a head 12 having an upper head portion 14 and a lower crowned head portion 16 with an axial spacer 18 therebetween.

Extending axially from head 12, and sharing a common axis therewith, is a flattened shank 20. A flange 22 extends axially along the flattened shank 20; another flange 22, not visible in Figure 1, extends axially along the other side of shank 20. On each side of the flattened shank 20 are a plurality of flexible fins 24 set at an oblique angle with respect to the axis of the shank 20. The fins 24 are planar and may be parallel to one

another. Further, fins 24 may be set perpendicularly to shank 20, or at an angle thereto.

The spiral flex tree fastener 10 also has a conical rounded point 26, which also shares a common axis with flattened shank 20. The conical rounded point 26 has a maximum diameter equal to the width, as seen in Figure 1, of flattened shank 20, both of which are substantially equal to the hole in which fastener 10 may be used.

Leaving Figure 1 for a moment, Figure 2 is another side plan view of the spiral flex tree fastener 10 taken from the left toward the right in Figure 1 as indicated by line 2-2 therein. Flexible fins 24 may be seen on both sides of flattened shank 20; those on the left side of flattened shank 20 are inclined downwardly away from the viewer, while those on the right side are inclined downwardly toward the viewer. Most importantly, for the purposes of our present discussion, a portion 28 of each fin 24 extends outwardly from the flattened shank 20 beyond the maximum extent of the conical rounded point 26. Those portions 28 are designed to interfere with the walls of the hole, whose diameter is substantially equal to the maximum diameter of the conical rounded point 26, by flexing thereagainst and by snapping out therebehind, so that the spiral flex tree fastener 10 may remain fixed immovably within that hole.

It may be readily appreciated by those of ordinary skill in the art that the flexible fins 24, set, as they are, obliquely on the flattened shank 20, each have a certain extent in the axial direction, as opposed to the fins in prior-art fasteners which have outer edges perpendicular to the axis of the fastener. As a consequence, even

when the fastener 10 is inserted into a hole through a thin panel, some of the flexible fins 24 will always be flexed against the walls thereof. This feature of the present fastener 10 ensures that it will not rattle or rotate, once it has been inserted into a hole of appropriate size.

Further, as the flexible fins 24 have oblique orientations on the flattened shank 20, their flexing will have a radial, as well as an axial component. This permits the fastener 10, and particularly the flexible fins 24, to have a continuous surface contact with the walls of a hole, and makes it unnecessary to provide the fastener with an overdrive feature.

Turning now to Figure 3, which is a cross section of the fastener 10 taken as indicated by line 3-3 in Figure 1, the flattened shank 20 has a width measured thereacross between opposite corners 30, that width being substantially equal to the diameter of the hole, indicated by circle 32, in which fastener 10 is to be used. Flanges 22, which appear as lobes in the cross section, have tips 34 which are separated from one another by the same amount. In this light, it may readily be appreciated that flanges 22 provide fastener 10 with the capacity to remain centered within a hole having substantially the same diameter as circle 32.

Referring to the flexible fins 24, it will be noted that portions 28 lie outside the circumference of circle 32. This characteristic of flexible fins 24, and portions 28 thereof, provide spiral flex tree fastener 10 with the ability to remain fixed in a hole having a diameter substantially equal to that of circle 32 without rotating or rattling.

Referring back to Figure 1, the flexible fins 24 are included in sufficient number and spacing that there will always be a set of fins flexed inside the hole to discourage rattle, rotation and removal. The relative spacing of the flexible fins 24 also results in a tight fit in panels of many thicknesses. This and the radial flex motion of the fins eliminate the need for a collapsible head in the shape of an umbrella, which can add significant cost to a fastener.

The shank 20, as noted above, is designed to keep the fastener 10 centered in a hole, thereby maximizing and controlling the contact made by the flexible fins 24 with the wall thereof to improve retention.

The insertion force and removal force of the fastener 10 may be predetermined by varying its design parameters.

Turning first to parameters which will bear on the insertion force, the amount by which portions 28 of flexible fins 24 extend beyond the circumference of a hole for which the fastener 10 is designed, and thus interfere with the walls thereof, has a direct bearing on the insertion force.

Reducing angle 36 (the oblique angle made by the flexible fins 24 with the axis of the fastener 10) provides more lead-in and allows the fins 24 to flex more easily, thereby lowering insertion force. Also, by reducing the thickness of the fins 24, insertion force will be lowered as thin fins 24 will flex more easily.

Finally, by increasing angle 38 (the acuteness of the edge 40 of the fins 24), the fins 24 will be forced to flex in the radial direction.

It should be understood that, during insertion, flexible fins 24 passing completely through the hole will be released from flexing and will reassume a plane condition on the underside of the panel.

5 Referring now to Figure 3, the insertion leading edge 41 makes contact with the walls of the hole far from flattened shaft 20. This ensures that, upon insertion, the fins 24 will be flexed readily to permit the relatively easy insertion of the fastener  
10 10 thereunto.

