

1 TWO-PART SNAP-TOGETHER PANEL FASTENER

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3 The present application is related to provisional patent application serial
4 number 60/354,920 entitled "Two-Part Snap-Together Panel Fastener" filed on
5 February 11, 2002, priority from which is hereby claimed.

6 FIELD OF THE INVENTION

7 The present invention relates to captive panel fasteners of the type having a
8 retractable screw which is captive and extendable within a ferrule that attaches to a
9 first panel. In fasteners of this type, the screw is usually held in its extended position
10 by a spring but when depressed may be threaded into a second panel thereby joining
11 the two panels.

12 BACKGROUND OF THE INVENTION AND PRIOR ART

13 Panel fasteners are well known in the art and include different means of
14 attaching the ferrule to the first panel. Both snap-in and clinch-fit means of attachment
15 are employed. The screw may be captivated in the ferrule by different means, but the
16 captivation means are usually permanent and thus the screw and spring assembly is not
17 detachable once the assembly of parts is completed. Thus, all elements of the fastener
18 assembly must be fixed to the panel at the same time and therefore all elements will
19 experience the same environment in subsequent steps of the manufacturing process to
20 which the greater assembly is subjected.

21 A problem exists, however, because this may not be desirable. The panel may
22 be subjected to manufacturing environments such as excessive heat that is not

1 compatible with the materials of the screw/spring assembly. By nature, the
2 screw/spring sub-assembly of these fasteners includes more delicate structures which
3 cannot survive many harsh manufacturing environments such as those experienced
4 during circuit board manufacture. However, there is a need to have the panel fastener
5 attachment occur during or prior to manufacturing steps such as wave soldering.
6 Therefore, while a permanently assembled panel fastener has the advantage of the
7 permanent retention of all components, it may not be suitable in all applications. There
8 may also be other applications in which the panel fastener not only unites two panels,
9 but is also required to support other structures. In these cases, some means for the
10 attachment/detachment of those structures to the body of the panel fastener is also
11 needed. In yet other applications, it may be desirable to have the panel fastener
12 installed on the panel in stages where the ferrule is attached first and then the spring
13 and screw assembly assembled at a later time at another location.

14 There is therefore a need in the art for a panel fastener assembly which will
15 permit the ferrule portion to be attached to the base panel in a step separate from
16 assembling the other components of the captive panel fastener. There is a further need
17 for having the final assembly of parts to be quick and efficient without the need for
18 special tools. And finally, there is a need for a captive panel fastener assembly which
19 will accommodate the attachment of other structures to the panel without additional
20 cost or complexity.

21 SUMMARY OF THE INVENTION

22 The present invention has been devised to meet the needs in the art described

1 above. The invention consists of a two-component, snap-together captive panel
2 fastener in which the two components are individual sub-assemblies kept separate
3 during different phases of the manufacturing operation. This is accomplished by a
4 unique configuration of snap-together elements which includes a detachable ferrule
5 portion and a snap-in screw/spring/retainer sub-assembly. The present invention's
6 two-part system permits, for example, a separate ferrule of very hard and durable
7 metal to be first wave-soldered to a printed circuit board with other elements of the
8 board. Later, the screw sub-assembly can be snapped into the ferrule mounted on the
9 circuit board when desired away from the harsh wave-soldering environment.

10 In another embodiment of the invention, the ferrule and the screw retainer
11 include cooperating outer flanges which captivate a pivoting structure such as a lever
12 so that the panel fastener may not only be used to secure the panel to a sub-structure,
13 but may also be employed to affix other hardware. In one embodiment, a lever is
14 fitted over the barrel of the ferrule and is retained against a bottom flange of the ferrule
15 by a top flange of the screw/spring sub-assembly retainer. Sufficient snap force
16 holding the two parts together is provided to withstand the forces of normal lever
17 actuation.

18 More specifically, the applicant has invented a captive panel fastener assembly
19 comprising a screw having an enlarged head, a shank, and a threaded portion of
20 greater diameter than the shank. The fastener includes a retainer having a flange at the
21 top, a bore receiving the screw, and a plurality of axially-extending resilient fingers at
22 the bottom, the fingers each include an outward-facing barb and an inward-facing

