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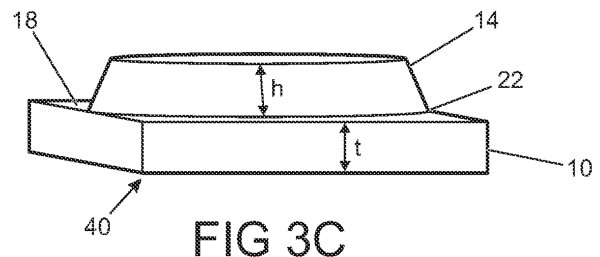
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**DE 004320068 A** **DE 102006001526 A**  
**JP 2006161820 A** **US 20110302755 A**

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INT CL **B21J, F16B**  
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(54) Title of the Invention: **A patch for use in replacement of a rivet and a method for replacing a rivet**  
Abstract Title: **A patched for use in replacement of a self-piercing rivet and a method for replacing a rivet**

(57) A patch for use in replacement of a self-piercing rivets, particularly in vehicles, comprising a protrusion 14 for fitting into a hole created by removal of a rivet; and a flange area 18 adjacent the protrusion. Preferably, the protrusion is chamfered and provides interference fit with the hole. Preferably, the flange surrounds the protrusion in two opposing portions, and provides a surface for receiving adhesive. Preferably, a recess 40 aids the location of a new rivet. A method of replacing a self-piercing rivet by removing a rivet, locating the patch in the hole and applying a new rivet. Preferably, the hole is chamfered. Preferably, the rivet is removed, a panel is removed from the material stack, a new panel added and a new rivet applied over the patch. Preferably, adhesive is applied to the flange of the patch.



