United States Patent [19]

Colbath

[11] **3,823,592**

[45] **July 16, 1974**

[54] **ROLL-FORMING MACHINE**

[76] Inventor: **Dan L. Colbath,** P.O. Box 1003, Sherman, Tex. 75090

[22] Filed: **Apr. 30, 1973**

[21] Appl. No.: **355,673**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 181,838, Sept. 20, 1971, Pat. No. 3,748,884.

[52] **U.S. Cl.** **72/181,** 72/238
[51] **Int. Cl.** **B21d 5/08**
[58] **Field of Search** 72/181, 180, 234, 235, 72/238

[56] **References Cited**

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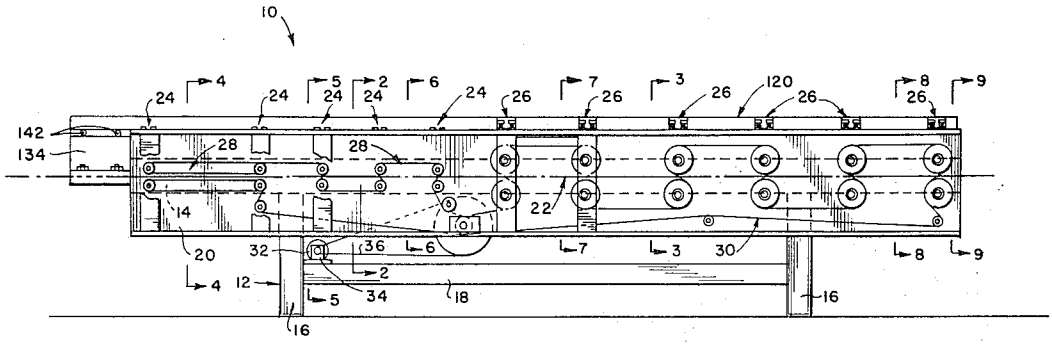
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Primary Examiner—Milton S. Mehr
Attorney, Agent, or Firm—Richards, Harris & Medlock

[57] **ABSTRACT**

A roll-forming machine includes a plurality of forming members which are mounted at spaced points on an elongate, rigid spine. This permits conversion of the machine from one roll-forming configuration to another by removing the spine and the roll-forming members attached thereto and then installing a different spine-forming member assembly in the roll-forming machine. In one embodiment of the invention the forming members comprise non-driven material engaging rollers and the roll-forming machine further includes a plurality of roll-stands each comprising non-forming driving rollers for moving material through the roll-forming machine. In another embodiment of the invention the forming members comprise combination driving and forming rollers and couplers are provided for forming driving connections to the rollers. In a third embodiment the rigid spine supports non-driven forming rollers and idler rollers which cooperate with driving rollers to move material through the roll-forming machine.

8 Claims, 12 Drawing Figures



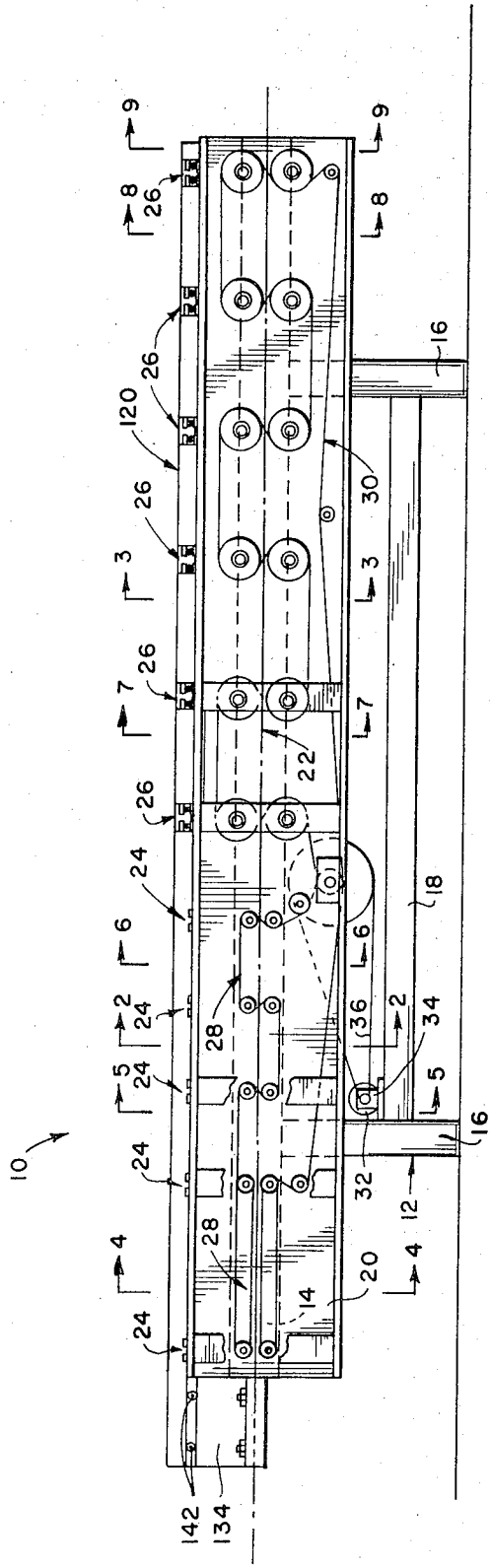


FIG. 1

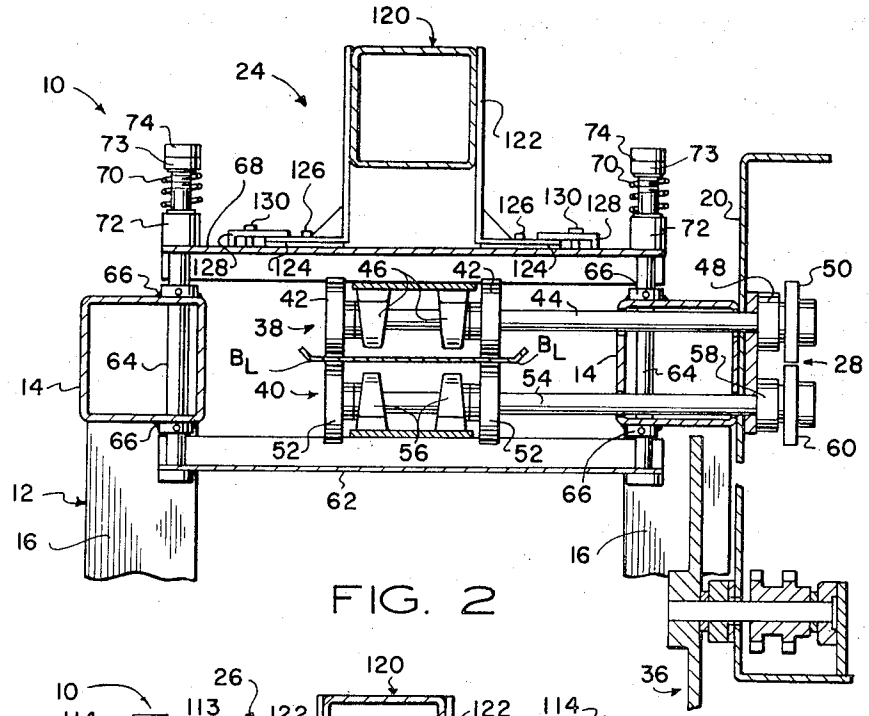

120
24
10
74
73
70
72
68
126
130
122
74
70
73
20
72
128
124
46
42
66
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44
38
64
14
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54
58
28
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56
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12
16

