

[72] Inventor **Andrew H. Hutton**
Middletown, Ohio
 [21] Appl. No. **841,062**
 [22] Filed **July 11, 1969**
 [45] Patented **July 27, 1971**
 [73] Assignee **Armco Steel Corporation**
Middletown, Ohio

[56]

References Cited

UNITED STATES PATENTS

1,317,581	9/1919	Kipniss et al.	72/178
2,251,967	8/1941	Yoder	72/181 X
3,475,937	11/1969	Lawler	72/181

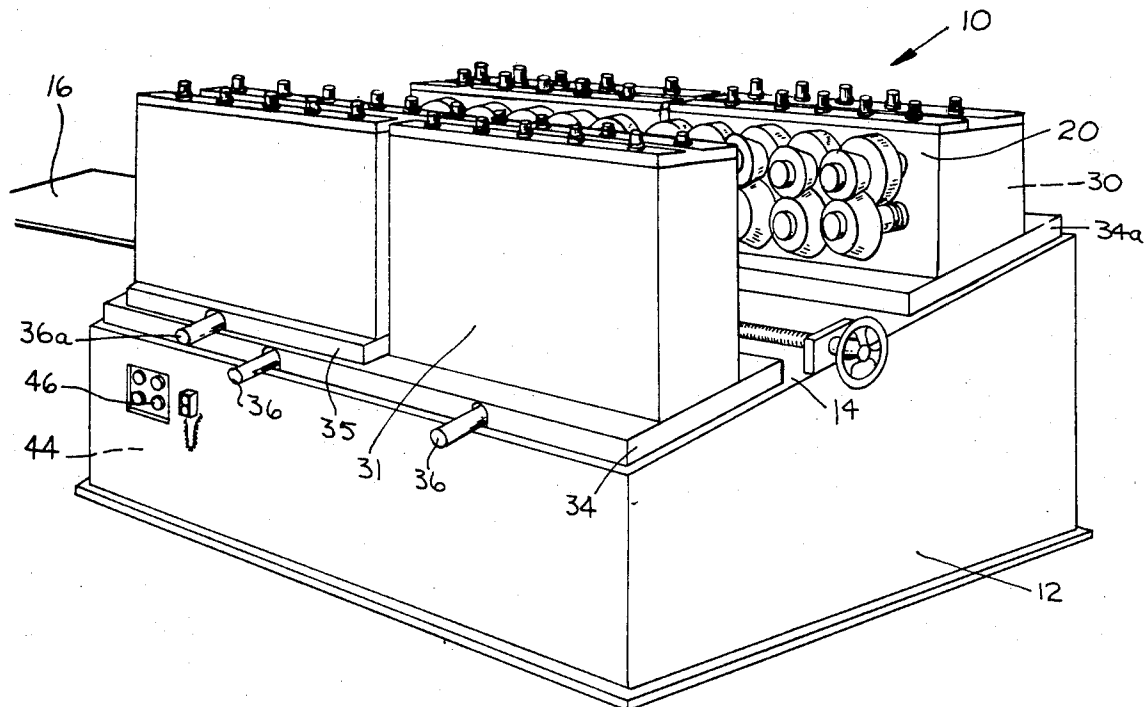
Primary Examiner—Milton S. Mehr

Attorney—Melville, Strasser, Foster and Hoffman

[54] **MACHINE FOR ROLL FORMING SECTIONS FROM SHEET MATERIAL**
14 Claims, 4 Drawing Figs.

[52] U.S. Cl. 72/181
 [51] Int. Cl. B21d 5/08
 [50] Field of Search 72/181,
 182, 179, 178

ABSTRACT: An improved machine and method for roll forming sections having a web which is provided with at least one flange from sheet material.



