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A CLADDING SHEET

The present invention relates to a roof or other cladding sheet, for example a wall cladding sheet.

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The present invention also relates to a method of forming, particularly roll-forming, a roof or other cladding sheet.

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The present invention also relates to a roll former for forming a roof or other cladding sheet.

The present invention relates particularly, although by no means exclusively, to a roof cladding sheet that is adapted to be secured to an underlying roof support structure and to a method of forming such a sheet.

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Typically, cladding sheets are roll-formed from painted or unpainted steel strip and include opposed sides, one or more than one lengthwise extending rib, side edge formations that enable the sheets to be positioned side by side in overlapping relationship, opposed ends, and pan sections that separate the side edge formations and the rib or ribs.

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It is known to secure cladding sheets to a support structure, such as a roof support structure, such as roof purlins, by fastening the sheets directly to the underlying structure using fasteners, such as roofing nails and screws, that pierce the sheets and penetrate the support structure.

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It is also known to secure cladding sheets to a support structure by using clips that are secured to the structure by fasteners and are formed to extend into the ribs and the side edge formations and include retaining members or tabs that can engage re-entrant, i.e. inwardly

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turned, portions of the ribs and the side edge formations and thereby retain the sheets to the clips. These clip assemblies are often preferred over nails because they enable concealed fixing of cladding sheets to a support structure.

In use, the concealed fixing retaining clips are secured to a support structure at spaced intervals related to the spacing between the ribs of the cladding sheets.

Thereafter, cladding sheets are positioned on the clips in overlapping relationship by successively pressing the sheets down onto the clips so that the sides of the ribs are initially forced outwardly to allow the re-entrant portions of the ribs or the side edge formations to pass over the retaining members and then snap inwardly into engagement with the retaining members.

There are a number of known concealed fixing retaining clips. The clips include a series of clips disclosed in International application PCT/GB91/00450 (WO 91/12392) in the name of Stramit Industries Limited, a clip disclosed in Australian patent 685102 and other Australian patents and patent applications in the name of Stramit Corporation, and clips disclosed in International applications PCT/AU01/00818 (WO 01/02666) and PCT/AU2003/000985 (WO 2004/013430) in the name of the applicant. The clips disclosed in International applications PCT/AU01/00818 and PCT/AU2003/000985 (WO 2004/013430) are marketed in Australia under the trade mark KLIPLOK.

Basically, the present invention is concerned with providing a roof or other cladding sheet that can be retained by concealed fixing retaining clips of the type that comprise a pair of retaining members that extend in opposite directions and are adapted to engage re-entrant portions in the sides of ribs or side edge formations of

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cladding sheets. Typically, the retaining members are in the form of outwardly and downwardly extending flanges that are adapted to engage re-entrant sections of clips and apply a force that biases the clips towards a support structure to which the clips are secured, and this force resists uplift of the cladding sheets from the support structure.

There are a number of known roof cladding sheets. The cladding sheets include cladding sheets marketed under the trade marks KLIPLOK, WIDEKLIP, HIKLIP, SPANFORM, and CUSTOMWALL, all registered Australian trade marks.

The above description of known cladding sheets and concealed fixing retaining clips and the following description of such known sheets and clips is not to be taken as an admission of the common general knowledge in Australia or elsewhere.

In broad terms, the present invention provides a roof or other cladding sheet that is adapted to engage a concealed fixing retaining clip and comprises at least one rib or side edge formation that has a lengthwise extending channel that opens upwardly relative to a base plane of the cladding sheet, as described herein, and is adapted to receive retaining members of the concealed fixing retaining clip.

The term "base plane of the cladding sheet" is understood herein to mean the plane in which the pans of the cladding sheet are located.

