Abstract: A method of, and apparatus for, reducing the width of a section of channel, wherein the channel includes a lower wall and at least two side walls, the method including the steps of: arranging first and second opposed rollers to come together to form a feed path such that a surface on each of the first and second rollers comes into contact with opposing surfaces of the lower wall, and feeding the channel through the first and second rollers to change a profile of the lower wall and reduce the width of the channel.
FIELD OF THE INVENTION

The present invention relates to a swaging method and apparatus. In particular, the present invention relates to a method of reducing the width of a section of channel and a metal forming apparatus for carrying out said method.

BACKGROUND

When producing steel frame components for use in, for example, wall panels and roof trusses it is required that individual steel frame components are able to pass through or intersect with a cut out portion of other steel frame components in order to form the structure required.

In order to enable such steel components to do this, the width of one of the components is reduced to allow the reduced width component to pass into the channel of other similar components of a non-reduced width.

Figure 1A shows two steel frame components (101A, 101B). The first component 101A has a width $W_A$, and the second component 101B has a width $W_B$. Before swaging has occurred, widths $W_A$ and $W_B$ are the same, and as such, neither of the steel frame components (101A, 101B) can be inserted into the channel of the other.

Figure 1B shows a cross sectional profile of either of the steel frame components (101A, 101B). The component includes a first side wall 103 and a second side wall 105 opposing the first side wall. One end of each of the sidewalls (103, 105) is connected at right angles to a lower wall 107. The other end of each of the side walls is connected at right angles to a lip 108. The side walls and lower wall form a substantially U-shaped channel. The lower wall 107 includes an inner surface 109 within the channel, and an outer surface 111.
One known technique for reducing the width of steel frame components is the punch and die system that is performed on roll forming machines. This system will now be described with reference to figures 2A, 2B and 2C.

Referring to figure 2A, the punch 201 is arranged to move within the channel of the steel frame component 101 B in the direction of the arrow 202. The steel frame component 101 B is located on a die 203 that includes a raised portion 205.

Referring to figure 2B, the punch 201 is forced down into the channel of the component 101 B towards the lower wall such that a profile 207 is formed in the lower wall of the component 101 B. The profile 207 is formed by the punch forcing the lower wall down and against the floor of the die, which includes the raised portion 205, so that the lower wall takes the same profile as the profile of the floor of the die. By causing the lower wall to take this new profile, the overall width of the channel is reduced.

Referring to figure 2C the punched component 101 B with the profile 207 can be seen with a reduced width Wc.

Referring to figure 3, the punched component 101 B can now be inserted into the unchanged component 101 A as the width Wc of the punched component 101 B is narrower than the width W_A of the unchanged component 101 A.

Referring to figure 4, once the component has been punched it may be arranged into the unchanged steel frame component to form the required structure as shown.

As the roll forming machine needs to stop each time that a punch operation is to take place, the throughput of formed steel frame components using the above described techniques is limited.

The present invention aims to overcome, or at least alleviate, some or all of the afore-mentioned problems, or to at least provide the public with a useful choice.
SUMMARY OF THE INVENTION

According to one aspect, the present invention provides a method of reducing the width of a section of channel, wherein the channel includes a lower wall and at least two side walls, the method including the steps of: arranging first and second opposed rollers to come together to form a feed path such that a surface on each of the first and second rollers comes into contact with opposing surfaces of the lower wall, and feeding the channel through the first and second rollers to change a profile of the lower wall and reduce the width of the channel.

According to a further aspect, the present invention provides a metal forming apparatus for reducing the width of a section of channel, wherein the channel includes a lower wall and at least two side walls, the apparatus including first and second rollers arranged to form a feed path, wherein a surface on each of the first and second rollers is arranged to come into contact with opposing surfaces of the lower wall, the first and second rollers further arranged to move in order to change a profile of the lower wall and reduce the width of the channel.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1A shows two steel frame components;
Figure 1B shows a cross sectional profile of a steel frame component;
Figure 2A shows a first step in a punch and die system;
Figure 2B shows a second step in a punch and die system;
Figure 2C shows a cross sectional profile of a steel frame component after being processed by a punch and die system;
Figure 3 shows two steel frame components after one component has been processed by a punch and die system;
Figure 4 shows two steel frame components joined together;
Figure 5 shows the main components of a metal forming apparatus according to an embodiment of the present invention;
Figure 6A shows a front view of the metal forming apparatus according to an embodiment of the present invention;

Figure 6B shows a right side perspective view of the metal forming apparatus according to an embodiment of the present invention;

Figure 6C shows a left side perspective view of the metal forming apparatus according to an embodiment of the present invention;

DETAILED DESCRIPTION OF THE INVENTION

First Embodiment

Figure 5 shows the main components of a metal forming apparatus that is arranged to reduce the width of a steel frame component 101. The steel frame component's width is reduced by reducing the width of a section of the channel of the steel frame component.

