United States Patent

Keyser

[15] **3,704,614**

[45] **Dec. 5, 1972**

[54] ADJUSTABLE STRIP CONDITIONER

[72] Inventor: **Naaman H. Keyser**, Hinsdale, Ill.

[73] Assignee: **Interlake, Inc.**, Chicago, Ill.

[22] Filed: **July 27, 1970**

[21] Appl. No.: **58,275**

[52] **U.S. Cl.** **72/165**

[51] **Int. Cl.** **B21d 1/02**

[58] **Field of Search** 72/160–165, 17

[56] **References Cited**

UNITED STATES PATENTS

3,006,401	10/1961	Wognum et al.	72/162
3,438,231	4/1969	Petzschke	72/160
2,323,768	7/1943	Hanna	72/165
3,459,027	8/1969	Brownstein	72/160
1,923,738	8/1933	McBain	72/165
2,963,071	12/1960	Krynytzky	72/163 X

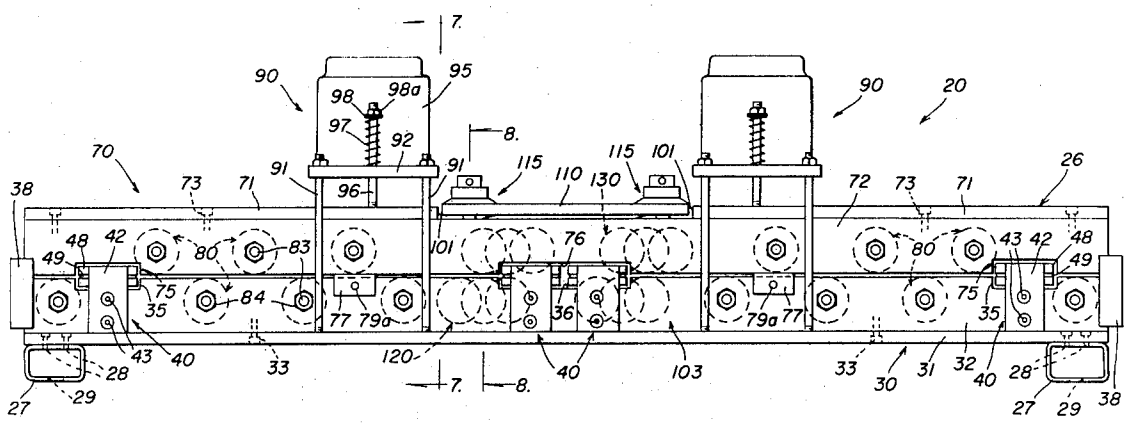
Primary Examiner—Milton S. Mehr

Attorney—Prangley, Clayton, Mullin, Dithmar & Vogel

[57] **ABSTRACT**

A metal strip conditioner includes a guide roll carriage for supporting a metal strip for longitudinal movement along a predetermined planar datum path and having a work section intermediate the ends thereof, a rectangular work platen mounted on the carriage above the work section and having four adjusting screws respectively mounted at the corner sections thereof for independently adjusting the positions thereof with respect to the datum path throughout a range of strip working positions, and a first assembly of edge and center working rolls carried by the platen and adjustable therewith toward and away from a like second assembly of working rolls carried by the work section of the guide carriage, the rolls of the first and second assemblies being so arranged that different combinations of edge and center working of the strip may be achieved by appropriate individual adjustment of the four drive assemblies; auxiliary guide rollers are provided adjacent to the working rolls for maintaining the unworked sections of the strip in the datum path.