PATENTED JUL 27 1971

3,595,056

SHEET 1 OF 2

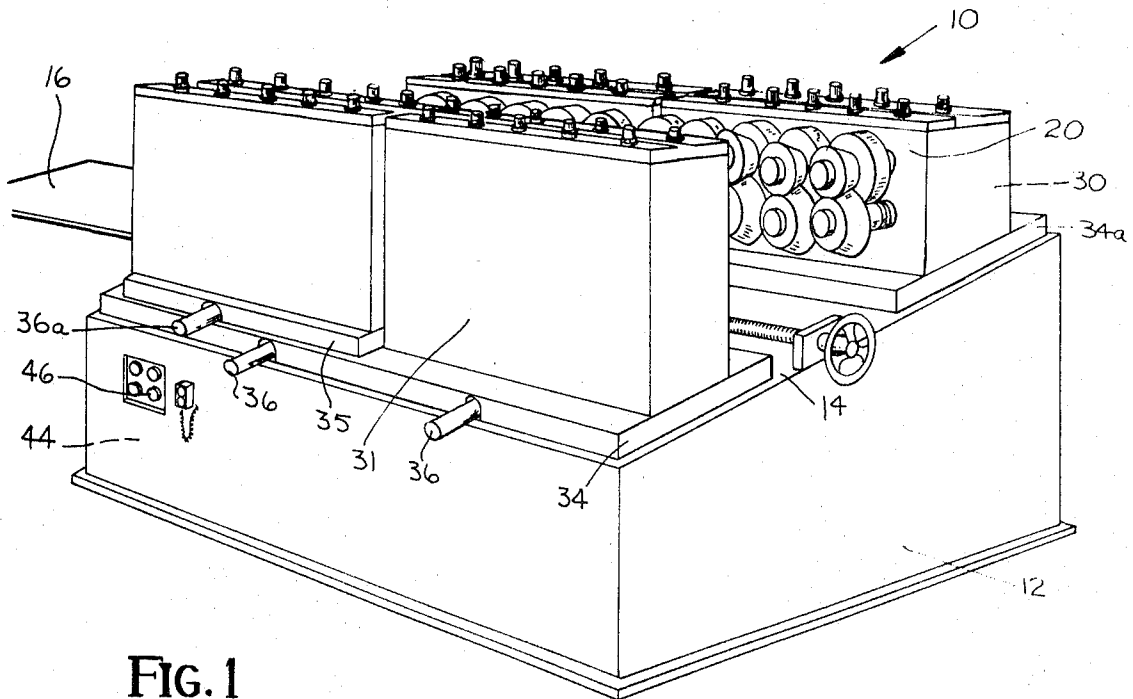


FIG. 1

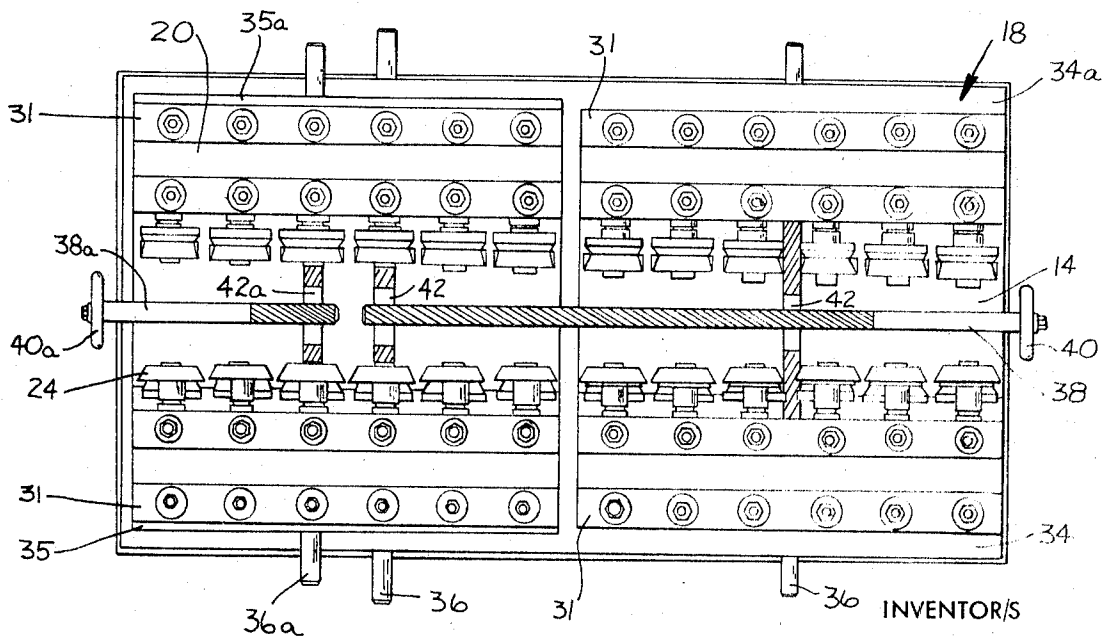


FIG. 2

INVENTOR/S
ANDREW H. HUTTON

BY *Melville, Strasser, Foster and Hoffman*
ATTORNEYS

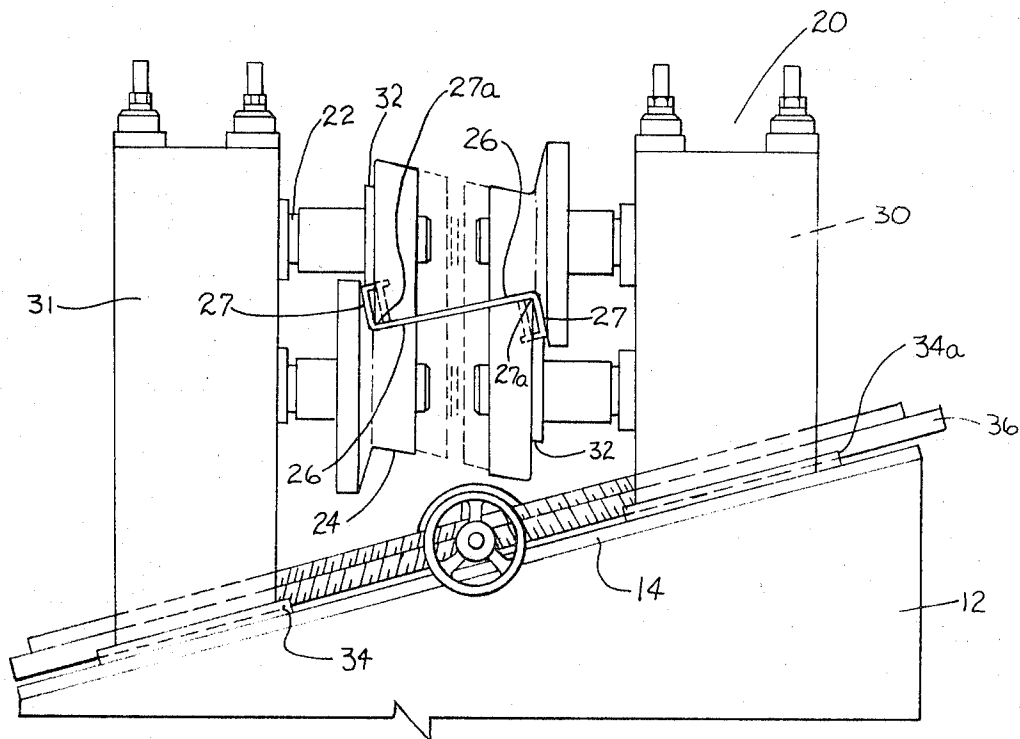


FIG. 3

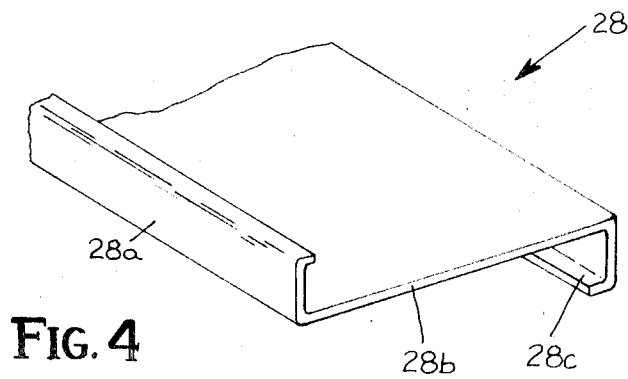


FIG. 4

INVENTOR/S
ANDREW H. HUTTON

BY *Melville, Strasser, Foster and Hoffman*
ATTORNEYS

MACHINE FOR ROLL FORMING SECTIONS FROM SHEET MATERIAL

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to machines for roll forming sections, and in particular, to machines for roll forming sections having at least one flange, from sheet material, which are readily adjustable so as to roll form sections having webs, flanges and lip stiffeners of any desired dimension.

2. Description of the Prior Art

Conventional roll forming is generally accomplished with a rolling machine consisting of a plurality of roll stations having opposed roll stands mounted on a horizontal surface of the machine base, each roll stand comprising two substantially horizontal parallel shafts on which are mounted a pair of cooperating rollers which maintain the sheet material in a horizontal plane parallel to the surface of the machine base. The parallel shafts are driven by transmitting power through extensions of the shafts at one of the roll stands, through universal couplings or gear boxes. In order to secure a width change so as to accommodate various widths of materials, it is necessary to remove one of the roll stands at each roll station, strip the rolls from the shafts and install the proper spacers between the working rolls, and replace the removed roll stand. This procedure is obviously extremely time consuming and expensive.