The metal forming apparatus includes first and second rollers (501, 502) that are arranged to form a feed path through which the steel frame component 101 can travel. The feed path is provided in between opposing surfaces of the first and second rollers (501, 502). The first and second rollers are arranged to rotate in opposing directions such that when a frame component 101 enters the feed path it is fed through by the friction of the opposing surfaces on the rollers.

A surface on each of the first and second rollers is arranged to come into contact with opposing surfaces of the lower wall on the frame component. That is, a surface on the first roller 501 comes into contact with an inner surface of the lower wall, and a surface on the second roller 502 comes into contact with an outer surface of the lower wall. Thus, as the first and second rollers rotate and pull the frame component into and through the feed path, the cross sectional profile of the lower wall is changed and the width of the frame component channel is reduced.

Further, according to this embodiment, the apparatus includes first and second side rollers (503, 504) that are arranged to come into contact with the outer
surface of the two side walls of the frame component. By applying pressure to
the outer surfaces of the side walls of the frame component via the side rollers,
the channel width of the frame component is kept substantially constant.

As can be seen from figure 5, the first roller 501 has a surface profile 505 that
comes into contact with the inner surface 506 of the lower wall of the frame
component 101. Also, the second roller 502 has a surface profile 507 that comes
into contact with the outer surface 508 of the lower wall of the frame component
101.

The surface profile 505 of the first roller 501 has a corresponding and opposite
profile to the surface profile 507 of the second roller 502. The arrangement of the
corresponding and opposite profiles enables the surface of the lower wall to be
formed in a predefined manner. That is, a new cross sectional profile is formed
on the lower wall due to the surface profiles (505 & 507) of the rollers (501 &
502). In this embodiment, the cross sectional profile of the lower wall is modified
across the width of the frame component channel. Also, in this embodiment, the
surface profiles (505, 507) on the first and second rollers (501, 502) are step
profiles. However, it will be understood that as an alternative, various other
profiles may be used, in order to reduce the width of the channel of the frame
component, other than step profiles.

The apparatus described is generally arranged to swage steel frame components
that have a preferable sheet metal thickness ranging from 0.55mm to 3.0mm to
form light gauge steel lipped or un-lipped channels. However, it will be
understood that the apparatus may be adapted to swage other smaller or larger
sheet metal thicknesses.

The dimensions of the profiles on the surfaces of the first and second rollers are
such that the width reduction across the channel is approximately either double
the sheet metal thickness of the frame component, or greater that the total
combined sheet metal thickness of the side walls of the frame component.
For example, for a frame component of a sheet metal thickness of 0.55mm, the profiles across the surfaces of the first and second rollers are such that the width reduction across the channel is at least 1.1mm. Whereas for a frame component of a sheet metal thickness of 3.0mm, the profiles across the surfaces of the first and second rollers are such that the width reduction across the channel is at least .6mm. These values will provide a sufficient reduction in width of the swaged channel to allow the swaged channel to fit inside a channel of a similar component that has not been swaged, i.e. the width reduction of the channel is at least twice the thickness of the walls of the frame component.

Figures 6A, 6B and 6C show a front view, right perspective view and left perspective view respectively of the components of the metal forming apparatus.

The apparatus includes a compression device arranged to compress the lower wall of the channel in between the first surface of the first roller and the second surface of the second roller to change the profile of the lower wall. Referring to figures 6A, 6B and 6C a hydraulic piston 601 is provided in this embodiment that applies a downward pressure on a top portion of the apparatus in order to drive the upper roller 501 downwards in the direction of the arrows 603. It will be understood that various other forms of compression devices known in the industry may be used other than a hydraulic piston, and that various different types of hydraulic piston may be used.

The apparatus also includes a rotating device, such as a motor and sprocket system, arranged to rotate the first rotating roller in an opposite direction to the second rotating roller. Referring to figures 6A, 6B and 6C upper sprocket 605 is driven by a motor connected thereto. After the upper portion of the apparatus has been driven down by the piston 601, the upper sprocket 605 turns due to the force of the connected motor and in turn drives the lower sprocket 607. The upper and lower sprockets are driven so that they rotate in opposite directions.