24 Claims, 12 Drawing Figures



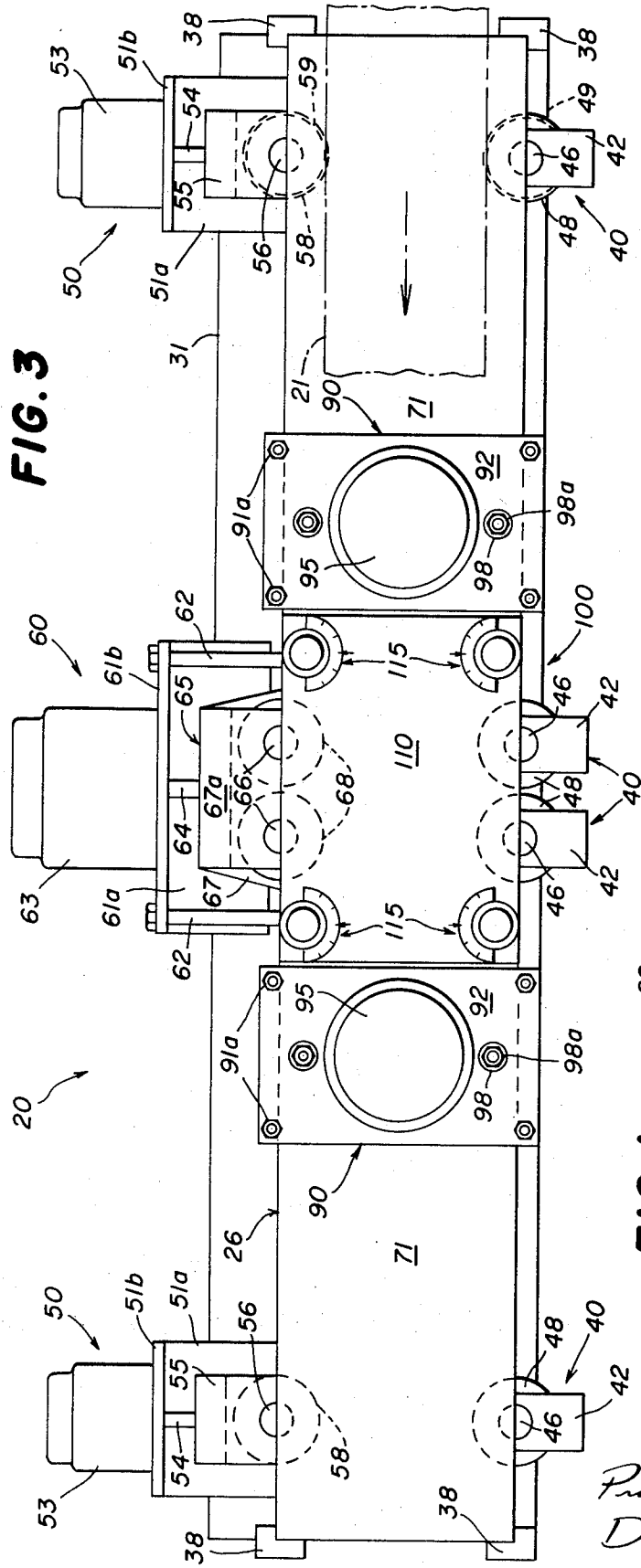


FIG. 3

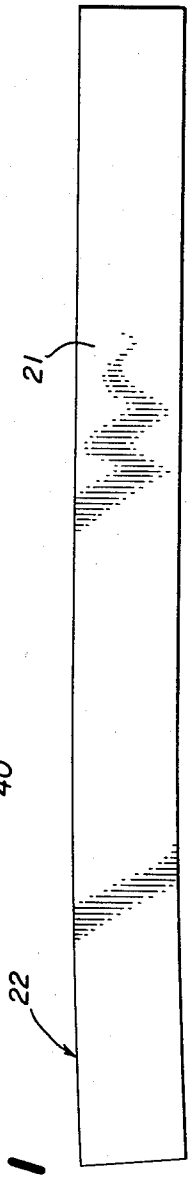


FIG. 1

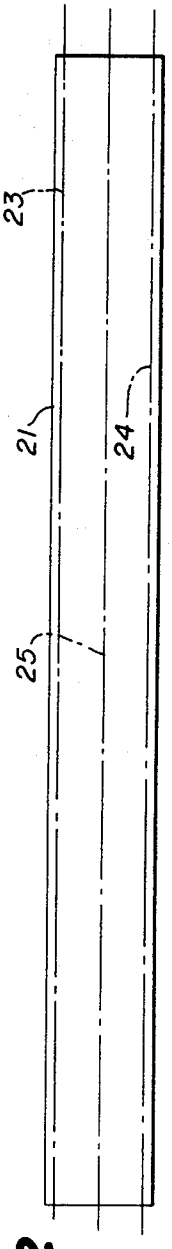


FIG. 2

INVENTOR
NAAMAN H. KEYSER

BY
Pravley, Clayton, Mullin,
Dithmar & Vogel
ATTYS.