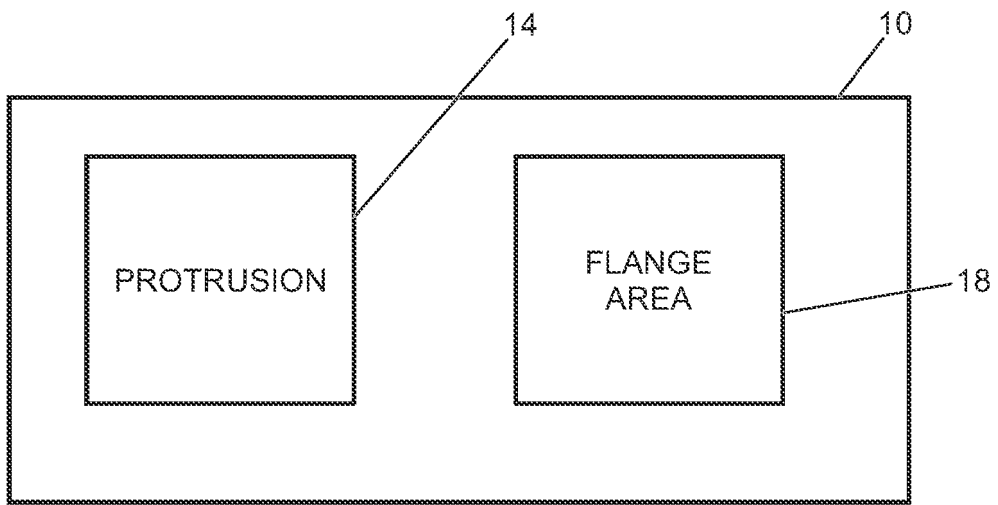


FIG 1

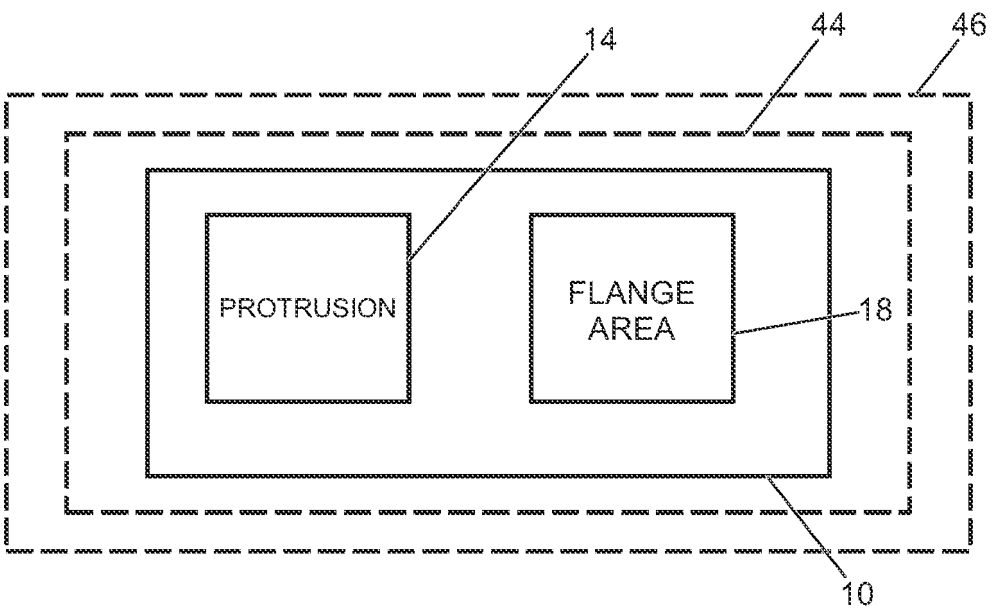


FIG 2

16 02 17

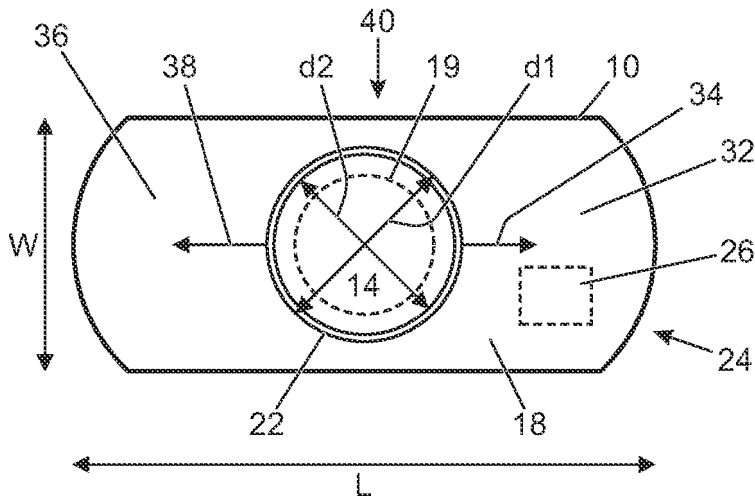


FIG 3A

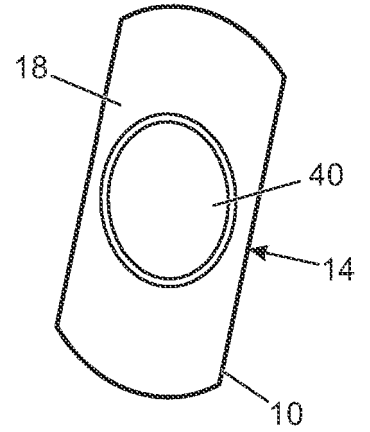


FIG 3B

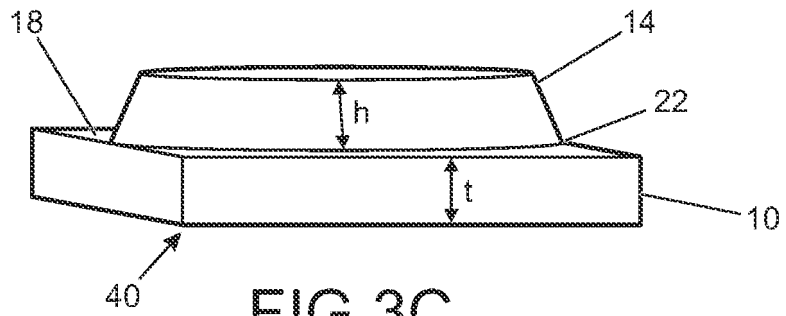


FIG 3C

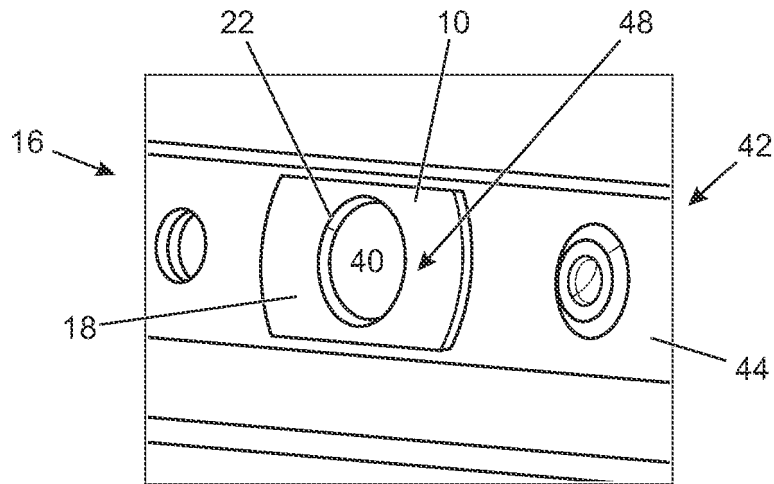


FIG 4

16 02 17

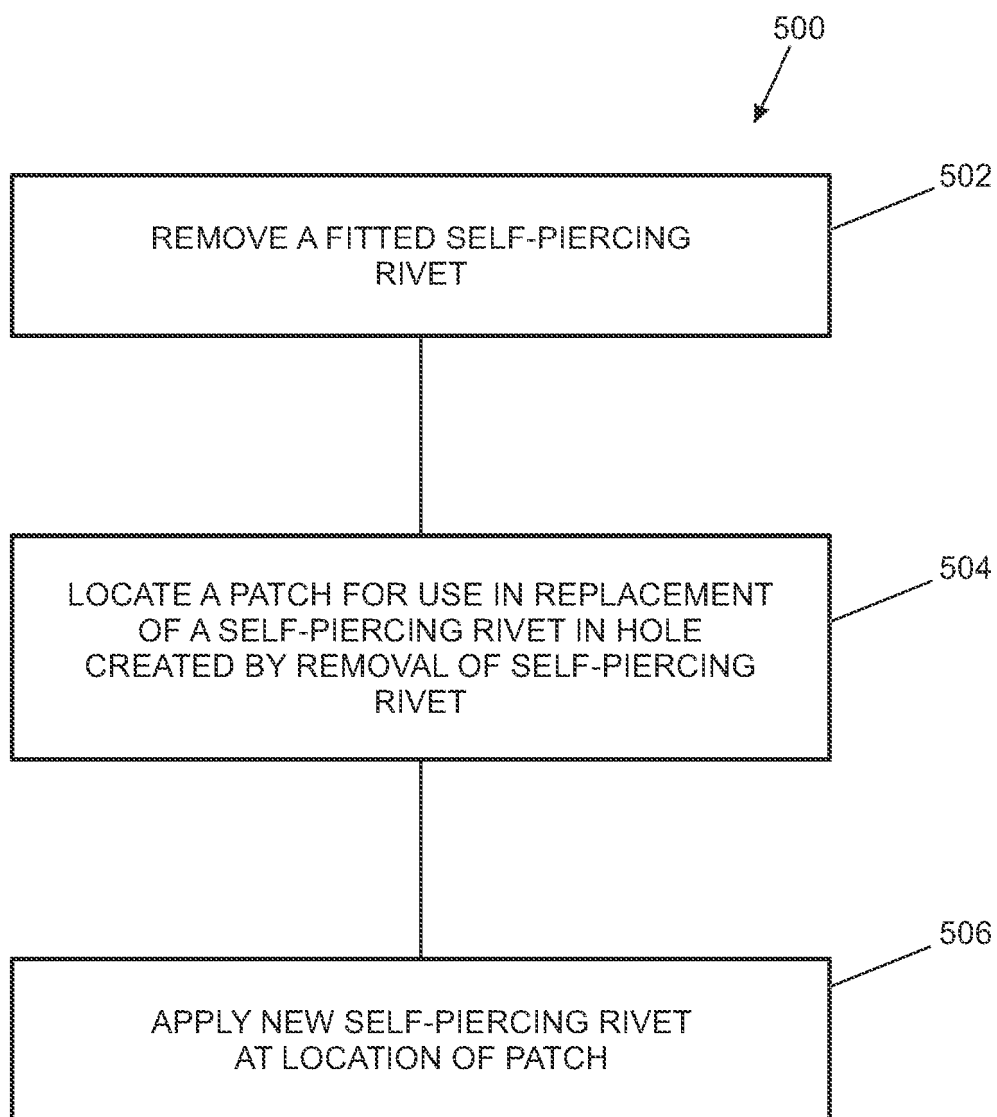


FIG 5

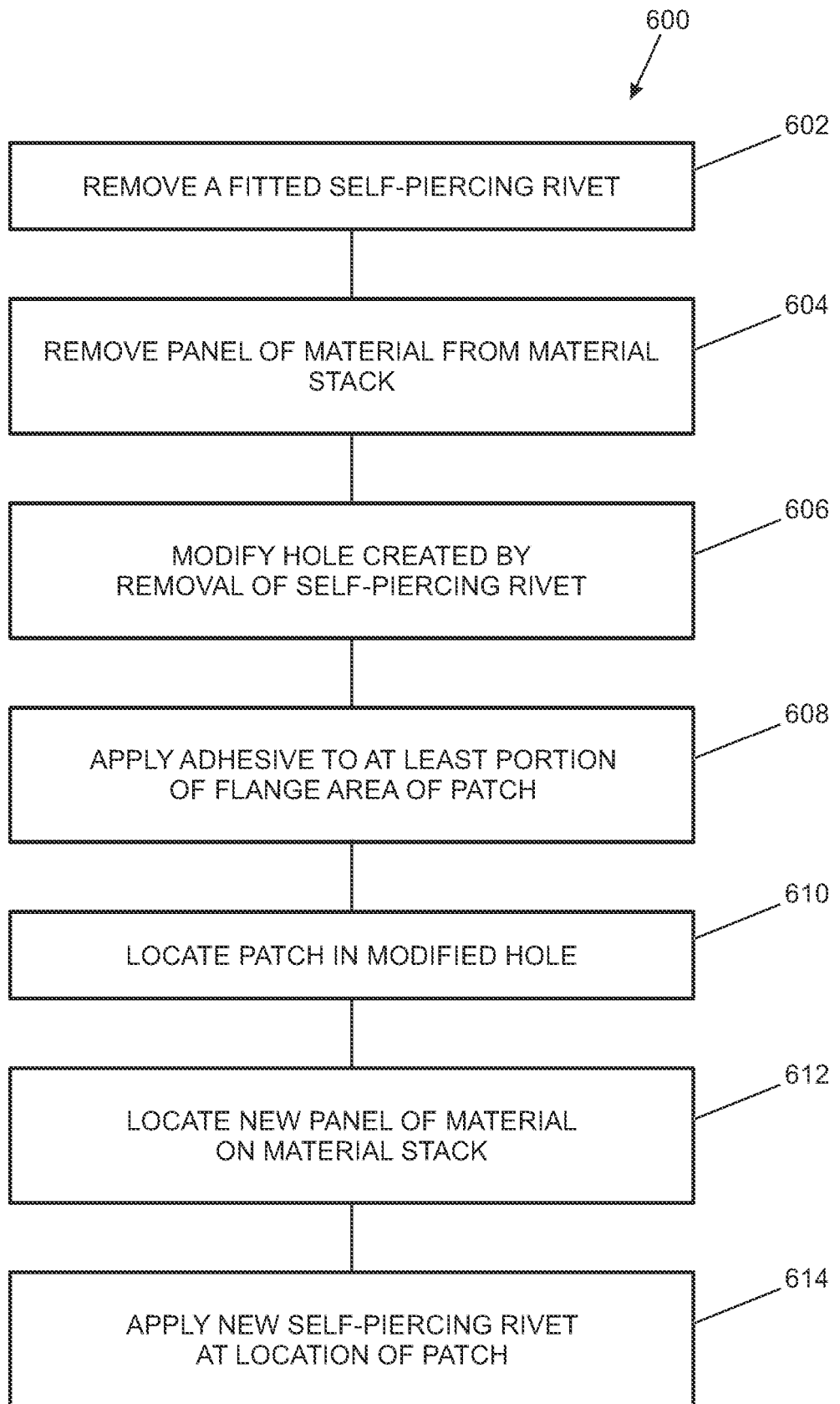


FIG 6

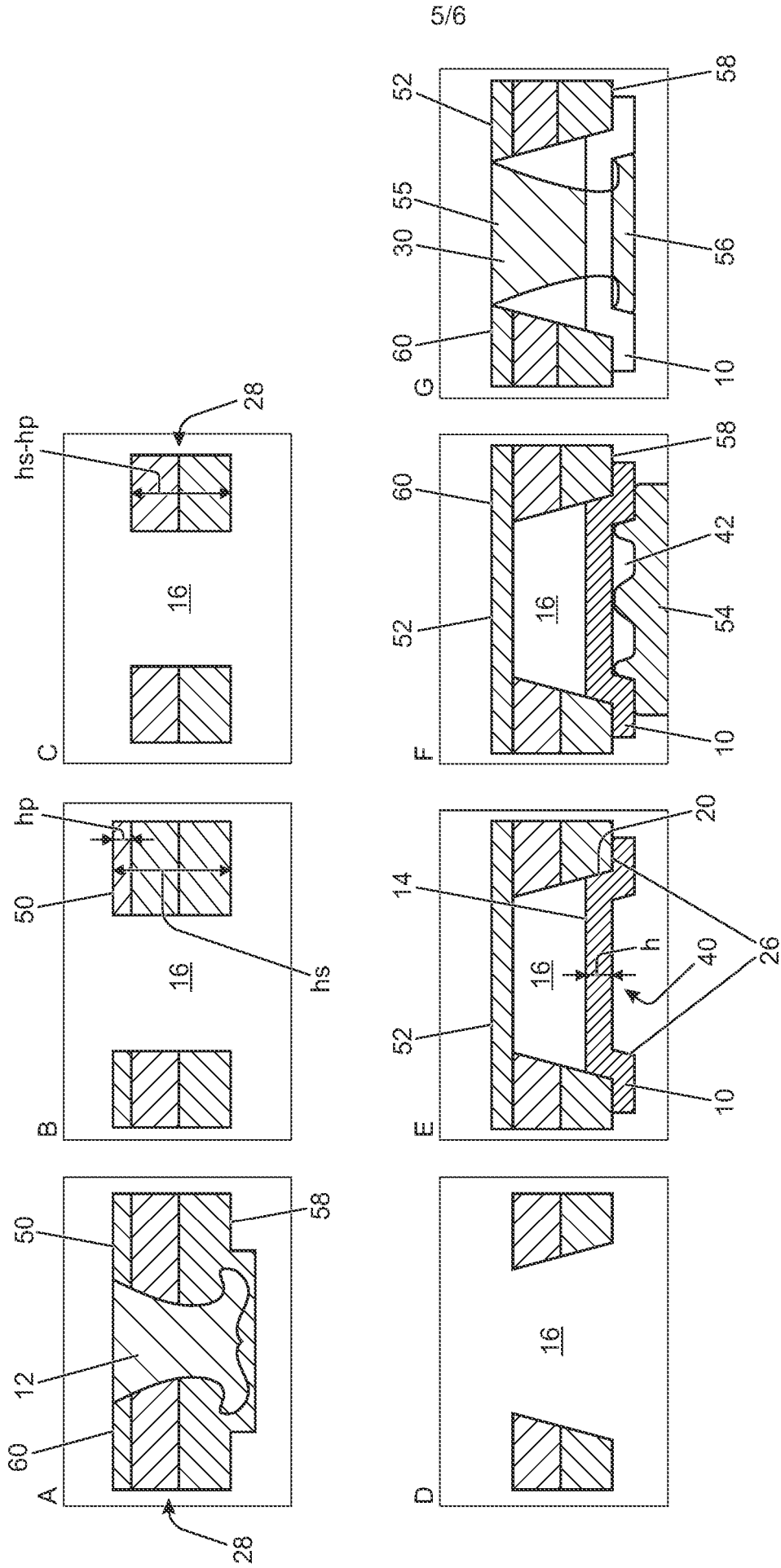


FIG. 7

16 02 17

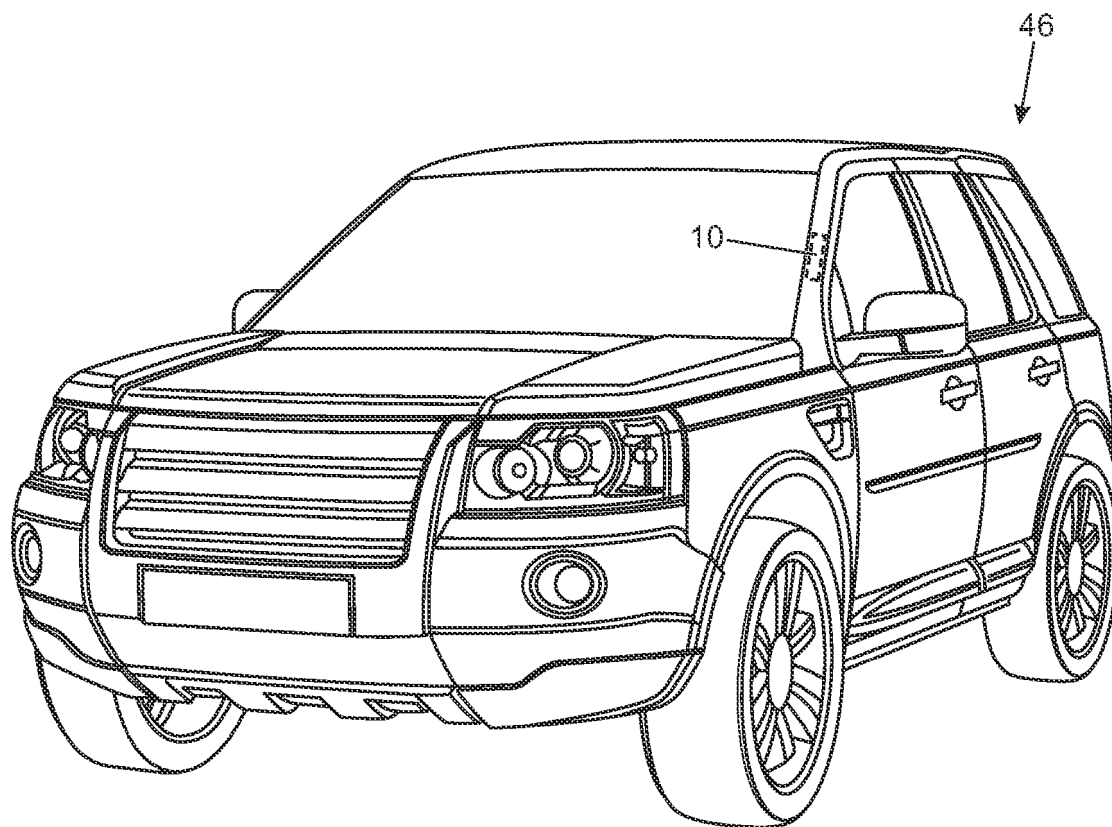


FIG 8

## **A PATCH FOR USE IN REPLACEMENT OF A RIVET AND A METHOD FOR REPLACING A RIVET**

### 5 TECHNICAL FIELD

The present disclosure relates to a patch for use in replacement of a rivet and a method for replacing a rivet. In particular, but not exclusively, it relates to a patch for use in replacement of a rivet and a method for replacing a rivet in a vehicle.

10

Aspects of the invention relate to a patch, a method, a vehicle part and a vehicle.

### BACKGROUND

15 Rivets, such as self-piercing rivets (SPRs) are used to join layers of materials together, for example, in an automotive application to create a vehicle body structure. In particular, self-piercing rivets are particularly useful in manufacture of predominantly aluminium or aluminium alloy vehicle body structures, where the SPR is arranged to create its own aperture in the material of the body panels it is being used to secure together, thus negating  
20 the need to pre-drill holes for each rivet.

Under certain circumstances a rivet, such as an SPR may need to be removed, for example to allow replacement of a damaged panel of material. In conventional methods a fitted rivet, such as an SPR, is drilled out leaving a hole at the original location of the fitted SPR.

25 Accordingly, if a new or replacement SPR is to be fitted, for example to attach a replacement panel, the original location for the SPR cannot be used and a new location for the replacement rivet must be found for use.

In some circumstances, such as if multiple repairs are required, there may be no suitable  
30 locations for a new rivet, such as an SPR, to be fitted. This may render the object unrepairable and therefore out of use.

In addition, during vehicle production for example, the production process may change the properties of materials joined using a rivet, such as an SPR, such as adhesives in and



between a stack of materials. Accordingly, if a new rivet, such as an SPR, is fitted an unsatisfactory joint may be achieved due to the change in the material properties subsequent to the original fitting of the rivet.