1 fingertip adjacent the shank when assembled. The diametric distance between the
2 fingertips at rest is less than the diameter of the threaded portion of the screw but
3 greater than the diameter of the shank. Spring means is operative between the screw
4 head and the retainer flange to bias the screw in a retracted position. A ferrule
5 includes a bore with an internal annular flange dimensioned to cooperate with the
6 resilient retainer fingers by snap action whereby the barbs are forceably engaged with
7 the internal flange to join the ferrule and the retainer. The ferrule further includes
8 panel attachment means adjacent a bottom end and a second radially extending outer
9 flange proximate the bottom end thereof. When applied, snap fingers and a solder
10 joint rigidly attaches the ferrule to an aperture in the circuit board panel. The ferrule
11 further includes a barrel portion located between the retainer flange and the second
12 outer flange proximate the bottom end thereof. The fastener may also include a device
13 that is captivated by the retainer flange and the ferrule outer flange whereby the device
14 is attached to the panel. In one embodiment, the device is a lever rotatable about an
15 outside surface of the barrel of the ferrule. Preferably, the retainer also includes a
16 bottom-facing bevel on the inside surface of each fingertip. This provides a locking
17 function since the threaded portion of the screw includes a downwardly-angled top
18 land which engages the bevel upon upward retraction of the screw from the ferrule.
19 Thus, if the screw is pulled away from the panel, the retainer fingers are forced
20 outwardly against the internal flange of the ferrule preventing further retraction. The
21 screw sub-assembly can only be released from the ferrule by first pushing in the screw
22 while pulling on the retainer. Since this operation requires the application of forces to

1 different parts of the assembly in different directions, inadvertent removal of the spring
2 sub-assembly from the ferrule is avoided.

3 It is therefore an object of the invention to provide a panel fastener with a
4 separatable spring/screw sub-assembly that may be pre-assembled away from the final
5 assembly site. It is another object of the invention to provide an assembled panel
6 fastener that may be accomplished quickly and efficiently without the need for special
7 tools. It is yet another object of the present invention to provide a captive panel
8 fastener assembly which will also secure other structures to the primary panel without
9 additional cost or complexity. Other objects and advantages will become apparent
10 from the following drawings and description of the preferred embodiment.

11 BRIEF DESCRIPTION OF THE DRAWINGS

12 Figure 1 is an exploded assembly view of the present invention.

13 Figure 2 is an exploded assembly view of the screw/spring sub-assembly.

14 Figure 3 is a side sectional view of the retainer of the spring screw sub-
15 assembly.

16 Figure 4 is a side sectional assembly view of the present invention.

17 Figure 5 is a side sectional view of the ferrule element of the invention shown
18 in isolation.

19 Figure 6 is a side sectional view of the present invention in its fully assembled
20 condition.

21 DESCRIPTION OF THE PREFERRED EMBODIMENT

22 Referring now to Figure 1, the present invention includes two major fastener

1 sub-assemblies 11 and 13 snapped together to captivate lever 15 between cooperating
2 flanges, one on each of the two inner fitting snap-together parts. The top part is a
3 screw/spring sub-assembly 21 which includes a retainer 12 that snaps into the bore of
4 the ferrule 23 that is pre-assembled to panel 25 in a separate assembly step. This
5 sequence of assembly may take place as different events separated by time and
6 distance as desired. For example, the assembly of the ferrule to the panel may take
7 place during a wave-soldering process where it is not desirable to expose the other
8 components to the heat and hazardous conditions in that manufacturing environment.
9 As described further herein, the assembly of parts may support a rotatable element
10 such as lever 15.

11 Referring now to Figures 2 and 3, an assembly view of the screw/spring sub-
12 assembly is shown with screw 31 fitted inside of spring 33 and both parts fitted within
13 the bore of retainer 35. The screw includes a head 30, a shank 32, and a threaded
14 portion 34 of greater diameter than the shank. Snap fingers 43 extend axially from the
15 base of the retainer. As more clearly shown in Figure 3, the retainer includes a flange
16 41 with snap fingers 43 extending axially around the circumference of an internal bore
17 45. The ends of the snap fingers include external, outward-facing barbs 47 for snap-in
18 engagement with an internal flange of the ferrule. Fingertips 49 are inward-facing to
19 provide a bottom opening of reduced diameter about the central axis so that the
20 smallest diameter between the snap fingers 42 is less than the major diameter of the
21 threaded portion 34 of the screw but greater than the diameter of the screw shank 32.
22 Therefore, when the screw is first pressed into the retainer, the fingertips 49 spread to

1 allow passage of the threaded portion **34** and then they contract about shank **32**. This
2 operation slidably captivates the screw in the retainer by the inward-facing surfaces of
3 the retainer snap fingers as shown in Figures 4 and 6. A bevel **48** is located around the
4 inside edge of each of the fingertips **49**. Bevel **48** contributes to a locking function of
5 the fastener that will be more fully explained with regard to Figure 6.

6 Referring now to Figure 4, the assembly of parts of Figure 1 is shown from a
7 side view. The screw sub-assembly **21** is shown in alignment with lever **15**, ferrule **23**,
8 and panel **25**. The lever includes an aperture **50** having an inside wall **52** which is
9 compatible with the outside diameter of the ferrule barrel **54** to provide an axle for the
10 lever to pivot. Referring now to Figure 5, the ferrule **23** further includes an area **56** of
11 increased diameter along the bottom portion of its bore forming an internal annular
12 flange **58**. As more clearly shown in Figure 6, the external barbs of the retainer snap
13 fingers expand into this area against the flange **58** to form the snap-fit connection of
14 the retainer into the ferrule. Outer flange **59** acts as a stop against the top side of the
15 attached panel and also provides an abutment for the lever to space it away from the
16 panel. The ferrule further includes snap-arms **55** to provide means for panel
17 attachment.