FIG. 4

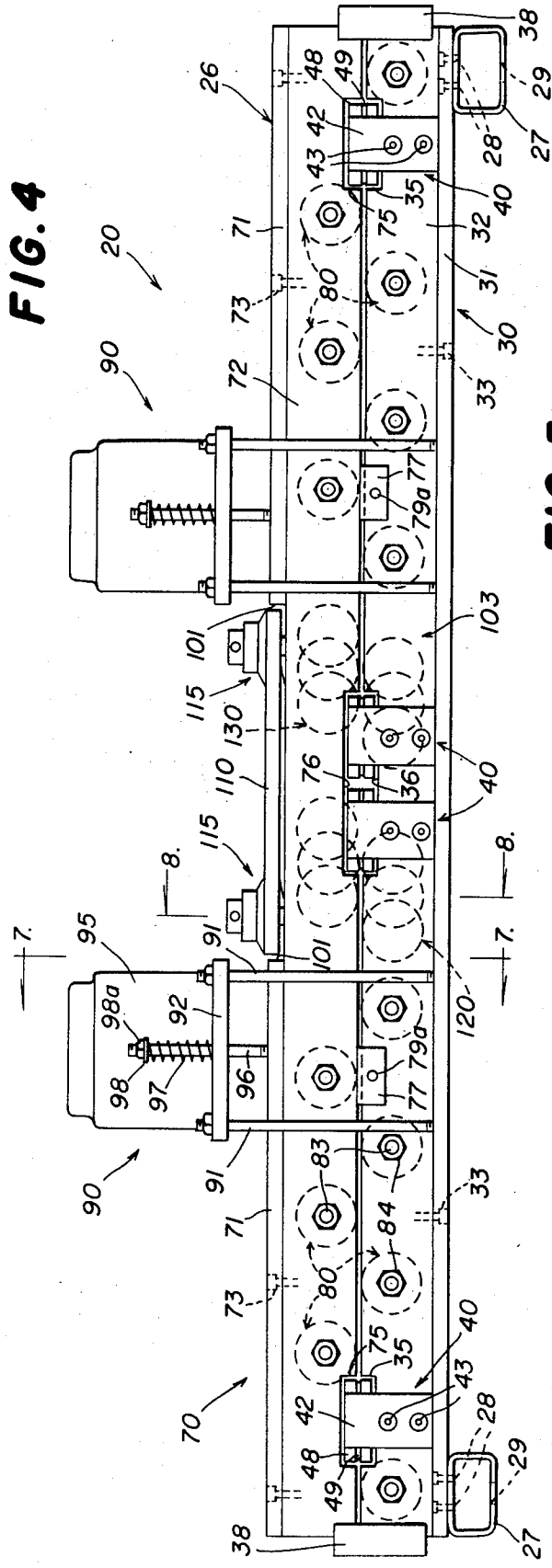


FIG. 5

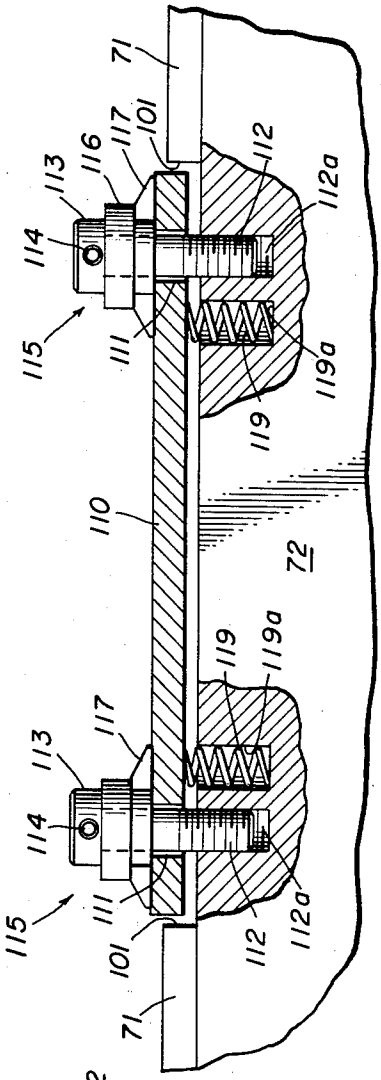


FIG. 6

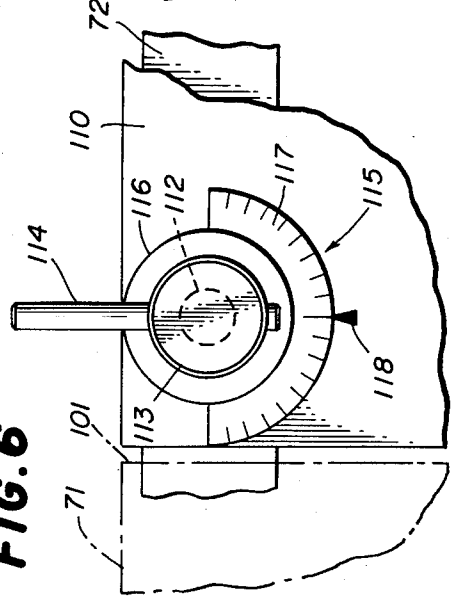


FIG. 7

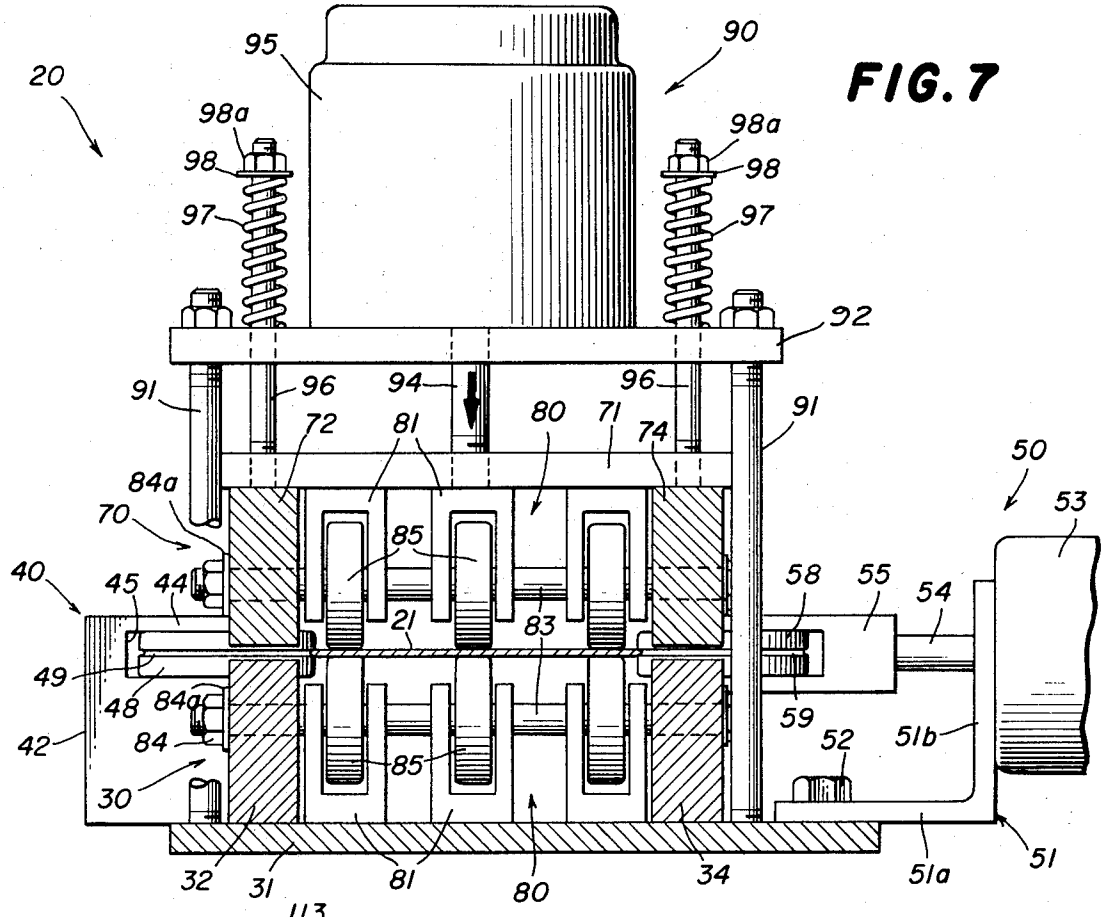

20
95
90
98a
98
97
92
91
96
94
72
81
80
71
74
84a
70
85
40
45
44
21
83
58
55
54
50
53
49
48
84a
59
52
51b
42
84
30
32
31
81
80
34
51a
51