- 5 It is an aim of the present invention to improve upon known techniques for the replacement of a rivet in the repair of a riveted structure.

#### SUMMARY OF THE INVENTION

- 10 Aspects and embodiments of the invention provide a patch, a method, a vehicle part and a vehicle as claimed in the appended claims.

According to an aspect of the invention, there is provided a patch for use in replacement of a self-piercing rivet, comprising:

- 15 a protrusion for fitting into a hole created by removal of a self-piercing rivet; and  
a flange area adjacent the protrusion.

The protrusion may be for fitting into a hole that has been modified following creation of the hole by removal of the self-piercing rivet.

20

The protrusion may be for fitting into a hole that has been modified by chamfering of the hole.

The protrusion may be for providing an interference fit with the hole.

25

The flange area may surround at least one edge of the protrusion.

The flange area may provide at least one surface for receiving adhesive to adhere the patch to a material stack that is to receive a replacement self-piercing rivet.

30

The flange area may comprise a first portion extending from the protrusion in a first direction and a second portion extending from the protrusion in a second direction.

The second direction may be opposite to the first direction.

The patch may comprise a recess for providing a location aid for application of a new self-piercing rivet.

5

According to a still further aspect of the invention, there is provided a method for replacing a self-piercing rivet, comprising:

- removing a fitted self-piercing rivet;
- 10 locating a patch as described in any of the preceding paragraphs in a hole created by removal of the self-piercing rivet; and
- applying a new self-piercing rivet at the location of the patch.

The method may comprise modifying the hole created by removal of the self-piercing rivet  
15 for accommodating the patch.

Modifying the hole created by removal of the self-piercing rivet may comprise chamfering the hole.

20 The fitted self-piercing rivet may be removed from a material stack, and the method may comprise removing at least one panel of material from the material stack after removal of the fitted self-piercing rivet.

The fitted self-piercing rivet may be removed from a material stack, and the method may  
25 comprise locating a new panel of material on the material stack to be fixed to the material stack by application of the new self-piercing rivet at the location of the patch.