FIG. 2

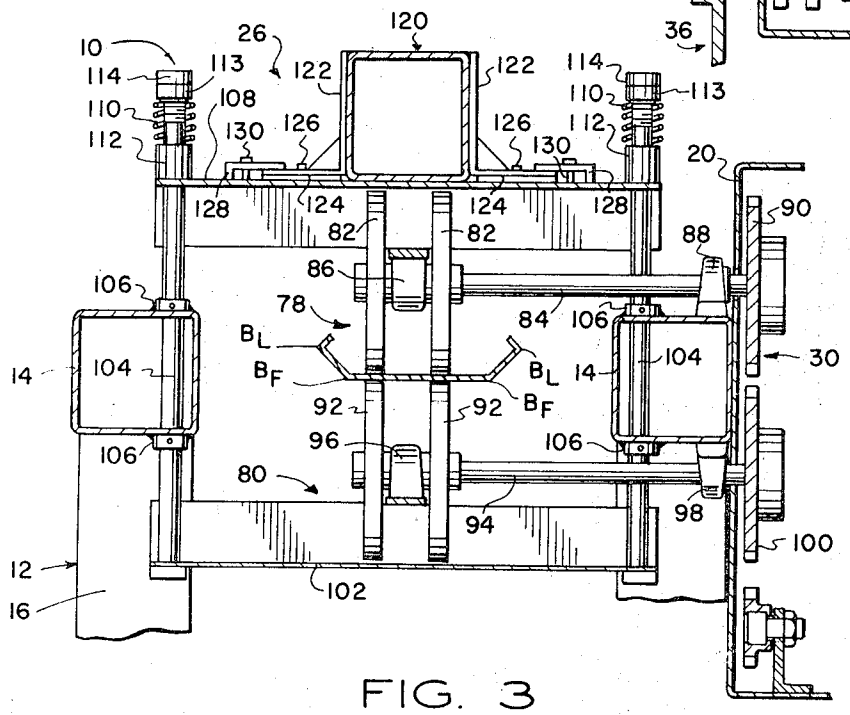

120
26
10
114
113
108
110
112
130
126
122
36
20
90
88
82
86
106
78
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104
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14
92
96
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94
98
100
102
12
16

FIG. 3

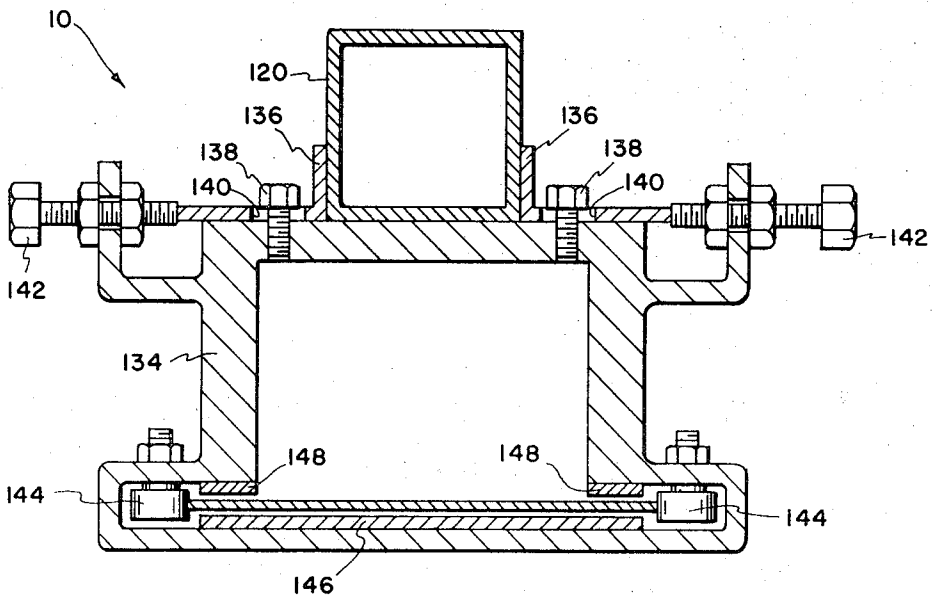

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120
136
136
138
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142
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134
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144
144
146