In this embodiment the motor is arranged to directly drive the upper roller 501, and the lower roller 502 is driven indirectly via the upper and lower sprockets. However, it will be understood that, as an alternative, each of the upper and
lower rollers may be driven independently, directly or indirectly by corresponding drive mechanisms.

The apparatus is arranged so that the channel is fed into the feed path lengthways. In this embodiment, the action of the rotating rollers coming together clamps the channel and causes the channel to be pulled through the feed path.

However, it will be understood that, as an alternative, a separate device for feeding the channel into the feed path may be used that holds the channel externally from the apparatus and directs the channel into the feed path.

In this embodiment, the apparatus further includes first and second side rollers (503 & 504) and bevels 609 attached to each side of the upper portion of the apparatus such that when the upper portion of the apparatus is driven down by the piston 601 the bevel causes a side roller support 610 to move laterally and pivot about a pivot point 611 so the side rollers attached thereto apply side roller pressure as shown by arrows 613. Therefore the side roller support 610 is arranged to move the first and second side rollers so that they come into contact with the two side walls of the channel as it is fed through the feed path.

In particular, the side roller support 610 is arranged to move the first side roller so that it comes into contact with an outer surface of a first side wall of the channel, and further arranged to move the second side roller so that it comes into contact with an outer surface of the second side wall of the channel.

The bevel thus applies the pressure to the side walls via the first and second side rollers.

The above described apparatus thus provides a method of reducing the width of a section of channel in a frame component. This method includes the steps of arranging the first and second opposed rollers to come together to form a feed path such that a surface on each of the first and second rollers comes into contact with opposing surfaces of a lower wall of the frame component.
The channel of the frame component is fed through a feed path formed by the first and second rollers in order to change the profile of the lower wall of the frame component and so reduce the width of the channel.

The first roller is rotated in an opposite direction to the second roller, and a profiled surface on the first roller is arranged to come into contact with an inner surface of the lower wall of the frame component. A profiled surface on the second roller is also arranged to come into contact with the outer surface of the lower wall of the frame component.

The lower wall of the channel is compressed between the profiled surfaces of the first and second rollers in order to change the profile of the lower wall. The profile of the lower wall is modified due to the profiled surfaces of the first and second rollers, where the profiled surfaces of the first and second rollers have substantially corresponding and opposite profiles.

By changing the shape of the cross sectional profile across the width of the channel, the width is reduced. In this embodiment, the profile of the channel is changed to a step profile. However, it will be understood that various other profiles may be used as long as the width of the channel is reduced in order to allow the swaged channel to fit into a channel that is not swaged.

Further, the method may include the step of causing first and second side rollers to come into contact with the two side walls of the channel in order to keep the reduced width of the channel substantially constant. The first side roller is moved so that it comes into contact with an outer surface of a first side wall of the frame component, and the second side roller is moved so that it comes into contact with an outer surface of a second side wall of the frame component. In this manner, pressure is applied to the side walls via the first and second side rollers.

By following this method, a channel is formed in the frame component that has a width reduction of at least twice the thickness of the lower wall or side walls of the frame component compared to a similar frame component not processed using the described method.
Certain advantages are provided over conventional systems. For example, the steel frame component is continuously fed through the machine without the need for the machine to stop to allow the frame component to be incrementally advanced and punched. Therefore, the above described system provides faster throughput and a more efficient system. Also, a greater section draw, or decrease in width, is provided over conventional systems.

Further Embodiments

It will be understood that the embodiments of the present invention described herein are by way of example only, and that various changes and modifications may be made without departing from the scope of invention.

Further, it will be understood that the system described herein may be used with materials other than sheet steel. For example, the system may be used to change the profile of channels of components made from other metals or plastics.

Further, it will be understood that the dimensions provided are examples only, and that the system described may be applied to components of differing dimensions.

Further, it will be understood that the profile of the channel does not have to be swaged along its full length. That is, only a portion of a first channel may be swaged such that the swaged portion of the first channel fits into the respective non-swaged second channel, and the remaining portion of the first channel is not swaged.
CLAIMS

1. A method of reducing the width of a section of channel, wherein the channel includes a lower wall and at least two side walls, the method including the steps of:
   - arranging first and second opposed rollers to come together to form a feed path such that a surface on each of the first and second rollers comes into contact with opposing surfaces of the lower wall, and
   - feeding the channel through the first and second rollers to change a profile of the lower wall and reduce the width of the channel.