The present invention also provides a roof or other cladding sheet that is adapted to engage a concealed fixing retaining clip that includes a pair of retaining members that extend in opposite directions and is adapted to be secured to a support structure, which cladding sheet

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comprises opposed sides, one or more than one lengthwise
extending rib, side edge formations that enable the sheets
to be positioned side by side in overlapping relationship,
and pan sections that separate the side edge formations
5 and the rib or ribs, and is characterised in that at least
one of the rib or ribs and the side edge formations
include a lengthwise extending channel that opens upwardly
relative to a base plane of the cladding sheet, as
described herein, and is adapted to receive the retaining
10 members of the concealed fixing retaining clip.

Preferably the upwardly opening lengthwise
extending channel is defined by (a) a side section of the
rib or the side edge formation and (b) a re-entrant, i.e.
15 in-turned, section of the rib or the side edge formation
that extends inwardly and then upwardly from a lower end
of the side section and is upwardly inclined relative to
the base plane of the cladding sheet.

20 The re-entrant section may be inclined upwardly
at an angle of at least 3° to the base plane of the
cladding sheet.

Preferably the re-entrant section is inclined
25 upwardly at an angle of at least 5° to the base plane of
the cladding sheet.

The roof or other cladding sheets known to the
applicant that are used with concealed fixing retaining
30 clips comprise re-entrant sections in the rib or ribs and
the side edge formations of the sheets that are defined by
in-turned side wall sections that extend parallel to or
downwardly towards base planes of the sheets. In effect,
these re-entrant sections define generally flat platforms
35 that, in use, are contacted and engaged by the retaining
members of clips. The applicant has realised that forming
at least one of the ribs and the side edge formations of a

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cladding sheet with a channel that opens upwardly relative to the base plane of the sheet means that there is more positive engagement of the retaining members of a clip with the sheet than is provided by the above-mentioned platforms. Specifically, the retaining members extend into the channel - rather than contacting an essentially flat surface as per the known cladding sheets. It can readily be appreciated that disengagement of this cladding sheet of the present invention from the clip requires downward and then outward movement of the sheet relative to the retaining members of the clip and that this is far more difficult to achieve than the outward and upward movement required to disengage a known cladding sheet from the same clip.

According to the present invention there is also provided a method of roll-forming the above-described roof or other cladding sheet from strip using a roll former that comprises a plurality of roll forming stands, each stand including upper and lower rolls and a notional roll centreline between the rolls in each stand, which method comprises roll forming at least one side of at least one of the rib or ribs and the side edge formations of the cladding sheet to have at least one lengthwise extending channel that opens upwardly relative to the base plane of the cladding sheet, as described herein, in at least one roll forming stand that has upper and lower rolls that rotate about axes that are transverse to the roll centreline of the stand and have complementary roll former surfaces that are shaped to deform the strip and form the channel.

Preferably the method comprises roll forming both sides of the rib or ribs of the cladding sheet to have lengthwise extending channels that open upwardly relative to the base plane of the cladding sheet in a plurality of roll forming stands that have upper and lower rolls that

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rotate about axes that are transverse to the roll
centrelines of the stands and have complementary roll
former surfaces that are shaped to deform the strip and
form the channels.

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The method may comprise roll forming both side
edge formations of the cladding sheet to have lengthwise
extending channels that open upwardly relative to the base
plane of the cladding sheet in a plurality of roll forming
10 stands that have upper and lower rolls that rotate about
axes that are transverse to the roll centrelines of the
stands and have complementary roll former surfaces that
are shaped to deform the strip and form the channels.

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According to the present invention there is also
provided a roll former for roll-forming the above-
described roof or other cladding sheet in the above-
described method from strip, the cladding sheet cladding
sheet comprising opposed sides, one or more than one
20 lengthwise extending rib, side edge formations that enable
the sheets to be positioned side by side in overlapping
relationship, and pan sections that separate the side edge
formations and the rib or ribs, and being characterised in
that at least one of the rib or ribs and the side edge
25 formations have a lengthwise extending channel that opens
upwardly relative to the base plane of the cladding sheet,
as described herein, and is adapted to receive a retaining
member of a concealed fixing retaining clip, the roll
former comprising a plurality of roll forming stands, each
30 stand including upper and lower rolls and a notional roll
centreline between the rolls in each stand, and the roll
former stands comprising at least one stand that has upper
and lower rolls that rotate about axes that are transverse
to the roll centreline of the stand and have complementary
35 roll former surfaces that are shaped to deform the strip
and form the re-entrant section of the side of the rib or
the side edge formation that defines a part of the

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channel.