FIG. 4

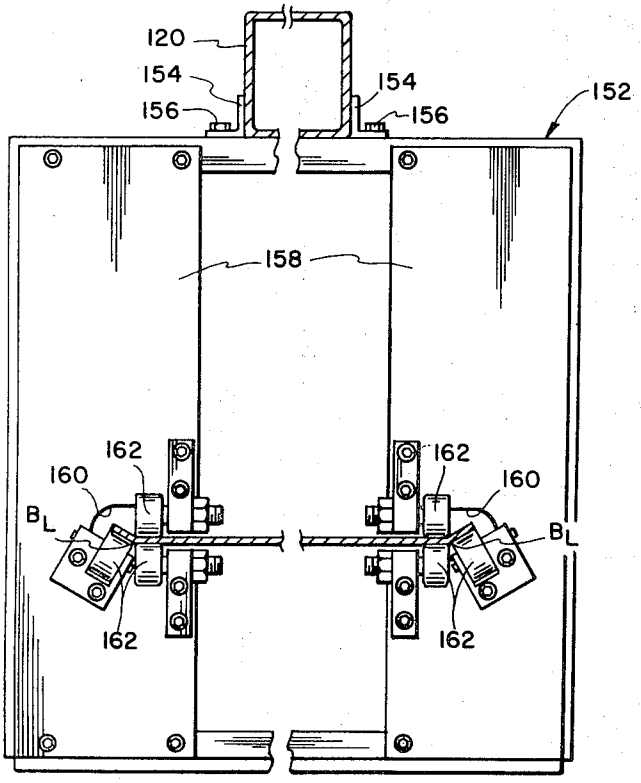

120
154
154
156
156
152
158
162
162
160
160
BL
BL
162
162

FIG. 5

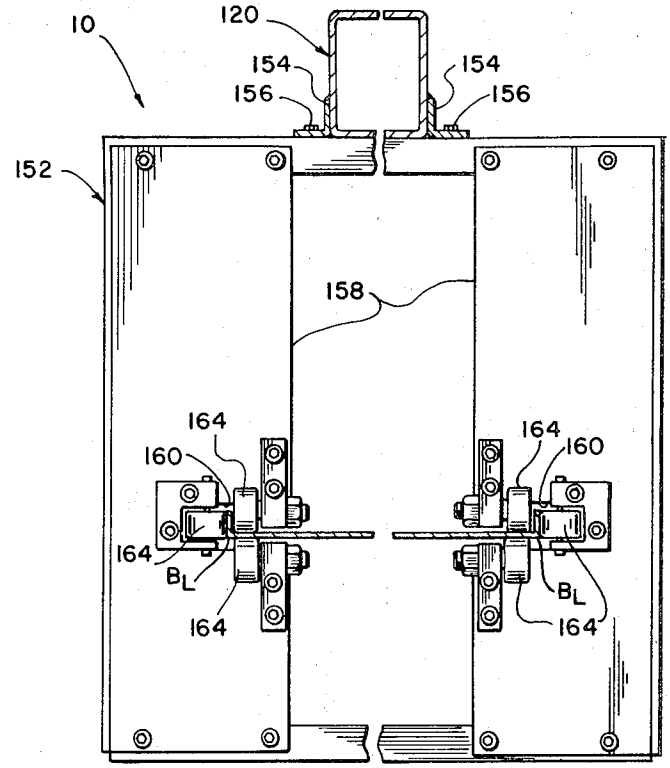

10
120
154
156
154
156
152
158
164
160
164
160
164
B_L
B_L
164
164

FIG. 6

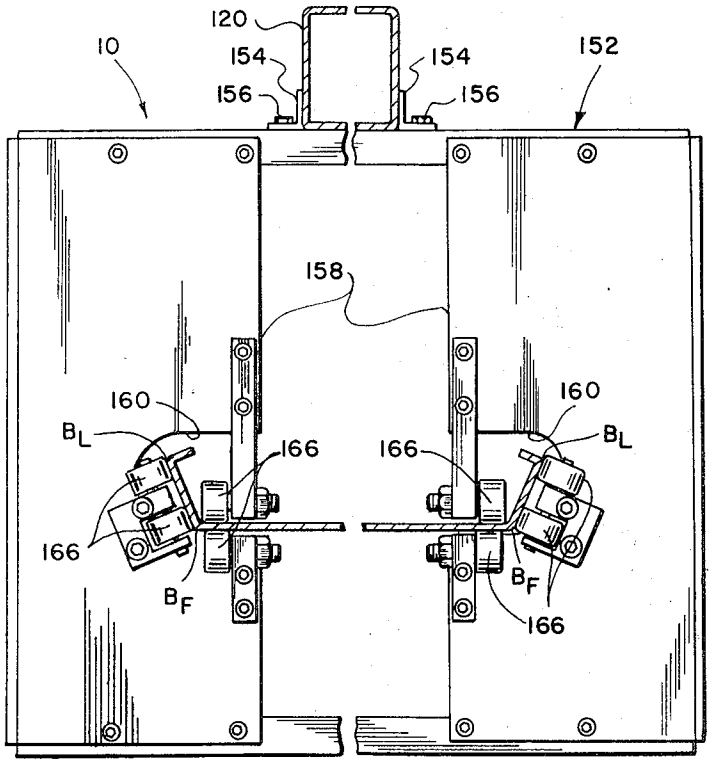

120
10
154
156
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158
160
B_L
166
160
B_L
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166
B_F
B_F
166

FIG. 7

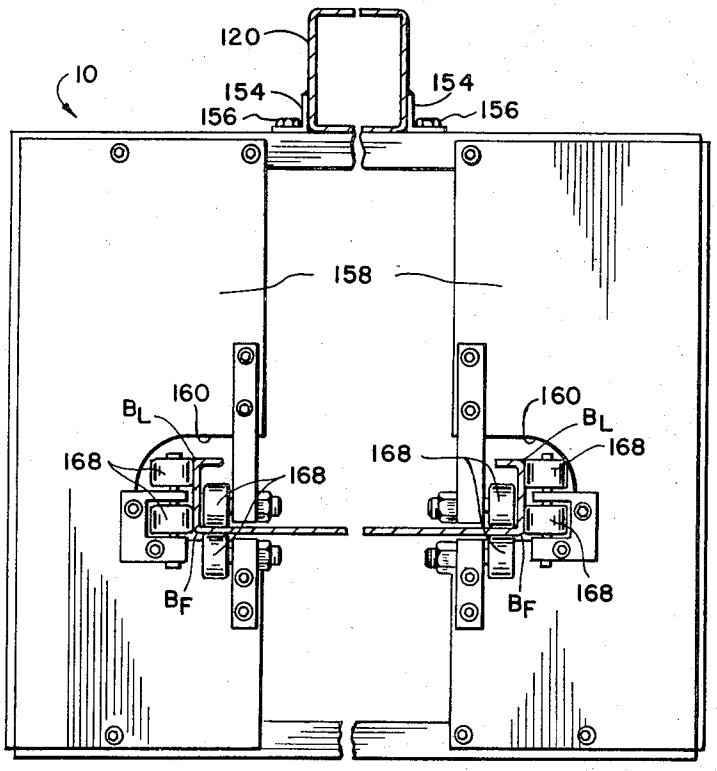

120
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160
B_L
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B_L
168
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168
B_F
B_F
168

FIG. 8

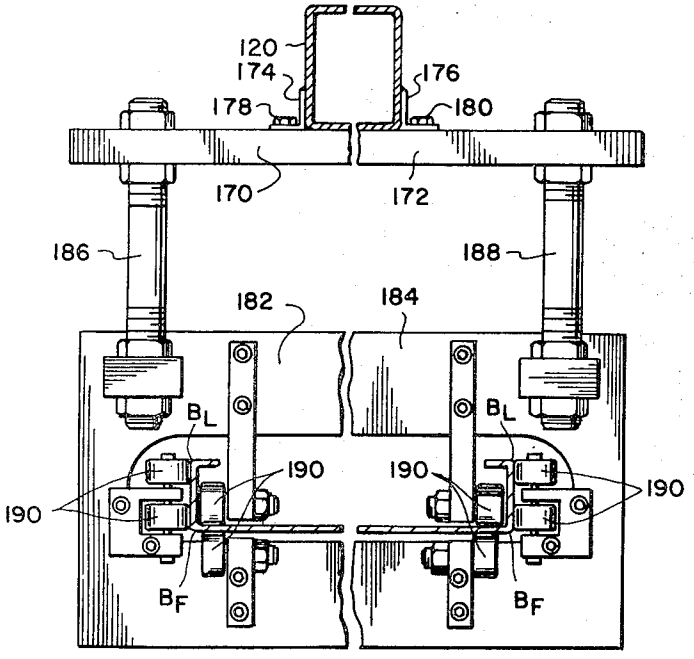

120
174
176
178
180
170
172
186
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182
184
B_L
B_L
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190
B_F
B_F