Most roll forming authorities promote the rolling of sections having at least one flange, such as Zee sections, with a roll arrangement to provide for inclination of the sheet material with respect to the horizontal surface of the machine base, and adjust the web of the Zee section at a fixed angle with respect to the horizontal axis of the machine. Such an inclined arrangement tends to minimize twisting, simplify tooling and provide better control. However, whenever it became necessary to effect a change of the machine so as to accommodate it to produce sections having webs, flanges and lip stiffeners of different dimensions, not only was it necessary to repeat the aforementioned procedure, that is adjusting the rolls horizontally, it was also necessary to adjust the rolls vertically due to the fact that the web was inclined with respect to the horizontal surface of the machine base.

SUMMARY OF THE INVENTION

The present invention provides an improved method and machine for roll forming sections having a web which is provided with at least one flange from sheet material. The machine generally comprises a support having a surface which is an inclined plane at any desired angle to the horizontal axis of the machine, at least one roll station positioned along the surface of the support comprising opposed roll stands, one on either side of the support surface, having pairs of cooperating rollers, and means for simultaneously rotating the pairs of cooperating rollers. Each roll stand is provided with two substantially horizontal, parallel shafts on which the pair of cooperating rollers are mounted. The cooperating rollers of at least one opposed roll stand are provided with mating web holding surfaces. The mating web holding surfaces of the pairs of cooperating rollers at each roll station are coplanar and parallel to the surface of the support. Accordingly, the sheet material, and thus the web of the section, is on an inclined plane at a fixed angle to the horizontal axis of the machine as it proceeds therethrough. One roll of each pair of cooperating rollers is provided with a forming surface angled from the web holding surface thereof against which a break of the section is formed, and the other roller of each pair of cooperating rollers has a mating forming surface which at least contacts the radius of the break of the sheet material. The opposed roll stands at each rolling station are adjustably mounted on the surface of the support for movement toward and away from each other along an axis parallel to the inclined plane, and means are pro-

vided to at least individually adjust the adjacent roll stands on one side of the machine. Thus, as the opposed roll stands are adjusted toward and away from each other with respect to a fixed center line on the inclined plane, the machine may be readily adjusted so as to form sections having web, flanges and lip stiffeners of any desired dimension from the sheet material.

In a preferred embodiment at least one of the rollers of each pair of cooperating rollers at the plurality of roll stations is adjustable in both a horizontal and vertical plane, and means are provided to accomplish this adjustment. Accordingly, the machine may be adjusted to form sections from any desired gauge of sheet material.

The means for adjusting the roll stands may also simultaneously adjust adjacent roll stands on each side of the machine at the roll stations so that all of the pairs of rollers on each side of the machine will move together. Additionally, the means for adjusting the roll stands may include means to simultaneously adjust at least one working group of adjacent roll stands on each side of the machine at the roll stations in each group so that pairs of cooperating rollers on each side of the machine in each group will move together.

The means for adjusting the roll stand may comprise at least one threaded allochiral shaft having a bushing and a worm gear associated therewith. An alternative means for adjusting the roll stands comprises a motorized screw jack.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a perspective view of the improved roll forming machine of the present invention.

FIG. 2 is a plan view of the improved machine.

FIG. 3 is an enlarged partial end view of the improved machine, showing opposed pairs of cooperating rollers forming a Zee section.

FIG. 4 is an enlarged partial perspective view of a typical section formed by the improved machine and method.

DESCRIPTION OF THE PREFERRED EMBODIMENT

For purposes of explanation, the improved machine for roll forming sections having at least one flange from sheet material will be described in terms of a machine for roll forming Zee sections. However, it should be clearly understood that such explanation is merely exemplary of one particular use to which the improved machine of the present invention may be put, because, broadly speaking, the present invention provides a machine and method for making any section when the forming operations on the section are performed in the same rotational direction relative to the longitudinal axis of the section being formed. In practice it has been found that the formation of such sections is improved when the sheet material, and thus the web of the section, is on an inclined plane at a fixed angle to the horizontal axis of the machine as it proceeds therethrough. This tends to minimize twisting, reduce the problems in connection with torque, simplify tooling and provide better control.