The present invention is described further by way of example with reference to the accompanying drawings, of which:

Figure 1 is a transverse section illustrating a part of one embodiment of a cladding sheet in accordance with the present invention positioned on a known concealed fixing retaining clip and showing inter-engagement of two successively laid cladding sheets on the clip;

Figure 2 is an enlargement of the left hand end, i.e. the leading edge, of one of the cladding sheets shown in Figure 1;

Figure 3 is an enlargement of the circled section of Figure 2;

Figure 4 is a perspective view of the clip shown in Figures 1 and 2;

Figures 5 to 18 illustrate the stages of one embodiment of a method of roll forming another, although not the only possible other, embodiment of a cladding sheet in accordance with the present invention; and

Figure 19 is a transverse section of the cladding sheet 3 manufactured by the roll forming method shown in Figures 5 to 18.

Figures 1 to 4 illustrate one embodiment of a cladding sheet 3 in accordance with the present invention.

Figures 1 to 4 also illustrate the interaction between two of the cladding sheets 3 and a known concealed fixing retaining clip generally identified by the numeral

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29.

The letter "A" in Figure 1 illustrates a direction of laying the cladding sheets 3.

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With particular reference to Figure 4, the known concealed fixing retaining clip 29 includes:

(a) a base 5;

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(b) two upstanding sections 7 that extend from the base 5; and

(c) a pair of flanges 9 that define retaining members for engaging re-entrant sections (described hereinafter) of side edge formations and ribs of cladding sheets (described hereinafter) that extend outwardly and downwardly from the upstanding sections 7, as shown in Figures 1 and 4.

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As can best be seen in Figures 1 and 2, the cladding sheet 3 is formed from steel strip and is generally rectangular with opposed lengthwise extending sides and opposed ends and is manufactured by forming, typically roll-forming, sheet steel.

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The cladding sheet 3 includes a leading edge formation generally identified by the numeral 31 (see Figures 1 and 2), a trailing edge formation generally identified by the numeral 11 (see Figure 1), at least one central lengthwise extending rib 65 (partially shown in Figure 1 - the embodiment shown in Figure 19 has two of the ribs 65) that is parallel to the side edge formations 11, 31, and plurality of lengthwise extending pans 51 (a) between the leading edge formation 31 and the adjacent rib 65, (b) between adjacent ribs 65, and (c) between the

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trailing edge formation 11 and the adjacent rib 65.

The cladding sheet 3 shown in Figures 1 to 4 has a base plane indicated by the letters BP-BP in Figures 1 and 2.

The cladding sheet 3 may be of any suitable length and width and may include any suitable number of ribs 65 separated by pans 51.

With reference to Figure 2, the leading edge formation 31 of the cladding sheet 3 includes two sides, generally identified by the numerals 35a, 35b that are separated by a flat upper section 33. The side 35a includes a section 41 that extends outwardly and downwardly from the upper section 33, an in-turned, i.e. re-entrant, section 43 that extends upwardly and inwardly from the lower edge of the section 41, and a section 45 that extends downwardly and outwardly from the section 43 and merges with a pan 51. The side 35b of the leading edge formation 31 of the cladding sheet 3 includes a section 41 that extends outwardly and downwardly from the upper section 33, an in-turned, i.e. re-entrant, section 43 that extends upwardly and inwardly from the lower edge of the section 41, and a relatively short section 45 that extends downwardly and outwardly and forms a leading end of the cladding sheet 3.