FIG. 9

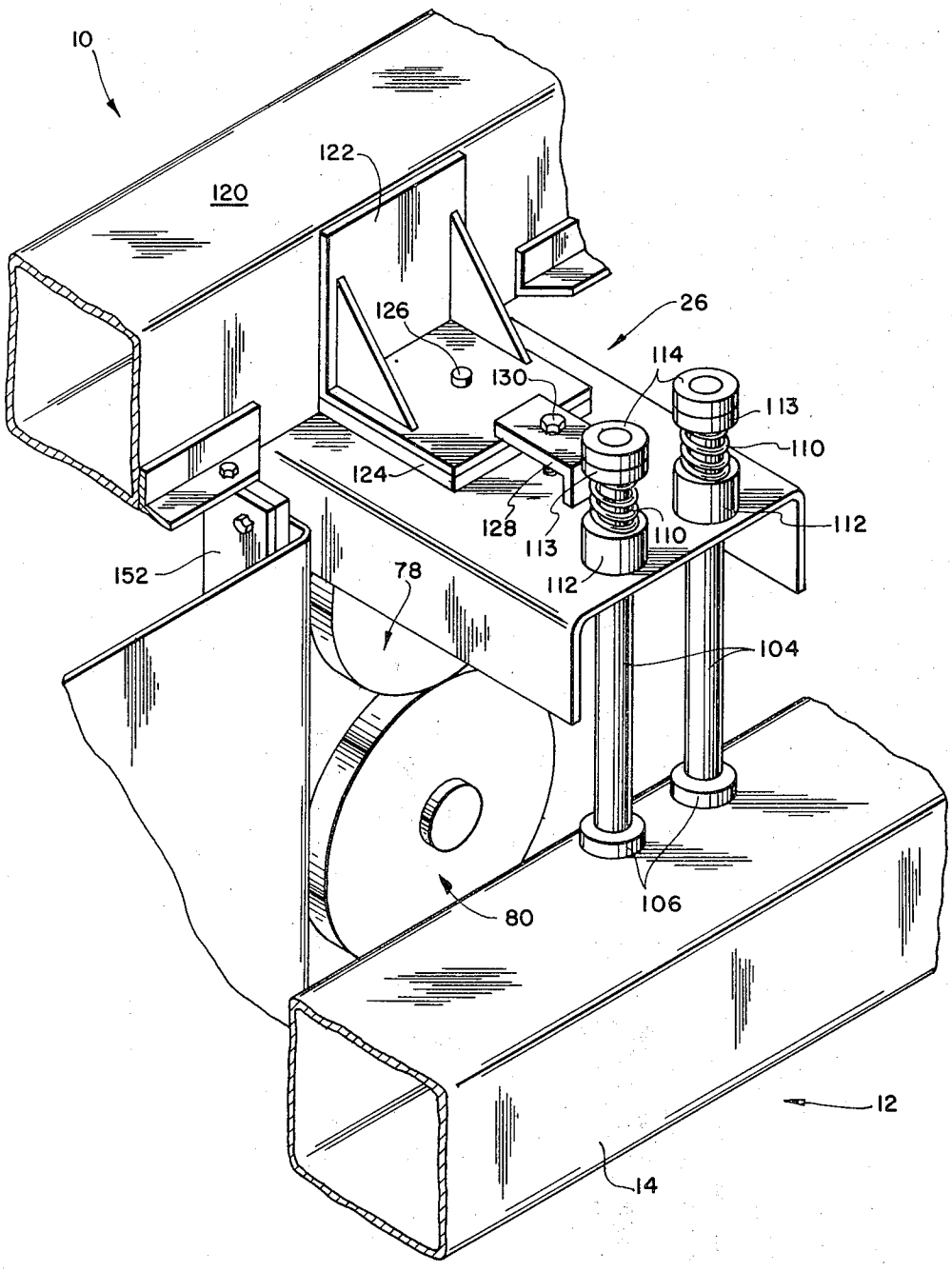

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122
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FIG. 10