The method may comprise applying adhesive to at least a portion of at least one surface of the flange area of the patch for adhering the patch to a material stack.

30

According to an aspect of the invention there is provided a patch comprising means for fitting into a hole created by removal of a self-piercing rivet to allow application of a new self-piercing rivet.

The means for fitting into a hole may comprise a protrusion.

The patch may comprise flange means adjacent the means for fitting into a hole.

5 According to yet another aspect of the invention, there is provided a patch for use in replacement of a rivet, comprising:

a protrusion for fitting into a hole created by removal of a rivet; and  
a flange area adjacent the protrusion.

10 The patch may comprise one or more apertures to allow insertion of the replacement rivet.

According to a further aspect of the invention there is provided a vehicle part comprising at least one patch as described in any of the preceding paragraphs.

15 According to a still further aspect of the invention there is provided a vehicle comprising at least one patch as described in any of the preceding paragraphs and/or at least one vehicle part as described in any of the preceding paragraphs.

20 According to another aspect of the invention, there is provided a method for replacing a rivet, comprising:

removing a fitted rivet;  
locating a patch as described in any of the preceding paragraphs in a hole created by removal of the rivet; and  
applying a new rivet at the location of the patch.

25

According to another aspect of the invention there is provided using a patch as described in any of the preceding paragraphs in replacement of a self-piercing rivet.

30 Within the scope of this application it is expressly intended that the various aspects, embodiments, examples and alternatives set out in the preceding paragraphs, in the claims and/or in the following description and drawings, and in particular the individual features thereof, may be taken independently or in any combination. That is, all embodiments and/or features of any embodiment can be combined in any way and/or combination, unless such features are incompatible. The applicant reserves the right to change any originally filed

claim or file any new claim accordingly, including the right to amend any originally filed claim to depend from and/or incorporate any feature of any other claim although not originally claimed in that manner.