18 Referring now to Figure 6, all elements of the present invention are shown in
19 their fully assembled condition. The lever **15** is comfortably received about the barrel
20 of the ferrule and between the retainer flange **41** and the ferrule flange **59** so that the
21 united parts form a rotatable attachment of the lever to panel **25**. From this figure the
22 importance of the radial bevel on the inside surface of the retainer snap fingertips can

1 be appreciated. Since the screw in its retracted position places the screw threads
2 against bevel 48, further retraction of the screw creates a wedge force between the
3 land of the top thread and the face of the bevel pushing the snap fingers outwardly
4 against the internal flange of the ferrule thus locking the retainer to the ferrule.
5 Therefore, pulling on the head of the screw in a completed assembly as shown in this
6 figure will not separate the parts until the pull-out force exceeds the pull-out limit of
7 the ferrule/panel connection. It should also be understood by these mechanical
8 relations that the same locking function provided by the screw, the retainer, and the
9 ferrule is operative whether or not the panel fastener assembly stands alone or is fitted
10 into other parts as shown in Figure 6. For the sub-assembly to be removed from the
11 ferrule, the screw must first be depressed downward until the smaller diameter of the
12 screw shank 32 resides between the tips of the retainer snap fingers. When the screw
13 is held in, the fingers are able to contract as the retainer is then pulled axially upward
14 out of the ferrule. Because opposing dual actions are required, accidental or
15 inadvertent disassembly of the parts is prevented. The assembly of parts shown in
16 Figure 6 may then, as a self-contained unit, be fastened to a chassis or other sub-
17 structure (not shown) by depressing the screw downwardly and threading it into the
18 sub-structure.

19 In this preferred embodiment, the panel is attached to the ferrule by snap-fit
20 provided by snap-in fingers 55 which axially extend from the bottom of the ferrule. It
21 should be understood, however, that other panel attachment means at the base of the
22 ferrule may be employed. Furthermore, there may be other modifications,

- 1 enhancements, or improvements to the described preferred embodiment without
- 2 departing from the nature and scope of the invention which is to be determined only by
- 3 the following claims and their legal equivalents.

CLAIMS

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3 1. A captive panel fastener assembly, comprising:

4 a screw having an enlarged head, a shank, and a threaded portion of
5 greater diameter than the shank;

6 a retainer having a flange at the top, a bore receiving said screw, and a
7 plurality of axially-extending resilient fingers at the bottom, said fingers each including
8 an outward-facing barb and an inward-facing fingertip adjacent said shank, the
9 diametric distance between said fingertips at rest being less than the diameter of said
0 threaded portion of said screw but greater than the diameter of said shank;

11 spring means operative between said screw head and said retainer
12 flange; and

13 a ferrule having a bore with a first internal annular flange dimensioned
14 to connect to said resilient retainer fingers by snap action whereby said barbs are
15 forceably engaged with said first internal flange.

16 2. The panel fastener of claim 1 wherein said ferrule further includes
17 attachment means adjacent a bottom end thereof.

18 3. The panel fastener of claim 2 wherein said ferrule further includes a
19 second radially extending outer flange proximate the bottom end thereof.

20 4. The panel fastener of claim 2 wherein said attachment means are snap
21 fingers for engaging an aperture in a panel.

22 5. The panel fastener of claim 1 further including a bottom-facing bevel on

1 the inside surface of said retainer fingertips.

2 6. The panel fastener of claim 5 wherein said threaded portion of said
3 screw includes a downwardly-angled top land which engages said bevel upon upward
4 retraction of said screw from said ferrule whereby said retainer fingers are forced
5 outwardly against said first internal annular flange of said ferrule preventing further
6 retraction.

7 7. The panel fastener of claim 4 wherein said ferrule further includes a
8 barrel portion located between said retainer flange and the second outer flange
9 proximate the bottom end thereof.

10 8. An assembly of parts including the panel fastener of claim 7 and further
11 including a device captivated between the retainer flange and the second ferrule outer
12 flange whereby said device is attached to a panel.

13 9. The assembly of parts of claim 8 wherein said device is a lever rotatable
14 about an outside surface of the barrel of said ferrule.

15 10. The assembly of parts of claim 2 wherein said attachment means rigidly
16 affixes said ferrule to a circuit board.

17 11. The panel fastener of claim 10 wherein said attachment means includes
18 a solder joint.

19 12. The panel fastener of claim 11 wherein said panel is a circuit board.