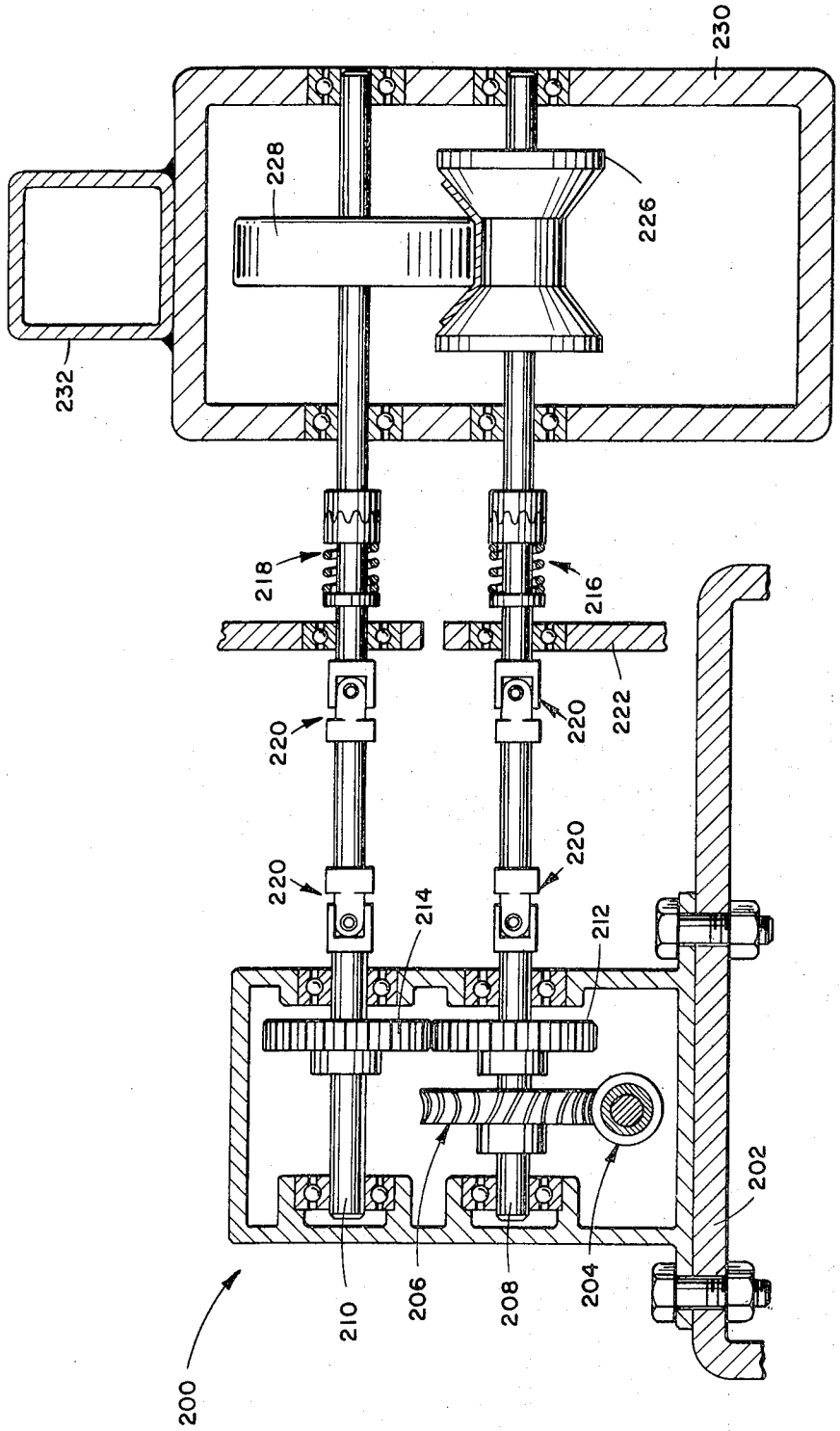

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FIG. 11

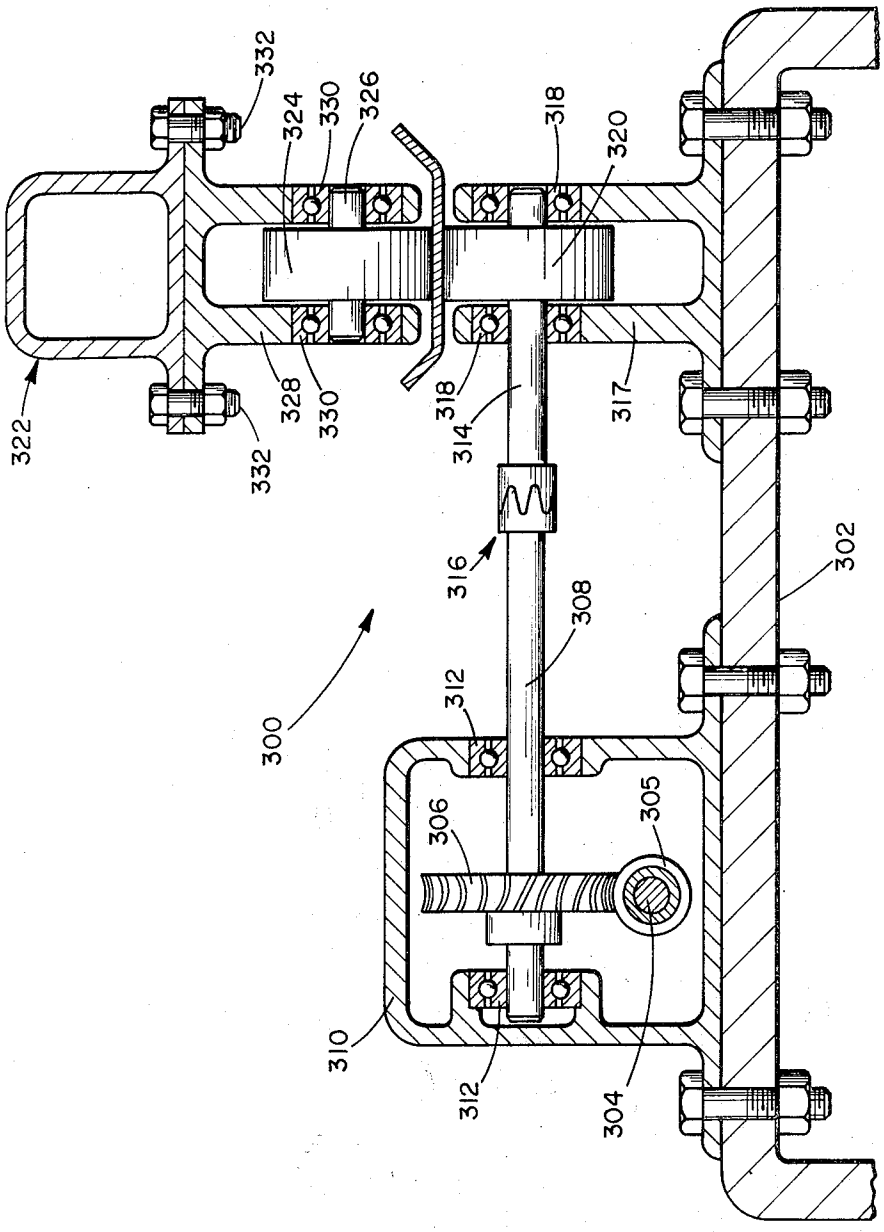

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FIG. 12

ROLL-FORMING MACHINE

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of co-pending U.S. Pat. application Ser. No. 181,838, now U.S. Pat. No. 3,748,884.

BACKGROUND AND SUMMARY OF THE INVENTION

This invention relates to roll-forming machines, and more particularly to a roll-forming machine which is quickly and easily changed from one roll-forming configuration to another.

As is well known, roll-forming machines are used in industry to form longitudinal bends in strips of metal or similar materials. The type of roll-forming machine that is most often employed at the present time is disclosed in U.S. Pat. No. 2,176,115, granted to Yoder on Oct. 17, 1939. In the Yoder device a plurality of roll-stands are mounted at spaced intervals and function to move material along a path and to simultaneously form longitudinal bends in the material. The roll-stands are driven by a common power source which is connected to the roll-stands by means of worm gear drives. The roll-stands generally comprise combination driving and forming rollers, however, in a given instance certain of the roll-stands may serve merely as driving rollers and in other instances non-driven forming rollers may be used in conjunction with the combination driving and forming rollers.

Roll-forming machines of the type disclosed in the Yoder Patent incorporate a number of inherently disadvantageous characteristics. First, in the case of a roll-forming machine designed to form complex shapes or to operate on relatively thick materials, the component parts of the roll-stands may be either complex or heavy or both. Second, all of the roll-stands in the Yoder type of device are power driven. Thus, in order to adapt a Yoder type roll-forming machine to perform a particular roll-forming operation, all of the rollers must be removed and replaced on an individual basis. For both of these reasons it typically requires a crew of skilled workmen and as long as eight hours to convert a conventional roll-forming machine from one roll-forming configuration to another.

A less critical but nevertheless significant disadvantage of the Yoder type of roll-forming machine involves the fact that the combination driving and forming rollers of such a device typically present more than one diameter to material that is traveling through the roll-forming machine. In such a case it is necessary that at least portions of the rollers slip relative to the material. This results in numerous problems including increased power requirements, excess heating of the material, possible tearing of the material, etc.

The present invention comprises a novel roll-forming machine which overcomes the foregoing and other disadvantages that are characteristic of the prior art. In accordance with the preferred embodiment of the invention, a plurality of forming members are supported on an elongate, rigid spine. Structure is provided for precisely locating the spine and thereby orienting the forming members for engagement with material passing through the roll-forming machine. Whenever it is desired to change the roll-forming machine to a different roll-forming configuration, the spine and the forming members supported thereon are removed from the roll forming machine and are then replaced with a different spine-forming member assembly. By this means the roll-forming machine is quickly and easily converted from one roll-forming configuration to another.

DESCRIPTION OF THE DRAWINGS

A more complete understanding of the invention may be had by referring to the following Detailed Description when taken in conjunction with the accompanying Drawings, wherein:

FIG. **1** is a side view of a roll-forming machine comprising the preferred embodiment of the invention;

FIGS. **2** and **3** are sectional views taken generally along the lines **2—2** and **3—3** of FIG. **1**, respectively, and illustrating the different types of roll-stands which are employed in the roll-forming machine;

FIG. **4** is a sectional view taken generally along the line **4—4** in FIG. **1** and illustrating a typical guide of the type used in the roll-forming machine;

FIGS. **5, 6, 7** and **8** are sectional views taken generally along the lines **5—5, 6—6, 7—7** and **8—8** of FIG. **1**, respectively, and illustrating various typical die-stands of the type used in the roll-forming machine;

FIG. **9** is a sectional view taken generally along the line **9—9** in FIG. **1** and illustrating a typical straightening mechanism of the type used in the roll-forming machine;

FIG. **10** is a partial perspective view of the roll-forming machine which further illustrates certain of the component parts of the roll-forming machine;

FIG. **11** is a sectional view illustrating a roll-forming machine comprising a second embodiment of the invention; and

FIG. **12** is a sectional view illustrating a roll-forming machine comprising a third embodiment of the invention.