## 5 BRIEF DESCRIPTION OF THE DRAWINGS

One or more embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

10 Fig 1 illustrates an example of a patch for use in replacement of a self-piercing rivet according to an aspect of the invention;

Fig 2 illustrates an example of a vehicle part according to another aspect of the invention;

15 Figs 3A to 3C illustrate an example of a patch for use in replacement of a self-piercing rivet;

Fig 4 illustrates an example of the patch of Figs 3A to 3C fitted to a body panel;

Fig 5 illustrates an example of a method according to a further aspect of the invention;

20

Fig 6 illustrates another example of a method;

Fig 7 illustrates a further example of a method; and

25 Fig 8 illustrates an example of a vehicle according to still another aspect of the invention

## DETAILED DESCRIPTION

30 Examples and aspects of the present invention relate to replacement of a rivet such as a self-piercing rivet.

The following description and the examples shown in the Figures, are directed to the use of self-piercing rivets. However, the present disclosure is not intended to be limited to self-piercing rivets and the patch and associated methods described below for using the patch

may be used for a variety of different types of rivets such as a pop-rivet (blind-rivet); a self-piercing rivet (SPR); a semi-tubular rivet; or a flush rivet. It will be appreciated that other types of rivet may be useful. Whilst the following description refers to a self-piercing rivet it is to be understood that the self-piercing rivet (SPR) is used by way of example only and that aspects of the present invention are not limited to the exclusive use with SPRs.

In examples, a patch is located in a hole created by removal of a self-piercing rivet to allow a new self-piercing rivet to be fitted at the original location of the removed self-piercing rivet.

10 A technical effect of at least some examples of the disclosure is that the use of a patch in replacement of a rivet, such as a self-piercing rivet, allows a new self-piercing rivet to be fitted at the original location meaning that, for example, unlimited repairs to a vehicle body can be made without exhausting locations for self-piercing rivet joints.

15 Furthermore, the use of patch in replacement of a self-piercing rivet also allows for control of the materials used in the new self-piercing rivet to provide for good quality consistent self-piercing rivet joints to be formed.

20 Additionally or alternatively the use of a patch in replacement of a self-piercing rivet provides that the button created by the new self-piercing rivet joint will be no thicker than the original self-piercing rivet joint. As a result, there will be no issues relating to, for example, fitting surrounding panels or seals over a new joint that can only tolerate certain overall thicknesses.

25 The use of a patch in replacement of rivets, such as self-piercing rivets, facilitates repair, permits component replacement and thus extends the service life of a riveted vehicle body in use.

30 Figs 1, 2, 3A to 3C, 4 and 7 illustrate a patch 10 for use in replacement of a self-piercing rivet 12, comprising; a protrusion 14 for fitting into a hole 16 created by removal of a self-piercing rivet 12; and a flange area 18 adjacent to the protrusion 14.

Figs 5 and 6 illustrate a method 500, 600 for replacing a self-piercing rivet 12, comprising; removing a fitted self-piercing rivet 12; locating a patch 10 as described herein in a hole 16

created by removal of the self-piercing rivet 12; and applying a new self-piercing rivet 30 at the location 48 of the patch 10.

5 Fig 1 schematically illustrates an example of a patch 10 for use in replacement of a self-piercing rivet 12. It is noted that some of the features referred to in relation to Figs 1 to 6 are illustrated in the example of Figs 7 and 8.

10 The patch 10 of Fig 1 may be comprised in a vehicle part 44 which may in turn be comprised in a vehicle 46. See, for example, the examples of Figs 2 and 8.

The patch 10 illustrated in the example of Fig 1 comprises a protrusion 14 and a flange area 18.

15 The protrusion 14 is for fitting into a hole 16 created by removal of an SPR. In some examples, the protrusion 14 is for fitting into a hole 16 that has been modified following creation of the hole 16 by removal of the SPR 12. In such examples, the modified hole 16 may still be considered to be the hole 16 created by removal of an SPR 12.

20 For example, the protrusion 14 may be for fitting into a hole 16 that has been modified by chamfering of the hole 16.

In examples, the protrusion 14 may be of any suitable size and/or shape. For example, the size and/or shape of the protrusion 14 may be selected in dependence upon the hole 16 created by removal of the SPR 12.

25 In some, but not necessarily all, examples the protrusion 14 may be circular in shape to match the hole 16 created by drilling out of a SPR 12.

30 Additionally or alternatively, the protrusion 14 may be tapered to match a modified hole 16 that has been chamfered (see, for example, the example of Fig 3C and Fig 7). The protrusion 14 may be tapered by any suitable amount.

The protrusion 14 may have any suitable height. The height of the protrusion 14 may be selected in dependence upon the usage of the patch 10. See, for example, Fig 3C.

In some examples, the protrusion 14 is for providing an interference fit 20 with the hole 16. For example, the size and/or shape and/or height of the protrusion may be selected to provide an interference fit with a hole 16 created by removal of an SPR 12.

5

In examples the patch 10 may comprise a plurality of protrusions 14.

In some examples the patch may comprise one or more apertures 19 (see Fig 3A) to allow insertion of a replacement rivet or rivets, such as a pop-rivet (blind-rivet), a semi-tubular rivet, or a flush rivet through the aperture(s).

10

In examples, such as the one illustrated in Fig 3A, the aperture 19 may be located on the protrusion 14.

The flange area 18 may be adjacent the protrusion 14. In some examples, the flange area 18 surrounds at least one edge 22 of the protrusion 14. See, for example, Figs 3A and 3B.

15

That is, in some examples, the flange area 18 may be located in every direction around an edge 22 of the protrusion 14.

20

The flange area 18 may have any suitable size and/or shape. In examples, the size and/or shape of the flange area 18 may be selected in dependence upon the intended use of the patch 10. For example, the size and/or shape of the flange area 18 may be selected to match the intended use location of the patch 10.

25

In examples, the flange area 18 comprises a first portion 32 extending from the protrusion 14 in a first direction 34 and a second portion 36 extending from the protrusion 14 in a second direction 38. The second direction 38 may be opposite to the first direction 34. See, for example, Figs 3A to 3C and Fig.4.

30

In examples, the first portion 32 and second portion 36 may be of the same shape and/or size. In other examples, the first portion 32 and second portion 36 may be of different shapes and/or sizes.

The flange area 18 may be for abutting a surface of a material stack 28 through which the replacement SPR is to be fitted (see, for example, Fig 7).

5 Additionally or alternatively the flange area 18 may provide at least one surface 24 for receiving adhesive 26 to adhere the patch 10 to a material stack 28 that is to receive a replacement SPR 30. See, for example, Fig 7.

10 In some examples, the flange area 18 forms a plane to abut against the surface of a material stack 28 to support the protrusion 14 when it is located in a hole 16 created by removal of an SPR 12 and/or to provide at least one surface 24 for receiving adhesive.

For example, the surface of the flange area 18 that is to abut the material stack 28 may be provided with an adhesive 26 to adhere the patch 10 to the material stack 28. The use of the adhesive 26 may provide for a stronger SPR joint.

15

In examples any suitable adhesive 26 may be used. For example epoxies and/or single or two component adhesives and/or polyurethane structural adhesives and so on.

20 The patch 10 is considered for use in replacement of an SPR 12 as it allows for a new SPR 30 to be fitted in the hole 16 created by removal of an SPR 12. That is, the patch 10 allows for fitting of a new SPR 30 but does not itself replace an SPR 12.