The sections 41 and 43 of both sides 35a and 35b of the leading edge 31 of the cladding sheet 3 define upwardly and inwardly opening channels 61 that are adapted to receive the flanges 9 of the clips 29. The channels 61 are upwardly and inwardly opening in relation to the base plane BP-BP of the cladding sheet 3.

The rib or ribs 65 of the cladding sheet 3 have similar transverse profiles to the leading edge formation

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31 of the cladding sheet 3 in the sense that each rib 65 has an upper section 33 and two sides that have the same shape as the above-described side 35a. The left hand side of the rib 65 shown in Figure 1 includes the sections 41, 43, and 45 and the upwardly and inwardly open channel 61.

The trailing edge formation 11 of the cladding sheet 3 has the same transverse profile as the leading edge formation 31.

In use, a plurality of the clips 29 are fastened to purlins 71 (see Figure 1) at spaced intervals along the length of the purlins using screws - one screw 75 is shown in outline in Figure 1.

Thereafter, cladding sheets 3 are successively placed over the purlins 71 in overlapping relationship - with the trailing edge formation 11 of a successive sheet 3 being positioned over the leading edge formation 31 of an already laid sheet - as shown in Figure 1.

The cladding sheets 29 are engaged with the clips 29 as the sheets are successively placed over the purlins 71.

This is achieved by successively pressing the leading edge formations 31, the ribs 65, and the trailing edge formations 11 of the sheets 29 onto the clips 29 so that the leading edge formations 31, the ribs 65, and the trailing edge formations 11 deflect outwardly and the flanges 9 of the clips 3 deflect inwardly.

This movement allows the leading edge formations 31, the ribs 65, and the trailing edge formations 11 to be positioned on the clips 29 with the flanges 9 of the clips 29 extending into the channels 61 of the sides 35a, 35b of the cladding sheets 3 so that the cladding sheets 3 are

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secured to the clips 29. It can readily be appreciated from the Figures that this engagement of the flanges 9 in the channels 61 securely locates the cladding sheets 3 onto the clips 29.

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Figures 5 to 18 illustrate the stages of one embodiment of a method of the present invention of roll forming another, although not the only possible other, embodiment of a cladding sheet 3 in accordance with the present invention.

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The embodiment of the cladding sheet 3 manufactured by the roll forming method is shown, in transverse section, in Figure 19. Figure 19 is a transverse section of the cladding sheet 3 manufactured by the roll forming method illustrated in Figures 5 to 18. The cladding sheet 3 shown in Figure 19 has the same basic features as the cladding sheet 3 shown in Figures 1 to 4, as described above, and the same reference numerals are used to describe the same features.

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It is relevant to note that roll forming the upwardly and inwardly opening channels 61 in the leading edge formation 31 of the cladding sheet 3 is not a straightforward exercise and that the method includes roll forming stages carried out on roll forming stands that rely on the use of roll segments, described as idler rolls (described hereinafter), that have axes of rotation that are transverse to the notional roll centrelines Z-Z of the stands and transverse to the axes of rotation of the rolls in the standard roll forming stages that precede and follow this part of the roll forming method.

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With reference to Figures 5 to 18 generally, the roll former comprises a series of roll forming stands, with each stand comprising an upper roll and a lower roll that are separated by a notional roll centreline Z-Z. The

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rolls may be driven or drive rolls. Each upper roll comprises a plurality of roll segments 81a, 81b, 81c and each lower roll comprising a plurality of corresponding roll segments 83a, 83b, 83c.

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With further reference to Figures 5 to 18 generally, the Figures show a part of the upper and lower rolls of each roll forming stand. It can be appreciated that there are a plurality of other such roll segments in the upper and lower rolls in each stand. The roll segments 81, 83 are arranged to rotate about the axes X-X and Y-Y shown in Figure 5. These axes of rotation are parallel to the roll centreline Z-Z. The roll segments 81, 83 in Figures 6, 7, 9, 12, and 14 to 18 are arranged to rotate about axes of rotation that are parallel to these axes of rotation and to the roll centreline Z-Z of these stands. As is described in more detail hereinafter, the roll segments, described as idler rolls 89, in the roll forming stands shown in the other Figures rotate about axes of rotation 91 that are transverse to these axes of rotation and to the roll centrelines Z-Z of these stands.