FIG. 8

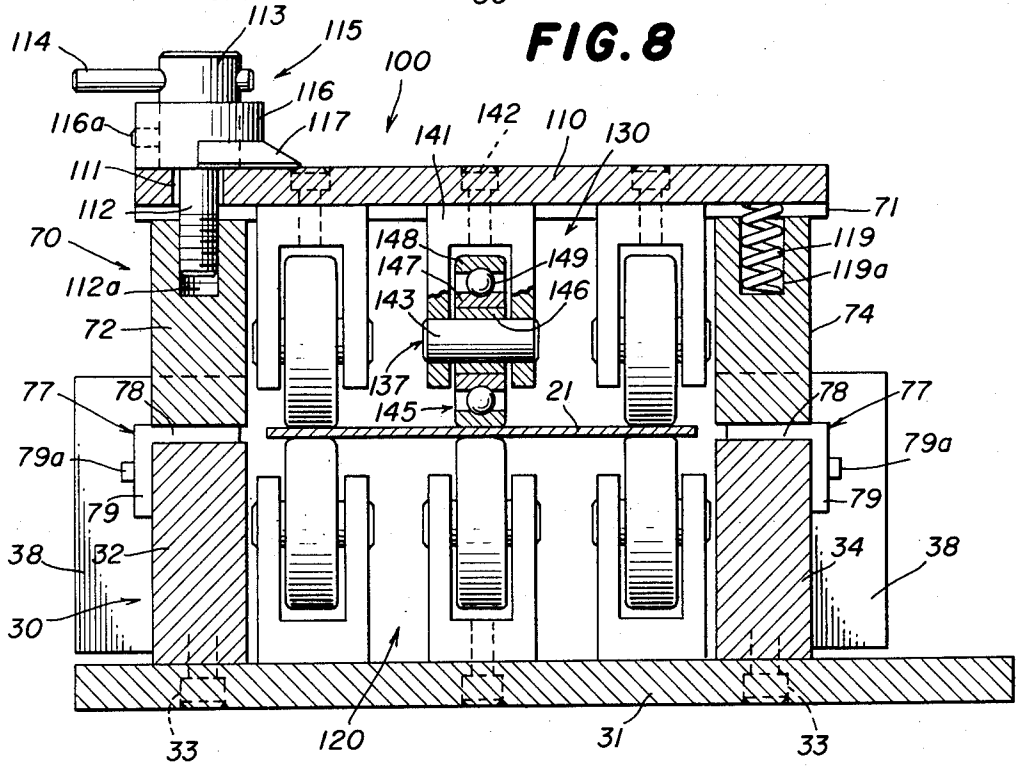

114
113
115
100
116
116a
117
141
142
110
130
111
112
71
70
148
147
149
119
119a
112a
143
146
74
72
137
145
21
77
78
79a
79
38
32
34
30
120
31
33