DETAILED DESCRIPTION

Referring now to the Drawings, and particularly to FIG. **1** thereof, there is shown a roll-forming machine **10** comprising the preferred embodiment of the invention. The roll-forming machine **10** includes a frame **12** which includes a pair of main beams **14**, a plurality of legs **16** which support the main beams **14**, and a plurality of brace beams **18** which interconnect the legs **16**. The main beams **14** extend longitudinally of the roll-forming machine **10** and serve to support the operating components thereof. One of the main beams **14** also supports a chain drive enclosing housing **20**.

The roll-forming machine **10** further includes a plurality of roll-stands which serve to move material through the roll-forming machine **10** along a path **22** extending from left to right (FIG. **1**) and parallel to the main beams **14**. The roll-stands of the roll-forming machine **10** are of two types and include a first type **24** which is used in the entry or forward portion of the roll-forming machine **10** and a second type **26** which is used in the exit or rearward portion of the roll-forming machine. All of the roll-stands **24** are driven by a chain drive **28** whereas all of the roll-stands **26** are driven by a chain drive **30**. Both of the chain drives **28** and **30** are mounted in the housing **20** and are driven by a common power source including an electric motor **32**, a suitable transmission **34** and a chain and sprocket drive **36**.

The structural details of the roll-stands **24** of the roll-forming machine **10** are illustrated in FIG. **2**. Each roll-stand **24** includes upper and lower roller assemblies **38** and **40** which comprise relatively small diameter, relatively widely spaced drive rollers mounted for cooperation to advance material through the roll-forming machine **10**. The upper roller assembly **38** includes a pair of rollers **42** which are supported on and driven by a shaft **44**. The shaft **44** is in turn supported in a pair of pillow-block bearings **46** and a self-aligning bearing **48** mounted on the housing **20**. The shaft **44** extends to a sprocket **50** comprising a portion of the chain drive **28**. Similarly, the lower roller assembly **40** includes a pair of drive rollers **52** which are supported on and driven by a shaft **54**. The shaft **54** is supported in a pair of pillow-block bearings **56** and a self-aligning bearing **58** which is mounted on the housing **20**. The shaft **54** extends to a sprocket **60** which also comprises a portion of the chain drive **28**.

The pillow-block bearings **56** are supported on a plate **62** which is in turn supported by a pair of rods **64**. The rods **64** extend through the main beams **14** of a roll-forming machine **10** and are secured with respect thereto by cooperating sets of collars **66** which are both welded to the beams **14** and pinned to the rods **64**. By this means the location of the shaft **54** and the rollers **52** of the roller assembly **40** is fixed relative to the frame **12** of the roll-forming machine **10**.

On the other hand, the pillow-block bearings **46** of the upper roller assembly **38** are secured to a plate **68** which is slidably supported on the rods **64**. A compression spring **70** is mounted on each rod **64** and is positioned between a collar **72** that is mounted on the plate **68** and a collar **73** that is threadedly engaged with the rod **64** and retained by a collar **74**. By this means the shaft **44** and the rollers **42** of the upper roller assembly **38** are urged toward the rollers **52** and the shaft **54** of the lower roller assembly **40** and yet are permitted to move upwardly to accommodate materials of various thicknesses. By way of example, it has been found that a roll-stand constructed as shown in FIG. **2** will function to properly move materials varying in thickness from between about 1/16 inch and about ⅜ inch.

Referring now to FIG. **3**, the structural details of the roll-stands **26** of the roll-forming machine **10** are shown. Each roll-stand **26** includes upper and lower roller assemblies **78** and **80** which comprise relatively large diameter, relatively closely spaced drive rollers. The upper roller assembly **78** includes a pair of rollers **82** which are supported on and driven by a shaft **84**. The shaft **84** is supported by a pillow-block bearing **86** and a self-aligning bearing **88** mounted on the frame **12** and extends to a sprocket **90** comprising a portion of the chain drive **30**. Similarly, the lower roller assembly **80** comprises a pair of rollers **92** which are supported on and driven by a shaft **94**. The shaft **94** is supported by a pillow-block bearing **96** and a self-aligning bearing **98** mounted on one of the main beams **14** of the frame **12** and extends to a sprocket **100** which also comprises a portion of the chain drive **30**.

The pillow-block bearing **96** is supported on a plate **102** which is in turn supported on a plurality of rods **104**. The rods **104** extend through the main beams **14** of the frame **12** and are rigidly located with respect thereto by a plurality of collars **106** which are both welded to the beams **14** and pinned to the rods **104**. By this means the rollers **92** and the shaft **94** of the lower roller assembly **80** are fixedly supported relative to the frame **12** of the roll-forming machine **10**. On the other hand, the pillow-block **86** is mounted on a plate **108** which is slidably supported on the rods **104**. A compression spring **110** is mounted on each rod **104** and is positioned between a collar **112** that is mounted on the plate **108** and a collar **113** that is threadedly engaged with the rod **104** and retained by a collar **114**. By this means the rollers **82** and the shaft **84** of the upper roller assembly **78** are urged toward the rollers **92** and the shaft **94** of the lower roller assembly **80** but are permitted to move upwardly against the action of the springs **110**. This construction permits the roll-stands **26** to properly drive materials of varying thicknesses through the roll-forming machine **10**. As has been indicated previously in conjunction with the roll-stands **24**, it has been found that the construction illustrated in FIG. **3** is adaptable to advance materials varying between about 1/16 inch and about ⅜ inch.

As will be apparent from the foregoing, the roll-stands **24** and **26** of the roll-forming machine **10** comprise component parts which are substantially permanently mounted on the frame **12** of the roll-forming machine. An important aspect of the preferred embodiment of the invention is that the drive rollers of the roll-stands **24** and **26** play no part whatsoever in forming material which is moved along the path **22** shown in FIG. **1**. Instead, the various rollers comprising the roll-stands **24** and **26** are employed solely to move material through the roll-forming machine **10**.

The function of forming the material which is moving through the roll-forming machine **10** under the action of the roll-stands is performed by a plurality of die-stands which are mounted at spaced points along the path **22** and alternately with respect to the roll-stands **24** and **26**. One of the most important features of the present invention is that all of the various die-stands which are employed in a particular roll-forming operation are mounted on a spine **120**. As is clearly shown in FIGS. **1, 2** and **3**, the spine **120** extends the entire length of the roll-forming machine **10** and is supported relative to the frame **12** of the roll-forming machine **10** by means of the plates **68** and **108** of the roll-stands **24** and **26**. The spine **120** comprises an elongate, rigid, hollow tube and has a plurality of feet **122** depending from it. Each foot **122** is welded to the spine **120** and has a locating aperture formed through it. One of the plates **68** and two of the plates **108** are provided with locating pads **124**, and each pad **124** has a locating pin **126** extending upwardly from it for cooperation with the locating aperture in one of the feet **122** to precisely locate the spine **120** relative to the frame **12** of the roll-forming machine **10**. The spine **120** is secured relative to the frame **12** by a plurality of L-shaped clamps **128** and a plurality of bolts **130** which are threadedly engaged with the plates **68** and **108** to clamp the spine **120** relative to the frame **12** of the roll-forming machine.