Figure 5 illustrates the first roll stand in the roll former. This stand carries out a first stage of roll forming a flat steel strip 85 into the cladding sheet having the profile shown in Figure 19. Figures 6 to 18 illustrate successive downstream roll stands that carry out successive stages of roll forming the strip 85 into the cladding sheet 3 shown in Figure 19.

The roll segments shown in Figures 5 to 18 are the roll segments required to form one of the ribs 65 of the cladding sheet 3. It can be appreciated that similar arrangements of roll segments are required to form other ribs 65 in the cladding sheet 3. It can also be appreciated that similar arrangements of roll segments are

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required to form the side edge formations 11, 31 of the cladding sheet 3.

5 The first three roll forming stages that are shown in Figures 5 to 7 are standard stages in the sense that the stages form re-entrant sections of the rib 65 that are typical of known cladding sheets. As is described above, these re-entrant sections of the rib 65 are generally flat platforms that, in use, are contacted and engaged by the retaining members 9 of a clip 29, such as the clip shown in Figure 4.

15 Figure 8 shows an arrangement of roll segments to start to form the re-entrant section 43 on the left hand side of the rib 65. As is described above, this re-entrant section 43 defines part of an upwardly and inwardly opening channel 61 on the left hand side of the rib 65 that provides more positive engagement of the rib 65 with a cladding sheet 3. The roll segments comprise a pair of opposed idler rolls 89 that are rotatable about axes 91 (only one of which is shown in the Figure) that are transverse to the roll centreline Z-Z and have complementary roll former surfaces 93 that are shaped to deform the essentially straight re-entrant section of Figure 7 to the S-shaped profile shown in Figure 8.

30 The roll segments 81a, 83b and 83a, 83b in the next roll forming stand shown in Figure 9 are provided to further develop the re-entrant section 43 on the left hand side of the rib 65. Specifically, the roll segments co-operate to start to form the section 41 of the left hand side of the rib 65. As is indicated above, the section 41 and the re-entrant section 43 define the channel 61. The start of the shape of the channel 61 is apparent in Figure 9.

Figure 10 shows an arrangement of roll segments

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in the next roll forming stand that complete the formation of the re-entrant section 43 on the left hand side of the rib 65. The roll segments are in the form of opposed idler rolls. The idler rolls 89 are rotatable about axes 91 (only one of which is shown in the Figure) that are transverse to the centreline Z-Z and have complementary former surfaces 93 that are shaped to continue deformation of the re-entrant section 43 of Figure 9 to the S-shaped profile shown in Figure 10.

The successive roll forming stands in Figures 11 to 13 show corresponding sets of roll segments, including idler rolls, to the sets of roll segments shown in Figures 7 to 9 to form the channel 61 on the right hand side of the rib 65.

Figures 14 to 18 show the roll segments in the successive roll forming stands that are required to complete roll forming the rib 65.

The above-described series of roll forming stands and stages is an effective roll former and roll forming method of manufacturing the cladding sheet 3 shown in Figure 19. As is indicated above, the use of the idler rolls 89 in the roll forming stands shown in Figures 8, 10, 11, and 13 are important structural features to form the inwardly and upwardly opening channels in the ribs 65 and the leading and trailing ends 11, 31 of the cladding sheet 3.

Many modifications may be made to the preferred embodiments of the cladding sheet and the embodiment of the method of roll forming a cladding sheet described above without departing from the spirit and scope of the present invention.

By way of example, whilst the embodiments are

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described in the context of a roof cladding sheet, the present invention is not so limited and extends to other cladding sheets, such as wall cladding sheets.

5 In addition, whilst the embodiments are described in the context of a particular concealed fixing retaining clip 29, the present invention is not so limited and extends to any suitable clips.