FIG. 9

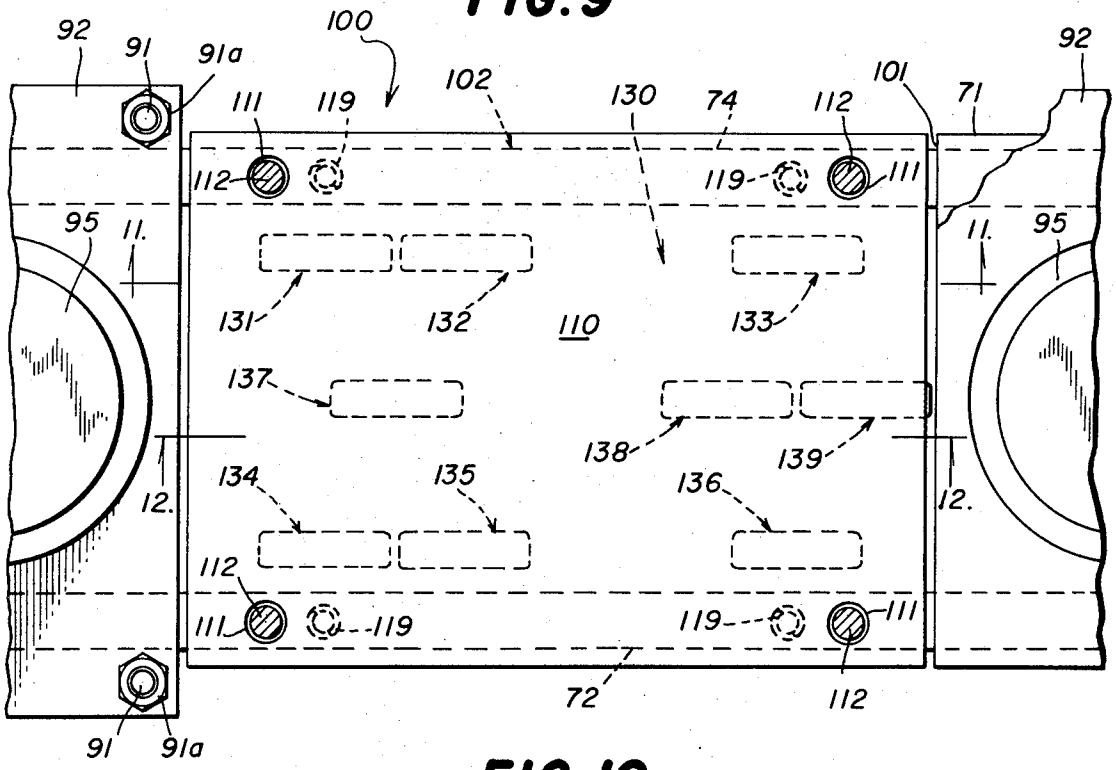

92
91
91a
100
102
111
119
130
74
112
101
71
92
112
119
111
95
11.
11.
95
131
132
110
133
137
138
139
12.
12.
134
135
136
112
111
119
119
111
72
112
91
91a

FIG. 10

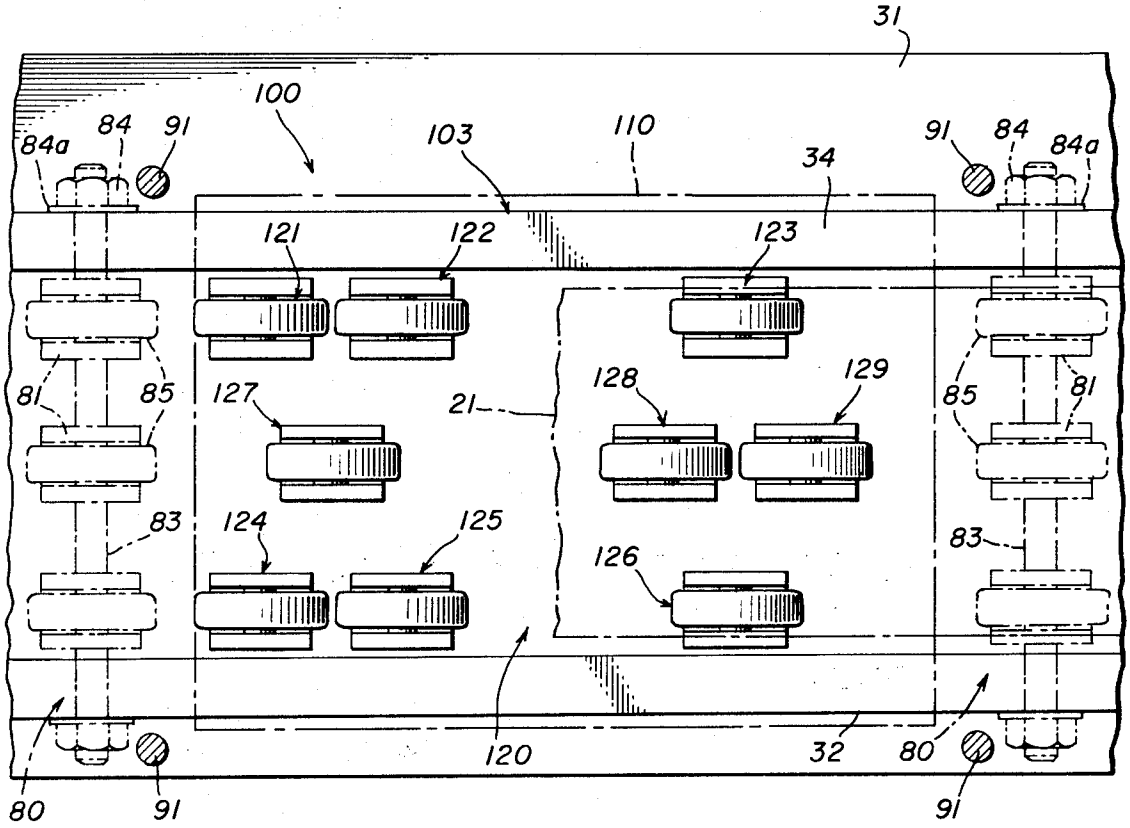

31
100
84a
84
91
103
110
34
91
84
84a
121
122
123
81
85
127
21
128
129
85
81
83
124
125
126
83
120
32
80
80
91
91