Turning first to FIG. 1, it will be seen that the improved roll forming machine 10 generally comprises a machine base or support 12 having a surface 14 which is at an inclined plane at a fixed angle to the horizontal axis of the machine 10. A plurality of roll stations 18 are positioned along the supporting surface 14, each roll station 18 comprising opposed roll stands 20, one at either side of the support surface 14. In practice, one or more roll stations 18 are combined to perform a forming operation or change of direction in the sheet material 16. It will be obvious that a group of roll stations will be required for forming each break of the section 28.

Two substantially horizontal, parallel shafts 22 are provided on each roll stand 20 on which are mounted a pair of cooperating rollers 24. The cooperating rollers 24 of the opposed roll stands 20 at each roll station 18 are provided with mating web holding surfaces 26 which are coplanar and parallel to the surface 14 of the support or base 12. One roller of each pair of cooperating rollers 24 is provided with a forming

surface 27 angled from the web holding surface 26 thereof against which changes in direction of the sheet material 16 are effected, such as the formation of the flanges 28a of the Zee section 28, and the other roller of each pair of cooperating rollers is provided with a mating flanging surface 27a which at least contacts the radius of the break of the sheet material, such as the radius between the web 28b and each flange 28a.

The flanging surface 27 may, of course, be angled from the web holding surface 26 as desired. For example, if the flanges 28a are substantially perpendicular to the web 28b, the flanging surfaces 27 will be at substantially a right angle to the web holding surfaces 26. It should also be noted that the amount of contact between a flange 28a and the flanging surface 27 will also govern the incline of the sheet material 16 to allow clearance for the lip stiffener 28c.

Additionally, it has been found that it is a minimum requirement for the mating flanging surface 27a to at least cover the radius of the break of the sheet material so as to avoid tool breakdown, if the top of a roller surface is unsupported, and to produce a satisfactory geometrical break in the sheet material 16. Preferably there will also be some contact between the mating flanging surface 27a and a flange 28a in order to obtain self-centering action for the roller surfaces and thus good break contour.

Means are provided for simultaneously rotating the pairs of cooperating rollers 24. In practice, the roll shafts 22 mounting the pairs of cooperating rollers 24 are driven by transmitting power through extensions of the shafts at the roll stands 20, through universal couplings or gear boxes 30 in the roll stand housings 31, as is well known in the art.

In operation, as the pairs of cooperating rollers are simultaneously rotated, the sheet material 16 proceeds on an incline parallel to the supporting surface 14 through the machine 10 and, as best seen in FIG. 3, is formed into the desired Zee section 28, which comprises a web 28b having parallel flanges 28a at the edges thereof. The parallel flanges 28a are formed when the sheet material 16 is pressed between the mating forming surfaces 27 and 27a of the pairs of cooperating rollers 24. If it is desired to produce a section wherein the edges of the flanges 28a remote from the web 28b are folded inwardly and arranged substantially parallel to the web 28b to form lip stiffeners 28c, a further group of roll stations must be provided to form this additional break in the section 28.

In the preferred embodiment of the present invention the roll stand housings 31 of each group of roll stations 18 are mounted upon a sub-base 34, 34a which is in turn adjustably mounted on the surface 14 of the machine base or support 12 for movement toward and away from each other along an axis parallel to the inclined plane of the sheet material 16. Additionally, means are provided to simultaneously adjust adjacent roll stand housings 31 on each side of the machine 10 so that all of the pairs of cooperating rollers 24 on each side of the machine 10 will move together. Accordingly, the opposed roll stands 20 in the opposed housings 31 may be adjusted toward and away from each other with respect to a fixed center line on the inclined plane of the sheet material 16, as indicated by the dashed lines in FIG. 3, so that the machine 10 may be readily adjusted to form Zee sections 28 having webs 28b of any desired width. It will be clear that all of the opposed roll stands 20 may be simultaneously adjusted toward and away from each other with respect to a fixed center line on the inclined plane.