2. The method of claim 1 further including the steps of arranging a first surface on the first roller to come into contact with an inner surface of the lower wall and a second surface on the second roller to come into contact with an outer surface of the lower wall.

3. The method of claim 2 further including the step of compressing the lower wall of the channel in between the first surface of the first roller and the second surface of the second roller to change the profile of the lower wall.

4. The method of claim 3, wherein the first surface of the first roller has a corresponding and opposite profile to the second surface of the second roller.

5. The method of claim 1 further including the step of changing the shape of the cross section profile across the width of the channel.

6. The method of claim 5 further including the step of changing the shape of the cross section profile to a step profile.

7. The method of claim 1, wherein the first and second rollers are rotating rollers, and the method further includes the step of rotating the first rotating roller in an opposite direction to the second rotating roller.
8. The method of claim 1 further including the step of arranging a first and second side roller to come into contact with the two side walls of the channel to keep the reduced width of the channel substantially constant.

9. The method of claim 8 further including the steps of moving the first side roller to come into contact with an outer surface of a first side wall, and moving the second side roller to come into contact with an outer surface of the second side wall.

10. The method of claim 9 further including the step of applying pressure to the side walls via the first and second side rollers.

11. A channel formed of steel produced by the method of any one of the preceding claims.

12. A frame component including a channel produced by the method of any one of the preceding claims.

13. The frame component of claim 12 wherein the channel of the frame component has a width reduction of at least twice the thickness of the lower wall or side walls compared to a similar frame component not produced by said method.

14. The frame component of claim 12, wherein the thickness of the lower wall or side walls of the frame component is in the range 0.55mm to 3.0mm.

15. A metal forming apparatus for reducing the width of a section of channel, wherein the channel includes a lower wall and at least two side walls, the apparatus including first and second rollers arranged to form a feed path, wherein a surface on each of the first and second rollers is arranged to come into contact with opposing surfaces of the lower wall, the first and second rollers further arranged to move in order to change a profile of the lower wall and reduce the width of the channel.
16. The apparatus of claim 15 further including a first surface on the first roller arranged to come into contact with an inner surface of the lower wall, and a second surface on the second roller arranged to come into contact with an outer surface of the lower wall.

17. The apparatus of claim 16 further including compression means arranged to compress the lower wall of the channel in between the first surface of the first roller and the second surface of the second roller to change the profile of the lower wall.

18. The apparatus of claim 16, wherein the first surface of the first roller has a corresponding and opposite profile to the second surface of the second roller.

19. The apparatus of claim 16, wherein the profiles on the first and second surfaces are step profiles.

20. The apparatus of claim 16, wherein the profiles on the first and second surfaces are arranged to cause a width reduction across the channel of at least twice the thickness of the lower wall.

21. The apparatus of claim 15 further arranged to change the profile of the lower wall across the width of the channel.

22. The apparatus of claim 15 wherein the first and second rollers are rotating rollers, and the apparatus further includes rotating means arranged to rotate the first rotating roller in an opposite direction to the second rotating roller.

23. The apparatus of claim 22, wherein the rotating means is arranged to drive one or both of the first and second rollers.

24. The apparatus of claim 15 further including feed means arranged to feed the channel into the feed path lengthways.
25. The apparatus of claim 15 further including a first and second side roller and side roller moving means, wherein the side roller moving means is arranged to move the first and second side roller to come into contact with the two side walls of the channel to keep the reduced width of the channel substantially constant.

26. The apparatus of claim 25, wherein the side roller moving means are further arranged to move the first side roller to come into contact with an outer surface of a first side wall, and move the second side roller to come into contact with an outer surface of the second side wall.

27. The apparatus of claim 26 further including side pressure means arranged to apply pressure to the side walls via the first and second side rollers.
**A. CLASSIFICATION OF SUBJECT MATTER**

*B21J 7/18(2006.01), B21J 5/06(2006.01)*

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC: B21D 5/08, B21D 5/06, B21B 17/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean Utility models and applications for Utility models since 1975
Japanese Utility models and applications for Utility models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKIPASS (KIPO INTERNAL) "swaging", "roll forming", "channel", "side roller", "steel frame"

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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- Further documents are listed in the continuation of Box C
- See patent family annex

* Special categories of cited documents
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22 MAY 2009 (22.05.2009)

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