25 The patch 10 may have any suitable size and/or shape. In examples, the size and/or shape of the patch 10 may be selected in dependence on the intended use of the patch 10. For example, the size and/or shape of the patch 10 may be selected in dependence upon the intended location of use of the patch 10 on a vehicle part 44 and/or on a vehicle 46.

The patch 10 may be made of/comprise any suitable material or materials.

30 The material of the patch 10 may be selected to have properties that ensure a satisfying strength and quality of SPR joint. For example the material or materials of the patch 10 may be selected to ensure a good SPR joint can be created using the patch 10.



In examples the material or materials of the patch 10 have a ductility percentage of approximately 20%. In some examples, an aluminium alloy that does not comprise silicon as an alloying element may be used.

5 Some examples of suitable materials are aluminium 5000 series, non-heat treatable aluminium, for example NG5754, and so on.

The patch 10 of Fig 1 may be made using any suitable method. For example, the patch 10 may be made using a forming process such as stamping or pressing and so on.

10

The patch 10 may comprise any number of additional elements not illustrated in the example of Fig 1.

15 For example, the patch 10 may comprise a recess 40. The recess 40 may correspond to the protrusion 14. For example, the recess 40 may be the reverse feature of the protrusion 14 on the patch 10. See, for example, Figs 3A to 3C. In some example, the recess 40 may not correspond to the protrusion 14.

20 In some examples, the recess 40 may include an aperture for receiving a non self-piercing type rivet, such as a pop-rivet (blind-rivet), a semi-tubular rivet; or a flush rivet as may be appropriate for a given riveted joint.

25 In examples, a recess 40 of the patch 10 is for providing a location aid 42 for application of a new SPR 30. For example, the recess 40 may provide an aid in locating a die 54 for fitting of a new SPR 30. See, for example, Fig 7.

Throughout the description like numerals will be used to indicate like features.

30 Fig 2 schematically illustrates an example of a vehicle part 44. In the example of Fig 2 the vehicle part 44 is comprised in a vehicle 46 and comprises a patch 10 illustrated in Fig 1.

In the example of Fig 2, the patch 10 is comprised in the vehicle part 44 as part of replacement of one or more SPRs 12 to replace one or more panels of the vehicle part 44 in

the vehicle 46. For example, the patch 10 may be comprised in a vehicle part 44 in the vehicle 46 as part of a repair of the vehicle part 44.

5 In examples, the vehicle part 44 may be any suitable vehicle part. For example, the vehicle part 44 may be an external part of a vehicle structure such as a vehicle body side, a rear quarter panel, an outer pillar panel and so on.

In some examples, the vehicle part 44 may comprise a plurality of patches 10.

10 The vehicle 46 may be any suitable vehicle 46 such as a car, van or truck and so on. In examples, the vehicle 46 may comprise a plurality of vehicle parts 44 comprising at least one patch 10.

An example of a vehicle 46 comprising a patch 10 is illustrated in Fig 8.

15

Figs 3A to 3C illustrate an example of a patch 10 for use in replacement of a self-piercing rivet 12. The patch 10 illustrated in the examples of Figs 3A to 3C is an example of a patch 10 illustrated in Figs 1 and/or 2.

20 In Fig 3A a top-down or plan view of the patch 10 is illustrated. In the example of Fig 3A, the protrusion 14 is circular and is pointing out of the page.

In Fig 3A, the protrusion 14 is tapered. This is illustrated in the figure by the diameter  $d_1$  of the circle at the base of the protrusion 14 being larger than the diameter  $d_2$  of the circle at the tip of the protrusion 14. The tapering of the protrusion 14 is illustrated more clearly in the example of Fig 3C.

25

Accordingly, in the example of Fig 3A the protrusion 14 is for fitting into a hole 16 that has been modified by chamfering of the hole 16. See, for example, Fig 7.

30

In examples, the diameters  $d_1$  and  $d_2$  may have any suitable size. For example, the diameter  $d_1$  may be dependent upon the diameter of the SPR 30 that is to be applied. For example, the diameter  $d_1$  may be chosen during manufacturing of the patch 10 in dependence upon the diameter of the SPR 30 that the patch 10 will be used with.

In some examples the diameter d1 is at least two times the diameter of the shaft of the SPR 30 that is to be applied to accommodate the SPR 30 that is to be applied. A typical value for d1 is approximately 10mm.

5

In examples, the difference between the d1 diameter and d2 diameter may be any suitable value. That is, in examples, the amount of tapering or chamfering of the protrusion 14 may be any suitable amount. For example, the amount of tapering of the protrusion 14 may match the amount of chamfering of the hole 16 into which the protrusion 14 is to be placed and/or may be selected to provide an interference fit 20.

10

In examples the patch 10 may comprise one or more apertures 19 to allow insertion of a replacement rivet. This is illustrated in Fig 3A by the dotted circular line on the protrusion 14.

15 In examples, the aperture 19 of the patch 10 may provide the aperture 19 into which a replacement pop-rivet (blind-rivet), a semi-tubular rivet, or a flush rivet may be fitted.

The aperture 19 may have any suitable size and shape to facilitate fitting of a replacement rivet such as a pop-rivet (blind-rivet), a semi-tubular rivet, or a flush rivet for example.

20

In the illustrated example the aperture 19 is located in the protrusion 14. However, in other examples the aperture 19 may be located at any suitable location on the patch 10.

25 In some examples the patch 10 may comprise a plurality of apertures 19 that may be of the same or different shapes and/or sizes to allow fitting of multiple replacement rivets.

In Fig 3A the flange area 18 surrounds an edge 22 of the protrusion 14. The edge 22 of the protrusion 14 is at the base of the protrusion 14.

30 In Fig 3A, the flange area 18 comprises a first portion 32 extending from the protrusion 14 in a first direction 34 and a second portion 36 extending from the protrusion 14 in a second direction 38. The second direction 38 is opposite to the first direction 34.

In the example of Fig 3A, the flange area 18 forms a plane for abutting against a material stack 28 that is to receive a new SPR 30. See, for example, Fig 7.

5 The flange area 18, of the patch 10 in Fig 3A comprises a surface 24 for receiving adhesive 26 to adhere the patch 10 to a material stack 28 that is to receive a replacement SPR 30. In the example of Fig 3A, the adhesive 26 is indicated by a dotted box. However, in examples, the adhesive 26 may cover some or all of the flange area 18.

10 In some examples, the flange area 18 may comprise a plurality of surfaces for receiving an adhesive 26. In examples, the adhesive may be pre-applied to at least a portion of the flange area 18 which, depending on the type of adhesive used, may be covered by a removable protective film to protect the adhesive from contamination or exposure to air during storage or transport prior to use. In examples, the protective film is removed by a user before the patch is fitted in place and the replacement rivet 30 applied.

15

In Fig 3A, the flange area 18 has a width  $W$  and a length  $L$ . In examples, the patch 10 may be considered to have a width  $W$  and a length  $L$ .

20 The flange area 18/patch 10 may have any suitable width  $W$  and/or length  $L$ . In examples the width  $W$  of the flange area 18/patch 10 may be dependent upon the size of the diameter  $d1$ . For example the width  $W$  may be chosen during manufacturing of the patch 10 in dependence upon the diameter  $d1$ . In examples the width  $W$  may be equal to or greater than diameter  $d1 + 10\text{mm}$ .