In order to change the dimensions of the flanges 28a of the sections 28, an additional group of roll stand housings 31 of the group affecting this break in the sheet material 16 are mounted upon the sub-bases 35 and 35a, which in turn are adjustably mounted in tandem upon the sub-bases 34 and 34a, respectively, for movement toward and away from each other along an axis parallel to the inclined plane of the sheet material 16. Means are also provided to simultaneously adjust the roll stand housings 31 of the group of roll stations on the sub-bases 35 and 35a so that all of the pairs of cooperating rollers

24 on each side of the machine 10 in these groups will move together. Accordingly, the opposed roll stands 20 in the opposed housings 31 in that group may be adjusted toward and away from each other with respect to a fixed center line on the inclined plane of the sheet material 16 so that the machine 10 may be readily adjusted to form Zee sections 28 having flanges 28a of any desired width.

The dimension of the first break of the section which is formed, such as the lip stiffeners 28c, is controlled by the choice of the width of the sheet material 16 which is utilized. However, in order to assure that the lip stiffeners 28c are maintained as formed when the sheet 16 proceeds through the group of roll stand housings 31, the surfaces 32 may be provided on the opposed pairs of cooperating rollers 24 on at least the last opposed roll stands 20 in the group of roll stand housings 31.

The means for adjusting the roll stands 20 on the sub-bases 34 and 34a, while not, of course, limited thereto, may comprise a motorized screw jack arrangement. In such an arrangement at least one allochiral threaded screw jack 36 is positioned on the machine base or support 12 and the sub-bases 34 and 34a are mounted thereon. A bar 38 having a wheel 40 at one end thereof and worm gears 42 positioned at spaced intervals therealong to correspond with the screw jack 36, is mounted along the middle of the machine 10 on the surface 14 of the support 12 such that the worm gears 42 mesh with the screw jacks 36. Accordingly, when the wheel 40 is rotated all of the roll stands 20 on each side of the machine 10 may be adjusted together. A motor 44 having a control 46 may also be utilized to adjust the roll stands 20.

The means for adjusting the roll stands 20 on the sub-bases 35 and 35a correspond generally to means for adjusting the roll stands 20 on the sub-bases 34 and 34a. In such an arrangement at least one allochiral threaded screw jack 36a is positioned on the sub-bases 34 and 34a and the sub-bases 35 and 35a, respectively, are mounted thereon. A bar 38a having a wheel 40a at one end thereof and worm gears 42a positioned at spaced intervals therealong to correspond with the screw jacks 36a is mounted along the center of the machine 10 on the surface 14 of the support 12 such that the worm gears 42a mesh with the screw jacks 36a. Accordingly, when the wheel 40a is rotated all the roll stands 20 on the sub-bases 35 and 35a on each side of the machine 10 may be adjusted together. The motor 44 may also be utilized to control the adjustment of these roll stands 20.

It will be seen that the machine according to the present invention is capable of forming a variety of sections with varying dimensions of webs, flanges and lip stiffeners. For example, the sub-bases 34 and 34a may be simultaneously adjusted toward and away from each other on the support surface 14 parallel to the inclined plane of the web 28b. Accordingly, the width of the web 28b may be altered and the flanges 28a of the section 28 will be identical in width. However, if in addition the position of the sub-base 35 relative to the sub-base 34 is different from the position of the sub-base 35a relative to the sub-base 34a, the flanges 28a will be of unequal width. Additionally, it will be obvious that one of the sub-bases 35 or 35a on one side of the machine 10 may be adjusted so that a flange 28a is not formed at that end of the sheet material 16. In this manner, for example, an L-shaped section may be produced.

I claim:

1. In a machine for roll forming sections having a web which is provided with at least one flange from a sheet of material of the type having:

- a. a support having a surface
- b. a plurality of roll stations positioned along said support, each said roll station comprising opposed roll stands, one on either side of said support, each said roll stand having two substantially parallel, horizontal shafts on which are mounted a pair of cooperating rollers, said pairs of cooperating rollers on said opposed roll stands being provided with mating web holding surfaces, said mating web holding surfaces of said pairs of cooperating rollers at

each roll station being coplanar and on an inclined plane at a fixed angle to the horizontal axis of said machine, whereby said sheet material is on an inclined plane at a fixed angle to the horizontal axis of said machine as it proceeds therethrough, one roller of each said pair of cooperating rollers being provided with a forming surface angled from said web holding surface thereof against which changes in direction of said sheet material are effected and a break of said section is formed, the other roller of each said pair of cooperating rollers having a mating forming surface which at least contacts the radius of the break of said sheet material; and

c. means for simultaneously rotating said pairs of cooperating rollers;

the improvement in combination therewith wherein the surface of said support is on an inclined plane at a fixed angle to the horizontal axis of said machine parallel to said mating web holding surfaces and said opposed roll stands at each said rolling station are adjustably mounted on said support surface for movement toward and away from each other along an axis parallel to said inclined plane, and wherein means are provided to adjust at least said adjacent roll stands on one side of said machine at said roll stations, whereby as said opposed roll stands are adjusted toward and away from each other with respect to a fixed center line on said inclined plane, said machine may be readily adjusted so as to form said sections having webs of any desired width.