In contrast, the removal leading edge 42 of fin 24 makes contact with the walls of the hole, when being drawn out from inside the panel, close to the flattened shank 20. This will inhibit the flexing  
15 of the fins 24 upon withdrawal, and will increase the retention force. It should be noted, in passing, that the removal leading edge 42, as shown in Fig. 3, may be a segment of a circle.

Several other factors will increase the  
20 retention force. Again, as before, by increasing the amount by which portions 28 of flexible fins 24 extend beyond the circumference of a hole for which the fastener 10 is designed, greater interference will be provided and the removal forces will  
25 increase.

By decreasing angle 36, that is, by making the oblique angle made by the flexible fins 24 with the axis of the fastener 10 smaller, the fins 24 will be less readily flexed and will prevent the fastener 10  
30 from being withdrawn from the hole. Of course, by increasing the thickness of the fins 24, the removal force will be increased, as thicker fins 24 will be stiffer and less likely to flex.

Finally, by decreasing angle 44 (the acuteness  
35 of the removal leading edge 42 of the fins), the

fins 24 will be prevented from flexing making removal more difficult.

Turning now to Figures 4 through 7, these show two alternate embodiments which will be described to the extent that they differ from that shown in Figures 1 through 3 for the purpose of drawing a contrast therewith. Figure 4 shows a first alternate embodiment of the spiral flex tree fastener 50 having only six, as opposed to eight, flexible fins 52 on each side of flattened shank 54. Flexible fins 52 may be observed to be at a smaller oblique angle with respect to the axis of fastener 50 than was the case in Figure 1.

Figure 5 is a cross section of fastener 50 taken as indicated by line 5-5 in Figure 4. The removal leading edge 56 of fins 52 may be seen to be straight, as opposed to the curved removal leading edges 42 shown in Figure 3.

Figure 6 shows a second alternate embodiment of the spiral flex tree fastener 60. Like the embodiment shown in Figure 1, fastener 60 has eight flexible fins 62 on flattened shank 64 set at an oblique angle.

Figure 7 is a cross section of fastener 60 taken as indicated by line 7-7 in Figure 6. The shape of fins 62 is substantially identical to that of fins 52 in Figure 5, except that removal leading edge 66 makes a smaller angle with flattened shank 64 than removal leading edge 56 does with flattened shank 54.

The fasteners of the present invention may be used in place of most so-called Christmas-tree fasteners because of its versatility. It is intended for applications with wide panel thickness variation, especially where overdrive is a problem

due to space constraints, or where the higher insertion forces needed for overdrive are undesirable.

In the automotive industry, the present fasteners may be used to attach door panels and interior trim, or as a fastener for brake and fuel line clips. They can also be used in spiral-weld applications, where tree fasteners are currently used, as well as in many other applications.

The present fasteners may be injection molded from any of the polymeric resin, or plastic, materials commonly used for the manufacture of tree fasteners by those of ordinary skill in the art. Nylon is but one example of a suitable material.

In summary, the present spiral flex tree fasteners, so-called because the oblique orientation of the flexible fins is suggestive of spirals about the shank, have as advantages: a smooth, non-incremental installation; low insertion and high retention forces; the ability to be customized to meet the specific needs of an application; reusability; no overdrive required; tight fit in all panel thicknesses without rattle or rotation; robustness; ease in manufacture and tooling; low cost; self-centering; and consistency.

Modifications to the present fasteners would be obvious to those of ordinary skill in the art, but would not bring the fastener so modified beyond the scope of the claims to follow.



**What Is Claimed Is:**

1. A spiral flex tree fastener for removable insertion into a hole in a panel, said fastener comprising:
  - a head;
  - an elongated shank having an axis and extending axially from said head; and
  - a plurality of flexible fins on said elongated shank, said flexible fins being disposed axially along said elongated shank at an oblique angle with respect to said axis, each of said flexible fins having a portion extending from said axis a distance greater than that separating an edge of said hole from said axis, so that, when said fastener is inserted in said hole, said flexible fins may flex against the walls thereof to hold said fastener therein.
2. A spiral flex tree fastener as claimed in claim 1 wherein said flexible fins are parallel to one another.
3. A spiral flex tree fastener as claimed in claim 1 wherein each of said flexible fins has an upper end and a lower end, said upper end being closer to said head than said lower end, and wherein said portion of each of said flexible fins extending from said axis a distance greater than that separating an edge of said hole from said axis is closer to said upper end than to said lower end.
4. A spiral flex tree fastener as claimed in claim 1 wherein said elongated shank has two sides, and wherein said plurality of flexible fins is disposed axially along one of said two sides of said elongated shank.



5. A spiral flex tree fastener as claimed in claim 4 further comprising a second plurality of flexible fins, said second plurality being disposed axially along the other of said two sides of said elongated shank at an oblique angle with respect to said axis, each of said flexible fins of said second plurality having a portion extending from said axis a distance greater than that separating an edge of said hole from said axis, so that, when said fastener is inserted in said hole, said flexible fins may flex against the walls thereof to hold said fastener therein.
6. A spiral flex tree fastener as claimed in claim 4 wherein said elongated shank has a flattened cross section.