Referring now to FIGS. **1** and **4**, the spine **120** also supports a pair of guides which are mounted on opposite sides of the first roll-stand **24** of the roll-forming machine **10**. Each guide comprises a frame **134** which is supported on a pair of brackets **136** by a plurality of bolts **138**. The brackets **136** are welded to the spine **120** and the bolts **138** are received in elongated slots **140** formed in the brackets **136**. Thus, the lateral positioning of the frame **134** relative to the spine **120** is ad-

justable by means of a plurality of adjusting members **142** supported on the frame **134** and extending into engagement with the brackets **136.** The frame **134** supports a plurality of rollers **144** which are positioned for engagement with the lateral edges of material entering the roll-forming machine **10** and also supports opposed plates **146** and **148.** By this means the guides function to align material entering the roll-forming machines relative to the die-stands of the roll-forming machine.

Typical die-stands suitable for use in the roll-forming machine **10** are illustrated in FIGS. **5, 6, 7** and **8.** Each die-stand comprises a rectangular frame **152** that is rigidly secured to the spine **120** by means of a pair of L-shaped brackets **154** which are welded to the spine **120** and a plurality of fasteners **156** which secure the rectangular frame to the brackets **154.** The frame **152** depends from the spine **120** and supports a pair of plates **158** each having a material receiving aperture **160** formed in it. A plurality of non-driven material engaging rollers are supported on each plate **158** for engagement with material passing through the roll-forming machine **10** under the action of the roll-stands **24** and **26.**

As those skilled in the art will appreciate, the positioning of the rollers of the various die-stands which are utilized in a particular roll-forming operation depends on the location of the die-stands in the roll-forming machine as well as other factors. For example, the die-stand illustrated in FIG. **5** is located in the forward portion of the roll-forming machine **10** and comprises a plurality of rollers **162** which are positioned to initiate lip bends B_L in material passing through the roll-forming machine. The die-stand illustrated in FIG. **6** is located at an intermediate point in the roll-forming machine and comprises a plurality of rollers **164** positioned to the lip bends B_L in the material passing through the roll-forming machine. The die-stand shown in FIG. **7** is located somewhat further into the roll-forming machine **10** and comprises rollers **166** positioned to cooperate with other rollers to form flange bends B_F in the material. The final die-stand of the roll-forming machine **10** is illustrated in FIG. **8** and comprises rollers **168** positioned to complete the flange bends B_F. As will be understood, all of the material engaging rollers of the various die-stands comprising the roll-forming machine **10** are non-driven rollers. Thus, in the use of the roll-forming machine **10** the material advancing and the material forming functions are completely divorced in that all of the material moving operations are carried out by the roll-stands **24** and **26** whereas all of the material forming operations are carried out by die-stands of the type illustrated in FIGS. **5, 6, 7** and **8.**

As is well known in the art, roll-forming machines are often provided with straightening mechanisms, whereby the course of the material leaving the roll-forming machine is determined and controlled. As material is transformed from an initial configuration to a desired configuration in a roll-forming machine, it is often necessary to stretch certain portions of the material to a greater extend than other portions. For example, when a channel shape of the type illustrated in FIG. **8** is formed in a length of material, the outer portions of the material are stretched to a greater extent than the central portions of the material. If no steps were taken to correct this situation, the material would curl down upon leaving the roll-forming machine. This situation may be overcome and corrected by appropriate straightening mechanisms.

The roll-forming machine **10** is equipped with two straightening mechanisms both of which are supported on the spine **120.** One of the straightening mechanisms is situated between the roll-stands **24** and the roll-stands **26** and functions to remove curl caused by forming the lip bends B_L in the material. The other straightening mechanism is situated at the right end (FIG. **1**) of the roll-forming machine to remove curl caused by forming the flange bends B_F in the material.

Referring now to FIG. **9,** the straightening mechanism at the end of the roll-forming machine **10** is shown. The straightening mechanism comprises a pair of upper bars **170** and **172** which are rigidly supported on the spine **120** by means of two L-shaped brackets **174** and **176** and two bolts **178** and **180.** A pair of plates **182** and **184** are supported on the bars **170** and **172,** respectively, by a plurality of relatively rigid bolts **186** and **188.** The plate **182** supports material engaging rollers **190** and the plate **184** supports material engaging rollers **192** which cooperate with the rollers **190** to straighten curl in the material due to the flange bends B_F formed therein. Thus, the material engaging rollers **190** and **192** do not serve to further form the material, but instead receive material that has already been shaped by the die-stands of the roll-forming machine **10** and function to remove curl from the material.

The angular and vertical positioning of the plates **182** and **184** relative to the spine **120** is adjustable by means of the bolts **186** and **188.** This permits positioning of the material engaging rollers **190** and **192** in such a way as to overcome and relieve any twisting or curling tendancy of material being formed in the roll-forming machine. As is well known in the roll-forming art, adjustment of the straightening mechanism of a roll-forming machine is a rather frequent operation in that changes in the characteristics of the material being processed can cause marked changes in the tendancy of the material to twist or curl after it has been formed in a roll-forming machine. For example, materials from different manufacturers, materials which may have been processed or stored under different conditions, and in fact lengths of material slit from different portions of the same roll or sheet often behave differently during processing in a roll-forming machine. Any such change may necessitate an adjustment of the straightening mechanisms of the roll-forming machine so that the material follows the desired course as it leaves the roll-forming machine.

Referring now to FIG. **10,** all of the various die-stands, guides and straightening mechanisms which are employed in a particular roll-forming operation are rigidly attached to a spine **120.** The spine **120** is in turn secured relative to the frame **12** of the roll-forming machine **10** by means of the L-shaped clamps **128** and the bolts **130.** Thus, by simply removing the bolts **130** and the clamps **128,** and then lifting the spine **120,** all of the die-stands, guides, and straightening mechanisms relating to a particular roll-forming operation are simultaneously removed from the roll-forming machine **10.** A second spine **120** having a plurality of die-stands, guides and straightening mechanisms rigidly attached thereto is then installed in the roll-forming machine **10.** This is accomplished by aligning the apertures of the feet **122** on the spine **120** with the pins **126** that project

upwardly from the pads **124** on the plates **68** and **108.** The L-shaped clamps **128** and the bolts **130** are then replaced, whereby the spine is rigidly secured in the roll-forming machine. At this point the roll-forming machine is adapted to perform a completely different roll-forming operation. In actual practice, it has been found that the foregoing procedure for changing the roll-forming machine shown in FIGS. **1–10** from one roll-forming configuration to another can be accomplished by two relatively unskilled workmen in as little as eight minutes. This is to be compared with a crew of several skilled workmen and a time period of as long as 8 hours which is required to change a conventional roll-forming machine from one roll-forming configuration to another.

Referring now to FIG. **11,** a roll-forming machine **200** comprising a second embodiment of the invention is shown. The roll-forming machine **200** includes a frame **202** which supports the various operating instrumentalities of the roll-forming machine. The roll-forming machine **200** further includes a suitable electric motor and transmission (not shown) which are employed to rotate a worm shaft **204.** The worm shaft **204** supplies operating power for the roll-forming machine **200** by means of a plurality of worm wheels **206** mounted in mesh with the worm shaft **204.**

Each worm wheel **206** drives a shaft **208** and also drives a shaft **210** by means of a spur gear **212** mounted on the shaft **208** and a spur gear **214** mounted on the shaft **210** and in mesh with the gear **212.** The shafts **208** and **210** are connected to a pair of couplers **216** and **218** through sets of universal joints **220.** The couplers **216** and **218** are supported by adjustable positioning members **222** and **224** and function to couple the shafts **208** and **210** to a pair of combination material moving and material forming rollers **226** and **228.** This permits alignment between the couplers **216** and **218** and rollers **226** and **228** having different axial positionings. The rollers **226** and **228** are supported in a rectangular frame **230,** and the frame **230** is secured to an elongate, rigid spine **232** by suitable means, such as welding.