FIG. 11

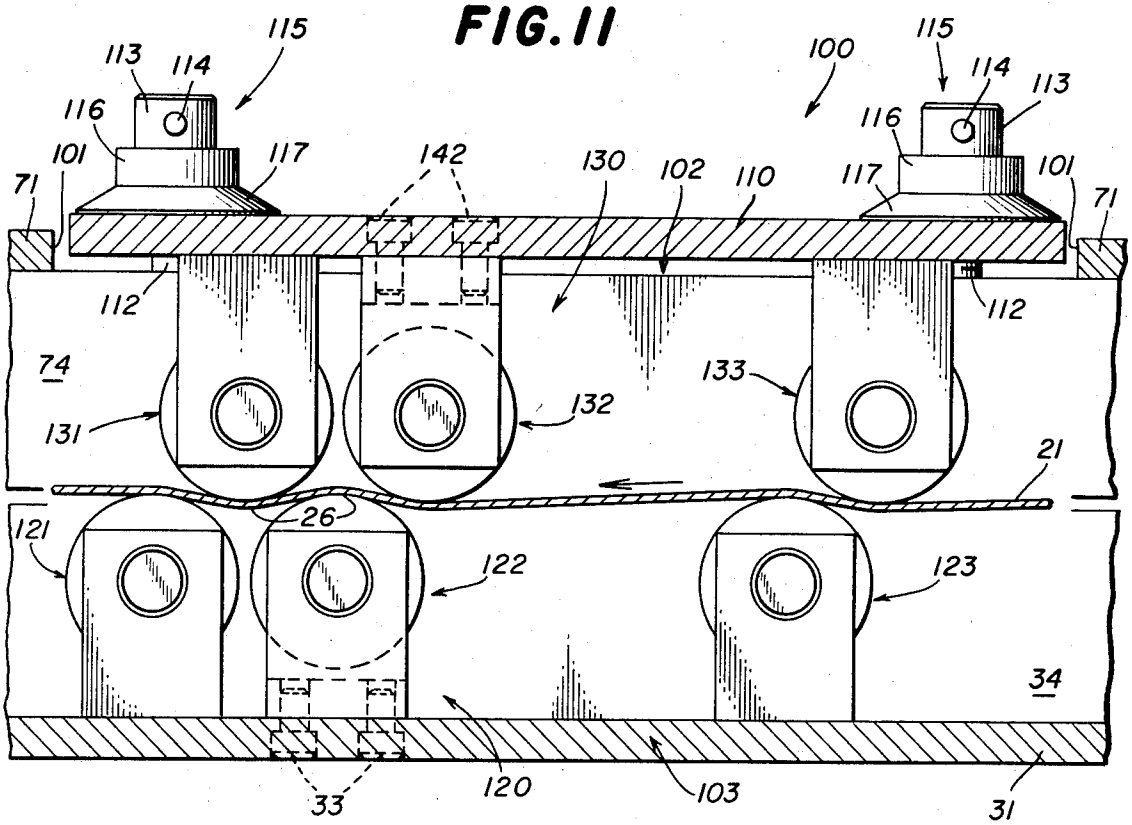
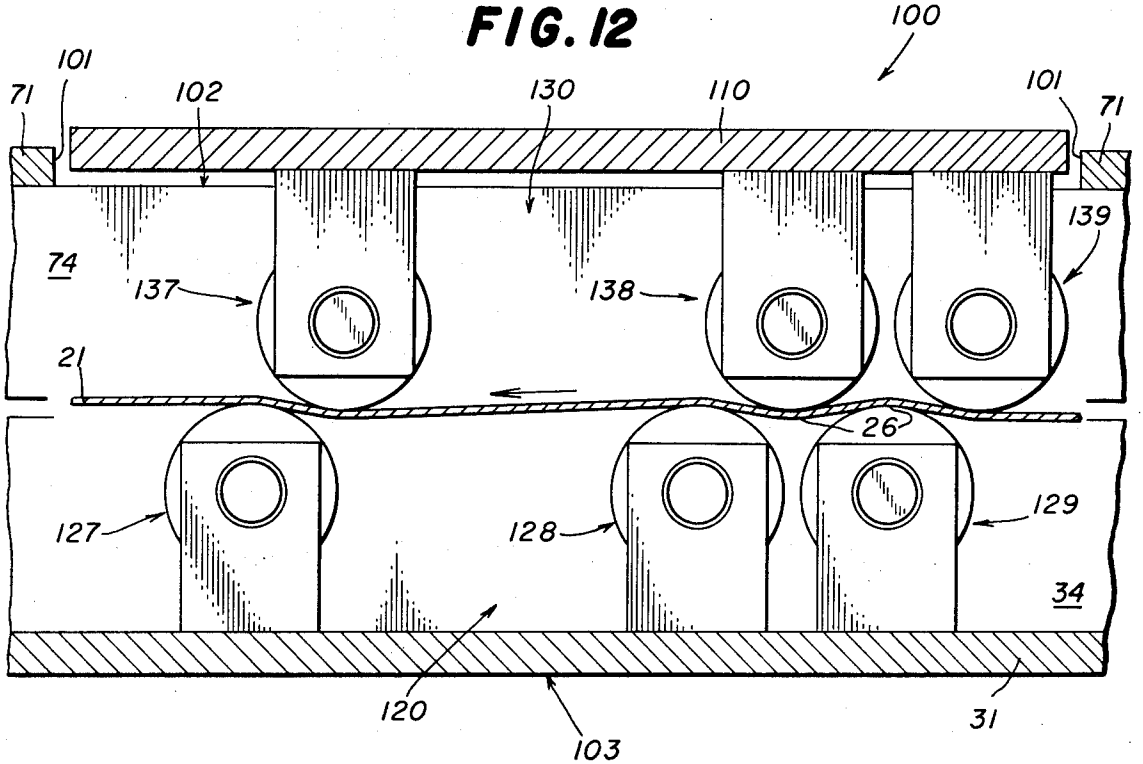

115
113
114
116
101
117
142
130
102
110
100
71
112
74
131
132
133
21
26
121
122
123
34
33
120
103
31

FIG. 12


100
101
71
102
130
110
139
74
137
138
21
26
127
128
129
34
120
103
31

ADJUSTABLE STRIP CONDITIONER

This invention relates to an improved apparatus for conditioning strip metal such as steel and the like, to redistribute therein non-uniform internal stresses whereby to produce a straightened longitudinal flat strip.

More particularly, the present invention relates to an improvement in a strip conditioning apparatus of the type disclosed in U. S. Pat. No. 3,006,401, issued Oct. 31, 1961, to James N. Wognum, Roy A. Moody, and Emil Simich, and assigned to the assignee of the present invention. This prior strip conditioning apparatus included guide means defining a planar datum path for the strip, and a plurality of individually adjustable upper and lower work rolls spaced apart longitudinally along substantially the entire length of the guide means for plastically working the strip.