25 In some examples the length  $L$  of the flange area 18/patch 10 may be dependent upon the size of the diameter  $d1$ . For example the length  $L$  may be chosen during manufacturing of the patch 10 in dependence upon the diameter  $d1$ . In examples the length  $L$  may be equal to or greater than  $d1 + 10\text{mm}$ .

30 In the example of Fig 3A, the patch 10 comprises a recess 40. The recess 40 corresponds to the protrusion 14 and is therefore on the underside of the patch 10 in the example of Fig 3A and not visible in the figure.

Fig 3B illustrates an example of a patch 10 for use in replacement of a self-piercing rivet 12. The example of Fig 3B illustrates a perspective view of the patch 10 illustrated in Fig 3A.

5 In Fig 3B, the protrusion 14 is directed into the page. Accordingly, the recess 40 corresponding to the protrusion 14 illustrated in Fig 3A can be seen in the example of Fig 3B.

10 Fig 3C illustrates an example of a patch 10 for use in replacement of a self-piercing rivet 12. The example of Fig 3C illustrates a side view of the patch 10 illustrated in the examples of Figs 3A and 3B.

In the example of Fig 3C, the protrusion 14 can be seen extending upwards from the flange area 18. The tapering of the protrusion 14 is visible in the example of Fig 3C.

15 In the example of Fig 3C, the protrusion 14 has a height  $h$  and the flange area 18 has a thickness  $t$ .

In examples, the protrusion 14 may have any suitable height  $h$  and/or the flange area 18 may have any suitable thickness  $t$ .

20 For example, the height  $h$  of the protrusion 14 may be greater than or equal to 1mm and less than or equal to 3mm. That is, in examples the height  $h$  of the protrusion 14 may be in the range  $1\text{mm} \leq h \leq 3\text{mm}$ . In examples the thickness  $t$  of the flange area 18 may be chosen in dependence upon the thickness of the vehicle part 44 that the patch 10 will be used with. In  
25 examples the thickness  $t$  may be less than or equal to 2.5mm.

Fig 4 illustrates an example of a patch 10 for use in replacement of a self-piercing rivet 12. In the example of Fig 4, the patch 10 is the patch illustrated in the examples of Figs 3A to 3C.

30 In the example of Fig 4, the patch 10 is comprised in a vehicle part 44 and is located in a hole 16 created by removal of a self-piercing rivet 12.

The recess 40 of the patch 10 is visible in Fig 4 and provides a location aid 42 for application of a new self-piercing rivet 30. In the example of Fig 4, the new self-piercing rivet 30 has not yet been applied.

5 It can be seen from the example of Fig 4 that the patch 10 provides for application of a new SPR 30 at the location 48 of the patch 10 at the recess 40. For example, the recess 40 may provide a location aid for locating a die 54 for use in fitting a new SPR 30. See, for example, Fig.7.

10 Fig.5 illustrates an example of a method 500. For example, the method 500 may be for replacing a self-piercing rivet 12.

At block 502 a fitted self-piercing rivet 12 is removed.

15 Any suitable method for removing a fitted self-piercing rivet 12 may be used. For example, removing the self-piercing rivet 12 may comprise drilling out the fitted self-piercing rivet 12.

In examples, removing the self-piercing rivet 12 creates a hole 16 through the material that had previously been the site of the riveted joint.

20

At block 504 a patch 10 for use in replacement of a self-piercing rivet 12 is located in the hole 16 created by removal of the self-piercing rivet 12.

In examples, the patch 10 may be as described in relation to Figs 1 and/or 2.

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The patch 10 may be located in the hole 16 by inserting the protrusion 14 of the patch 10 into the hole 16. See, for example, Figs 4 and 7.

30 In examples, the protrusion 14 of the patch 10 may provide an interference fit 20 with the hole 16 to maintain the patch 10 in position in the hole 16.

At block 506 a new, that is to say, a replacement rivet 30 such as a self-piercing rivet 30 is applied at the location of the patch 10. Any suitable method for applying the new self-piercing rivet 30 at the location of the patch 10 may be used.

For example, a die 54 may be positioned in the recess 40 of the patch 10 and a self-piercing rivet driven into the material of the protrusion 14. See, for example, Fig 7.

5 As the new SPR 30 is driven into the material of the protrusion 14 the displaced material of the protrusion 14 may be forced back into the recess 40. This provides the advantage that the button created by application of the new SPR 30 will not be larger than the original button of the original SPR 12.

10 In examples, the application of the new self-piercing rivet 30 may hold a repaired or replacement panel on a vehicle part 44.

Fig 6 illustrates an example of another method 600. For example, the method 600 may be for replacing a self-piercing rivet 12.

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At block 602 a fitted self-piercing rivet 12 is removed. Block 602 corresponds to block 502 of Fig 5 and may be as described in relation to block 502 of Fig 5.

20 At block 604 at least one panel of material is removed from a material stack 28 from which the fitted self-piercing rivet 12 was removed. For example, the removed panel 50 may be damaged panel of a vehicle part 44 of a vehicle 46.

25 At block 606 the hole 16 created by removal of the self-piercing rivet 12 is modified. Any suitable method for modifying the hole 16 may be used. For example, the hole 16 may be chamfered using a countersunk drill or a machine driven hole punch to create a hole having the required shape.

30 At block 608 adhesive 26 is applied to at least a portion of at least one surface of the flange area 18 of the patch 10. Any suitable adhesive may be used. For example, any suitable adhesive for adhering the patch 10 to the material stack 28 may be used.

In examples, the adhesive 26 may comprise single or two component adhesives and/or polyurethane structural adhesives and so on. Other adhesive materials and compounds are useful.

At block 610 the patch 10 is located in the modified hole 16. This corresponds to block 504 of Fig 5 and may be as described in relation to block 504 of Fig 5.

5 At block 612 a new panel of material 52 is located on the material stack 28 to be fixed to the material stack 28 by application of the new SPR 30 at the location 48 of the patch 10. Any suitable method for locating the new panel of material 52 on the material stack 28 may be used.

10 In examples a panel of a vehicle 46 may be located on the material stack 28 to replace a damaged panel that has been removed.

At block 614 a new self-piercing rivet is applied at the location 48 of the patch 10. This corresponds to block 506 of Fig 5 and may be as described in relation to block 506 of Fig 5.

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In examples, methods 500 and 600 may be considered methods for repairing one or more items such as one or more vehicles.

Fig 7 illustrates an example of a method for replacing a self-piercing rivet 12. Fig 7 is split into 7 parts labeled A to G respectively.

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Part A of Fig 7 illustrates a fitted SPR 12 in a material stack 28 that comprises a panel of material 50 that is damaged and is to be removed.

25 In part B of the example of Fig 7 the SPR 12 has been removed and hole 16 created by removal of the SPR 12. In part B of the example of Fig 7 the SPR 12 has been removed by drilling out of the SPR 12.

30 In part C of the example of Fig 7 the panel of material 50 has been removed from the material stack 28.

In part D of the example of Fig 7 the hole 16 has been modified. In part D of the example of Fig 7 the hole 16 has been chamfered.



In part E of the example of Fig 7 a patch 10 has been located in the hole 16 created by removal of the SPR 12. In the example, the patch 10 is as described in relation to Figs 1 and or 2.

5 In part E of the example of Fig 7 the protrusion 14 of the patch 10 has been inserted into the hole 16 and has formed an interference fit 20 with the hole 16.