The spine **232** is detachably supported on the frame **202** of the roll-forming machine **200** by suitable structure (not shown). Thus, by releasing the couplers **216** and **218** and then detaching the spine **232,** all of the combination material moving and material forming rollers comprising the roll-forming machine **200** may be removed from the roll-forming machine simultaneously. Subsequently, a second spine **232** having sets of combination material moving and material forming rollers supported thereon which are adapted to perform a different roll-forming operation is mounted in the roll-forming machine **200.** This is accomplished by securing the second spine **232** to the frame **202,** repositioning the couplers **216** and **218** as necessary, and then re-engaging the couplers **216** and **218** to supply operating power to the combination material moving and material forming rollers. Thus, the present invention is equally adapted for use in roll-forming machines having non-driven material forming rollers and in roll-forming machines having combination material moving and material forming rollers.

A roll-forming machine **300** incorporating a third embodiment of the invention is illustrated in FIG. **12.** The roll-forming machine **300** includes a frame **302** which supports all of the operating components of the roll-forming machine. These components include a suitable electric motor and transmission (not shown) which are utilized to rotate a worm shaft **304.** The worm shaft **304** supplies operating power for the roll-forming machine **300** by means of a plurality of worm wheels **306** each mounted in mesh with a worm **305** on the worm shaft **304.**

Each worm wheel **306** drives a shaft **308** which is rotatably supported in a housing **310** by means of a pair of bearings **312.** The shaft **308** is connected to a shaft **314** by means of a suitable flexible coupling **316** which is utilized to accommodate possible misalignment between the shafts **308** and **314.** The shaft **314** is rotatably supported in a subframe **317** by means of a pair of bearings **318.** A driving roller **320** is supported on and driven by the shaft **314.**

The roll-forming machine **300** further includes an elongate, rigid, hollow spine **322** which is detachably supported on the frame **302** by suitable structure which is preferably similar to that shown in FIG. **10.** The spine **322** in turn supports a plurality of die-stands, typical examples of which are illustrated in FIGS. **5, 6, 7** and **8.** Each die-stand comprises a plurality of non-driven forming rollers which function to form longitudinal bends in material passing through the roll-forming machine **300.**

The spine **322** also supports a plurality of idler rollers **324.** Each idler roller **324** is mounted on a shaft **326** which is rotatably supported in a subframe **328** by means of a pair of bearings **330.** The subframe **328** is in turn supported on the spine **322** by suitable means, such as a plurality of bolts **332.**

Each idler roller **324** is mounted directly in alignment with one of the rollers **320.** It will thus be understood that the driving rollers **320** and the idler rollers **324** cooperate to define a plurality of roll-stands which function to move material longitudinally through the roll-forming machine **300.** In the embodiment of the invention illustrated in FIG. **12,** the roll-stands comprise non-forming rollers, that is, the rollers **320** and **324** comprising each roll-stand do not serve to form the material but merely to move material through the roll-forming machine **300.**

The principal difference between the embodiment of the invention illustrated in FIGS. **1–10** and the embodiment illustrated in FIG. **12** relates to the construction of the roll-stands of the two roll-forming machines. Thus, in accordance with the first embodiment of the invention, each roll-stand comprises upper and lower rollers both of which are driven and both of which are fixedly mounted relative to the frame of the roll-forming machine. On the other hand, in accordance with the embodiment of the invention illustrated in FIG. **12,** each roll stand comprises a lower driving roller which is fixedly mounted relative to the frame of the roll-forming machine and an upper idler roller which is secured to the elongate, rigid spine of the roll-forming machine and is therefore detachably mounted relative to the frame of the roll-forming machine.

From the foregoing, it will be understood that the present invention comprises a roll-forming machine in which all of the material forming members as well as the guides and the material straightening mechanisms are rigidly secured to an elongate, rigid spine. The spine is detachably supported on the roll-forming machine whereby the material forming members, the guides and the straightening mechanisms are quickly and easily removed from the remainder of the roll-

forming machine. The use of the invention is highly advantageous in the roll-forming art in that it both increases the speed at which a roll-forming machine can be changed from one roll-forming configuration to another and also reduces the cost of such a change-over operation. By this means, roll-forming machines are readily adapted to very short run operations and are not restricted to use in high volume manufacturing operations.

Although preferred embodiments of the invention have been illustrated in the accompanying Drawings and described in the foregoing specification, it will be understood that the invention is not limited to the embodiments disclosed, but is capable of rearrangement, modification, and substitution of parts and elements without departing from the spirit of the invention.

What is claimed is:

1. A roll-forming machine comprising:
- a frame;
- an elongate, rigid spine;
- cooperative means on the frame and the spine for detachably securing the spine to the frame;
- a plurality of die-stands each rigidly secured to the spine and positioned thereby at spaced points along a predetermined path and each comprising at least one roller mounted for engagement with material moving along the predetermined path to at least partially transform the material from an initial configuration to a desired configuration;
- a plurality of roll-stands mounted on the frame at spaced points along the predetermined path and each comprising at least one roller fixedly supported relative to the frame and at least one roller mounted on the spine and positioned thereby in alignment with the fixedly supported roller; and
- power means for actuating the fixedly supported roller of each roll-stand and thereby advancing material along the predetermined path.

2. The roll-forming machine according to claim **1** wherein the die-stands each comprise non-driven forming rollers and wherein the driving and idler rollers comprising each roll-stand are non-forming rollers.

3. The roll-forming machine according to claim **2** wherein the die-stands each comprise a subframe fixed to the spine and a plurality of rollers mounted on the subframe for engagement with material moving along the path.

4. The roll-forming machine according to claim **3** wherein the roll-stands and the die-stands are alternately arranged relative to the predetermined path.

5. A roll-forming machine comprising:
- frame means;
- a plurality of driving rollers fixedly mounted at spaced points along the frame means to define a predetermined path of material movement;
- an elongate, rigid spine detachably mounted on the frame means and extending parallel to the predetermined path;
- a plurality of die-stands each secured to the spine and each comprising at least one non-driven forming roller mounted for engagement with material moving along a predetermined path;
- a plurality of idler rollers each secured to the spine in alignment with one of the driving rollers for cooperation therewith to define a plurality of roll-stands; and
- power means for actuating the driving rollers of the roll-stands and thereby advancing material along the predetermined path.

6. The roll-forming machine according to claim **5** wherein the die-stands and the roll-stands are alternately arranged along the path.

7. The roll-forming machine according to claim **5** wherein each die-stand includes a subframe mounted on the spine and a plurality of non-driven forming rollers mounted on the subframe for engagement with material moving along the path.

8. A roll-forming machine according to claim **5** wherein each roll-stand comprises non-forming rollers and wherein each die-stand comprises non-driving rollers.

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