It is a general object of the present invention to provide a strip conditioning apparatus wherein the work rolls are all confined to a central portion of the guide means, with the upper ones of the work rolls being carried by a movable work platen having the position thereof adjustable with respect to the guide means throughout a range range of strip working positions.

It is an important object of this invention to provide apparatus for conditioning an elongated metal strip comprising guide means for supporting a metal strip for longitudinal movement along a predetermined planar datum path, a work platen disposed adjacent to the guide means and having the position thereof adjustable with respect to the guide means throughout a range of strip-working positions, and a plurality of deflecting members carried by the work platen and adjustable therewith in directions substantially normal to the plane of the datum path, the deflecting members engaging the strip and cooperating with the guide means for deflecting the strip out of the plane of the datum path plastically to work the strip, adjustment in the position of the platen relative to the guide means serving to change the amount of deflection of the strip by the deflecting members for thereby adjusting the amount of work done on the strip.

It is another object of this invention to provide a conditioning apparatus of the type set forth, wherein the guide means has a strip working section provided with a plurality of first deflecting members thereon, a plurality of second deflecting members being carried by the work platen and adjustable therewith, the first and second deflecting members respectively engaging the strip along the opposite planar surfaces thereof and cooperating to effect deflection thereof out of the plane of the datum path plastically to work the strip.

Another object of this invention is to provide a conditioning apparatus of the type set forth which further includes a drive assembly coupled to the work platen for effecting controlled movement thereof toward and away from the guide means to adjust the position of the work platen.

Another object of the invention is to provide a conditioning apparatus of the type set forth, wherein the work platen is generally rectangular in shape and extends longitudinally of the guide means, and further including four drive assemblies coupled to the work platen for respectively effecting controlled movement of the four corner sections thereof toward and away from the guide means to adjust the position of the work

platen, the deflecting members including a pair of edge deflecting members disposed adjacent to one end of the platen for deflecting and plastically working the edge sections of the strip, and a center deflecting member disposed adjacent to the other end of the work platen for deflecting and plastically working the center section of the strip, each of the drive assemblies being individually operable for adjusting the position of the associated corner of the work platen to effect different combinations of the deflections of the edge and center deflecting members.

In connection with the foregoing object, it is another object of this invention to provide a conditioning apparatus of the type set forth wherein a first assembly of edge and center deflecting members are carried by the strip working section of the guide means, and a corresponding second assembly of edge and center deflecting members are carried by the work platen, the first and second deflecting members cooperating to effect deflection of the strip alternately in opposite directions out of the plane of the datum path.

A still further object of this invention is to provide a conditioning apparatus of the type set forth, which further includes center guide means for holding the center longitudinal section of the strip in the datum path at points disposed transversely of the edge deflecting members, and edge guide means for holding the edge sections of the strip in the datum path at points disposed transversely of the center deflecting member.

Further features of the invention pertain to the particular arrangement of the parts of the strip conditioning apparatus whereby the above outlined and additional operating features thereof are attained.

The invention, both as to its organization and method of operation, together with further objects and advantages thereof will best be understood with reference to the following specification taken in connection with the accompanying drawings, in which:

FIG. 1 is a top plan view of a portion of a flat metal strip having a lateral curvature or camber therein;

FIG. 2 is a top plan view similar to FIG. 1, and showing the section of strip illustrated in FIG. 1 in the straightened condition after having had the camber removed therefrom by the strip conditioner of the present invention, and indicating the longitudinal lines along which the strip is worked by the conditioner of the present invention;

FIG. 3 is a top plan view of an adjustable strip conditioner constructed in accordance with and embodying the the features of the present invention;

FIG. 4 is a side elevational view of the adjustable strip conditioner illustrated in FIG. 3;

FIG. 5 is an enlarged fragmentary side elevational view in partial section of the work platen of the adjustable strip conditioner of this invention;

FIg. 6 is a further enlarged fragmentary top plan view of one of the drive assemblies for the work platen illustrated in FIG. 5;

FIG. 7 is an enlarged view in vertical section taken along the line 7—7 in FIG. 4 and illustrating the guide rolls and one of the carriage positioning assemblies of the present invention;

FIG. 8 is a further enlarged view in vertical section taken along the line 8—8 in FIG. 4 and illustrating the work roll assemblies of the present invention;

FIG. 9 is an enlarged fragmentary top plan view, in partial section of the work platen of the present invention, illustrating the position of the platen work roll assembly;

FIG. 10 is a view, similar to FIG. 9 but with the work platen and the top plates of the upper carriage removed to show the position of the lower carriage work roll assembly;

FIG. 11 is a view in vertical section taken along the line 11—11 in FIG. 9 and illustrating the cooperation of the upper and lower outboard edge working rolls of the present invention; and

FIG. 12 is a view in vertical section taken along the line 12—12 in FIG. 9, and illustrating the cooperation of the upper and lower center working rolls of the present invention.

Referring now to the drawings and in particular to FIGS. 1 and 2 thereof, there is illustrated in FIG. 1 a section of metal strip 21 having a lateral curvature or chamber therein, as illustrated at 22. The nature and causes of this lateral deformation are discussed in the aforementioned U. S. Pat. No. 3,006,401, the disclosure of which is incorporated herein by reference. In FIG. 2, there is illustrated the section of metal strip in a straightened condition produced by removal of the chamber therefrom. This straightening operation entails plastic working of the strip along the opposite side edge sections thereof, as illustrated by lines 23 and 24, and along the center section thereof as illustrated by line 25. This working of the center and edge sections of the strip is brought about by applying tensional forces greater than the elastic limit of the material to these sections of the strip, all as is explained in great detail in the aforementioned U. S. Pat. No. 3,006,401.