Furthermore, adhesive 26 has been applied to a surface of the flange area 18 of the patch 10 to adhere the patch 10 to the material stack 28.

10

In part E of the example of Fig 7 a new panel of material 52 has been located on the material stack 28. The new panel of material 52 is to be fixed to the material stack 28 by application of a new SPR 30 at the location 48 of the patch 10.

15 The new panel of material 52 replaces the removed panel of material 50 and in the example is for repairing a panel on a vehicle 46.

In part F of the example of Fig 7 a die 54 has been located in the recess 40 of the patch 10. The patch 10 has therefore provided a location aid 42 for the application of a new SPR 30 at the location 48 of the patch 10.

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In part G of the example of Fig 7 a new SPR 30 has been applied at the location of the patch 10. The new SPR 30 has extended into the material of the protrusion 14 of the patch 10 to join the material stack 28, including the new panel of material 52, together.

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The method illustrated in the example of Fig 7 may be considered a method for repairing a vehicle part 44 and/or a vehicle 46.

As used herein “for” should be considered to also include “configured or arranged to”. For example, a patch for use in replacement of a self-piercing rivet should be considered to also include a patch configured to or arranged to be used in replacement of a self-piercing rivet.

30

Examples of the present disclosure provide a number of advantages. For example, examples of the present disclosure provide for application of a new self-piercing rivet at a location previously used for a self-piercing rivet joint.

- 5 In addition, examples of the present disclosure provide for consistent, secure SPR joints to be created when replacing SPR joints.

10 It will be appreciated by one skilled in the art that the patches and methods described herein and illustrated in the Figures may be adapted in order to be applied with a type of rivet other than a SPR as may be desired. For example, it will be appreciated by a person skilled in the art that the method shown in Fig 7 may be adapted in order to be applied with a type of rivet other than an SPR and that the example of Fig 7 is given by way of example of how patch 10 may be employed to effect an economical repair of a riveted joint.

15 The blocks illustrated in Figs 5 and 6 may represent steps in a method. The illustration of a particular order to the blocks does not necessarily imply that there is a required or preferred order for the blocks and the order and arrangement of the block may be varied. Furthermore, it may be possible for some steps to be omitted.

20 Where a structural feature has been described, it may be replaced by means for performing one or more of the functions of the structural feature whether that function or those functions are explicitly or implicitly described.

25 The term 'comprise' is used in this document with an inclusive not an exclusive meaning. That is any reference to X comprising Y indicates that X may comprise only one Y or may comprise more than one Y. If it is intended to use 'comprise' with an exclusive meaning then it will be made clear in the context by referring to "comprising only one.." or by using "consisting".

30 Although embodiments of the present invention have been described in the preceding paragraphs with reference to various examples, it should be appreciated that modifications to the examples given can be made without departing from the scope of the invention as claimed.

Features described in the preceding description may be used in combinations other than the combinations explicitly described.

5 Although functions have been described with reference to certain features, those functions may be performable by other features whether described or not.

Although features have been described with reference to certain embodiments, those features may also be present in other embodiments whether described or not.

10 Whilst endeavoring in the foregoing specification to draw attention to those features of the invention believed to be of particular importance it should be understood that the Applicant claims protection in respect of any patentable feature or combination of features hereinbefore referred to and/or shown in the drawings whether or not particular emphasis has been placed thereon.

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## CLAIMS

1. A patch for use in replacement of a self-piercing rivet, comprising:  
a protrusion for fitting into a hole created by removal of a self-piercing rivet; and  
5 a flange area adjacent the protrusion.
2. A patch for use in replacement of a self-piercing rivet as claimed in claim 1, wherein  
the protrusion is for fitting into a hole that has been modified following creation of the hole by  
removal of the self-piercing rivet.  
10
3. A patch for use in replacement of a self-piercing rivet as claimed in claim 2, wherein  
the protrusion is for fitting into a hole that has been modified by chamfering of the hole.
4. A patch for use in replacement of a self-piercing rivet as claimed in any preceding  
15 claim, wherein the protrusion is for providing an interference fit with the hole.
5. A patch for use in replacement of a self-piercing rivet as claimed in any preceding  
claim, wherein the flange area surrounds at least one edge of the protrusion.
- 20 6. A patch for use in replacement of a self-piercing rivet as claimed in any preceding  
claim, wherein the flange area provides at least one surface for receiving adhesive to adhere  
the patch to a material stack that is to receive a replacement self-piercing rivet.
7. A patch for use in replacement of a self-piercing rivet as claimed in any preceding  
25 claim, wherein the flange area comprises a first portion extending from the protrusion in a  
first direction and a second portion extending from the protrusion in a second direction.
8. A patch for use in replacement of a self-piercing rivet as claimed in claim 7, wherein  
the second direction is opposite to the first direction.  
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9. A patch for use in replacement of a self-piercing rivet as claimed in any preceding  
claim, comprising a recess for providing a location aid for application of a new self-piercing  
rivet.

10. A vehicle part comprising at least one patch as claimed in at least one of claims 1 to 9.
11. A vehicle comprising at least one patch as claimed in at least one of claims 1 to 9 and/or at least one vehicle part as claimed in claim 9.
12. A method for replacing a self-piercing rivet, comprising:  
removing a fitted self-piercing rivet;  
locating a patch as claimed in at least one of claims 1 to 9 in a hole created by removal of the self-piercing rivet; and  
applying a new self-piercing rivet at the location of the patch.
13. A method for replacing a self-piercing rivet as claimed in claim 12, comprising modifying the hole created by removal of the self-piercing rivet for accommodating the patch.
14. A method for replacing a self-piercing rivet as claimed in claim 13, wherein modifying the hole created by removal of the self-piercing rivet comprises chamfering the hole.
15. A method for replacing a self-piercing rivet as claimed in any of claims 12 to 14, wherein the fitted self-piercing rivet is removed from a material stack, the method comprising removing at least one panel of material from the material stack after removal of the fitted self-piercing rivet.
16. A method for replacing a self-piercing rivet as claimed in any of claims 12 to 15, wherein the fitted self-piercing rivet is removed from a material stack, the method comprising locating a new panel of material on the material stack to be fixed to the material stack by application of the new self-piercing rivet at the location of the patch.
17. A method for replacing a self-piercing rivet as claimed in any of claims 12 to 16, comprising applying adhesive to at least a portion of at least one surface of the flange area of the patch for adhering the patch to a material stack.
18. A patch and/or a vehicle part and/or a vehicle and/or a method as described herein with reference to the accompanying drawings.



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**Claims searched:** 1-18

**Date of search:** 26 February 2016

**Patents Act 1977: Search Report under Section 17**

**Documents considered to be relevant:**

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1, 4-8, 10, 11	JP2006161820 A (TAJIMA). See figures.
A		DE102006001526 A (AUDI)
A		DE4320068 A (AUDI)
A		US2011/302755 A (WANG)

**Categories:**

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

**Field of Search:**

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC<sup>X</sup> :

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Worldwide search of patent documents classified in the following areas of the IPC

B21J; F16B

The following online and other databases have been used in the preparation of this search report

WPI, EPODOC

**International Classification:**

Subclass	Subgroup	Valid From
B21J	0015/02	01/01/2006
B21J	0015/50	01/01/2006
B23P	0006/00	01/01/2006