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CLAIMS

1. A roof or other cladding sheet that is adapted to engage a concealed fixing retaining clip comprises at least one rib or side edge formation that has a lengthwise extending channel that opens upwardly relative to a base plane of the cladding sheet, as defined herein, and is adapted to receive retaining members of the concealed fixing retaining clip.

2. A roof or other cladding sheet that is adapted to engage a concealed fixing retaining clip that includes a pair of retaining members that extend in opposite directions and is adapted to be secured to a support structure, which cladding sheet comprises opposed sides, one or more than one lengthwise extending rib, side edge formations that enable the sheets to be positioned side by side in overlapping relationship, and pan sections that separate the side edge formations and the rib or ribs, and is characterised in that at least one of the rib or ribs and the side edge formations include a lengthwise extending channel that opens upwardly relative to a base plane of the cladding sheet, as defined herein, and is adapted to receive the retaining members of the concealed fixing retaining clip.

3. The cladding sheet defined in claim 1 or claim 2 wherein the upwardly opening lengthwise extending channel is defined by (a) a side section of the rib or the side edge formation and (b) a re-entrant, i.e. in-turned, section of the rib or the side edge formation that extends inwardly and then upwardly from a lower end of the side section and is upwardly inclined relative to the base plane of the cladding sheet.

4. The cladding sheet defined in claim 3 wherein the re-entrant section is inclined upwardly at an angle of at

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least 3° to the base plane of the cladding sheet.

5. The cladding sheet defined in claim 4 wherein the re-entrant section is inclined upwardly at an angle of at least 5° to the base plane of the cladding sheet.

6. A method of roll-forming the roof or other cladding sheet defined in any one of the preceding claims from strip using a roll former that comprises a plurality of roll forming stands, each stand including upper and lower rolls and a notional roll centreline between the rolls in each stand, which method comprises roll forming at least one side of at least one of the rib or ribs and the side edge formations of the cladding sheet to have at least one lengthwise extending channel that opens upwardly relative to the base plane of the cladding sheet, as defined herein, in at least one roll forming stand that has upper and lower rolls that rotate about axes that are transverse to the roll centreline of the stand and have complementary roll former surfaces that are shaped to deform the strip and form the channel.

7. The method defined in claim 6 comprises roll forming both sides of the rib or ribs of the cladding sheet to have lengthwise extending channels that open upwardly relative to the base plane of the cladding sheet in a plurality of roll forming stands that have upper and lower rolls that rotate about axes that are transverse to the roll centrelines of the stands and have complementary roll former surfaces that are shaped to deform the strip and form the channels.

8. The method defined in claim 6 or claim 7 comprises roll forming both side edge formations of the cladding sheet to have lengthwise extending channels that open upwardly relative to the base plane of the cladding sheet in a plurality of roll forming stands that have

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upper and lower rolls that rotate about axes that are transverse to the roll centrelines of the stands and have complementary roll former surfaces that are shaped to deform the strip and form the channels.

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9. A roll former for roll-forming the roof or other cladding sheet defined in any one of claims 1 to 5 in the method defined in any one of claims 6 to 8 from strip, the cladding sheet comprising opposed sides, one or more than one lengthwise extending rib, side edge formations that enable the sheets to be positioned side by side in overlapping relationship, and pan sections that separate the side edge formations and the rib or ribs, and being characterised in that at least one of the rib or ribs and the side edge formations have a lengthwise extending channel that opens upwardly relative to the base plane of the cladding sheet, as described herein, and is adapted to receive a retaining member of a concealed fixing retaining clip, the roll former comprising a plurality of roll forming stands, each stand including upper and lower rolls and a notional roll centreline between the rolls in each stand, and the roll former stands comprising at least one stand that has upper and lower rolls that rotate about axes that are transverse to the roll centreline of the stand and have complementary roll former surfaces that are shaped to deform the strip and form the re-entrant section of the side of the rib or the side edge formation that defines a part of the channel.

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