2. The machine according to claim 1, wherein at least one of said rollers of each said pair of cooperating rollers is adjustable in both a horizontal and vertical plane, and means are provided to accomplish said adjustment, whereby said machine may be adjusted to form said sections from any desired gauge of sheet material.

3. The machine according to claim 2, wherein said means to adjust each of said rollers in both a horizontal and vertical plane comprises a screw adjustment.

4. The machine according to claim 2, wherein said means to adjust each of said rollers in both a horizontal and vertical plane comprises a shim adjustment.

5. The machine according to claim 1, wherein said means to adjust said roll stands simultaneously adjusts adjacent roll stands on each side of said machine at said roll stations so that all of said pairs of cooperating rollers on each side of said machine will move together.

6. The machine according to claim 5, wherein said means to adjust said roll stands includes means to simultaneously adjust at least one working group of adjacent roll stands on each side of said machine, so that said pairs of cooperating rollers on each side of said machine in each said group will move together, whereby said machine may be readily adjusted so as to also form said sections having flanges of any desired width.

7. The machine according to claim 6, wherein all of said roll stands on each side of said machine are mounted on a first base which is adjustably mounted on said support surface, said first bases being mounted on said support surface for movement toward and away from each other, and wherein each said group of adjacent roll stands on each side of said machine is mounted on a second base which is adjustably mounted on said first base for movement toward and away from each other along an axis parallel to said support surface.

8. The machine according to claim 6, wherein a finishing surface is provided on at least one of said rollers of said pairs

of cooperating rollers against which a first change in direction of said sections being formed may be given final shape during the formation of said flanges.

9. The machine according to claim 1, wherein said means for adjusting said roll stands comprises at least one threaded allochiral shaft having a bushing and worm gear associated therewith.

10. The machine according to claim 1, wherein said means for adjusting said roll stands comprises a motorized screw jack.

11. In a process for roll forming sections having a web which is provided with at least one flange from a sheet of material including the steps:

a. providing a support having a surface;

b. positioning a plurality of roll stations along said support, each said roll station comprising opposed roll stands, one on either side of said support;

c. arranging two substantially horizontal, parallel shafts on each said roll stand on which are mounted a pair of cooperating rollers, said pairs of cooperating rollers on said opposed roll stands being provided with mating web holding surfaces, said mating web holding surfaces of said pairs of cooperating rollers at each roll stand being coplanar and on an inclined plane at a fixed angle to the horizontal axis of said machine, one roller of each said pair of cooperating rollers being provided with a forming surface angled from said web holding surface thereof against which a break of said section is formed, the other roller of each said pair of cooperating rollers having a mating forming surface which at least contacts the radius of the break of said sheet material;

d. simultaneously rotating said pairs of cooperating rollers; and

e. feeding said sheet material into said rotating pairs of cooperating rollers;

the improvement which comprises the steps of inclining the surface of said support at a fixed angle to the horizontal axis of said machine parallel to said mating web holding surfaces, adjustably mounting said opposed roll stands at each said roll station on said supporting surface for movement toward and away from each other along an axis parallel to said inclined plane, and adjusting at least said adjacent roll stands on one side of said roll stations, whereby as said opposed roll stands are adjusted toward and away from each other with respect to a fixed center line on said inclined plane, section having webs of any desired width may be formed.

12. A method according to claim 11, including the step of adjusting at least one of said rollers of each said pair of cooperating rollers in both a horizontal and vertical plane so that sections may be formed from any desired gauge of sheet material.

13. The method according to claim 12, wherein said step of adjusting at least said adjacent roll stands on one side of said roll station includes simultaneous adjustment so that all of said pairs of cooperating rollers on each side of said roll stations will move together.

14. The method according to claim 13, including the step of simultaneously adjusting at least one working group of adjacent roll stands on each side of said roll stations, so that pairs of cooperating rollers on each side of said machine in each said group will move together, whereby sections may be formed having flanges of any desired width.