Referring now to FIGS. 3 to 12 of the drawings, there is illustrated an adjustable strip conditioning machine, generally designated by the numeral 20, constructed in accordance with and embodying the features of the present invention for plastically working the edge and center sections of a metal strip 21 in the manner described above. The conditioning machine 20 includes a lower carriage 30 and an upper carriage 70 assembled one above the other, the entire apparatus being mounted on a pair of base members 27, respectively disposed at the opposite ends of the machine 20. Each of the base members comprises a generally tubular structural member 27, substantially rectangular in transverse cross section, and secured by means of bolts 28 to the bottom of the machine 20. Each of the base members 27 is also provided with a swivel opening 29 therein for receiving therethrough a pivot pin, to facilitate the mounting of the machine 20 in a strip processing line between other pieces of strip processing equipment. The lower carriage 30 includes a flat elongated, substantially horizontal bottom plate 31, and a pair of laterally spaced-apart upstanding side plates 32 and 34, respectively disposed substantially normal to the bottom plate 31 adjacent to the opposite side edges thereof and secured thereto by means of bolts 33. Each of the side plates 32 and 34 is provided with a pair of recesses 35 respectively disposed in the upper edge thereof adjacent to the opposite ends thereof, and a center recess 36 disposed in the upper edge thereof substantially midway between the ends thereof, the center recess 36 having a length approximately twice the length of one of the end recesses 35. Respectively secured to the opposite ends of each of the side plates 32 and 34 by suitable fasteners (not shown) are four end retainers 38, each of the retainers 38 being in the form of an angle bracket having one leg disposed along the outer side surface of the associated side plate 32 or 34 and the other leg thereof disposed along the end surface of the associated side plate, each of the end retainers 38 extending upwardly a slight distance beyond the upper edge of the associated side plate 32 or 34.

The lower carriage 30 is provided with a plurality of edge-engaging guide roll assemblies 40 along one side thereof (the left-hand side as viewed in FIG. 7). For convenience, this side of the conditioning machine 20 will hereinafter be referred to as the outboard or operator's side, while the opposite side of the machine 20 will be referred to as the inboard side. Preferably, four of the edge-engaging guide roll assemblies 40 are provided, with one assembly being disposed adjacent to each of the recesses 35 and with two of the assemblies 40 being disposed side-by-side adjacent to the recess 36. The roll assemblies 40 are all identically constructed, whereby the same reference numerals have been applied to like parts of each. Each of the roll assemblies 40 includes a mounting block 42 secured to the outer surface of the side plate 32 by suitable bolt and nut assemblies 43. The block 42 is provided with a generally rectangular shaped recess 45 on the inner surface thereof adjacent to the upper end thereof, thereby defining an upper flange or lip 44 which extends inwardly above the associated recesses 35 or 36. Preferably, the lower edge of the recess 45 is substantially coplanar with the lower edge of the associated recess 35 or 36 in the side plate 32, and cooperates therewith to define a mounting recess for a guide roll 58, mounted for rotation about a vertically extending pivot pin 46 journaled in the block 42. The guide roll 48 is provided with a groove 49 extending circumferentially around the outer surface thereof for accommodating therein the adjacent edge of the metal strip 21 as it passes through the conditioning machine 20, as is best illustrated in FIG. 7. It will be noted that the central recess 36 in the side plate 32 has a width sufficient to accommodate two of the roll assemblies 40 arranged side-by-side.

Arranged along the inboard side of the lower carriage 30, directly opposite the end ones of the roll assemblies 40, are two edge-engaging roll assemblies 50, the roll assemblies 50 being identically constructed wherefor the same reference numerals have been applied to like parts of each. Each of the roll assemblies 50 includes an angle mounting bracket 51 having a horizontal flange 51*a* secured by a nut and bolt assembly 52 to the upper surface of the bottom plate 31, and a vertically extending flange 51b integral with the horizontal flange 51*a* and extending upwardly therefrom at the outer end thereof. An air motor 53 is secured by suitable means to the vertically extending flange 51*b*, the air motor 53 having a piston rod 54 extending substantially horizontally through a complementary opening in the vertically extending flange 51*b* and coupled at the inner end thereof to a mounting block 55. The mounting block 55 is substantially in the form of a clevis and is provided with a vertically ex-

tending pivot pin **56** journaled therein, a guide roll **58** being mounted for rotation about the pivot pin **56**. The guide roll **58**, identical in construction to the guide rolls **48**, is provided with a groove **59** extending circumferentially about the outer surface thereof for receiving therein the adjacent edge of the metal strip **21**, as is best illustrated in FIG. **7**. In use, the piston rod **54** of the air motor **53** is retracted to the right, as viewed in FIG. **7**, for accommodating insertion of the metal strip **21** into the conditioning machine **20**. Thereafter, the air motor **53** is actuated to move the piston rod **54** thereof to the left, as viewed in FIG. **7**, thereby engaging the grooved outer surface of the guide roll **58** with the adjacent edge of the metal strip **21**.

Another edge engaging roll assembly, generally designated by the numeral **60**, is disposed along the inboard side of the lower carriage **30** adjacent to the center recess **36** in the side plate **34**. The roll assembly **60** includes an angle mounting bracket **61** having a horizontally extending flange **61***a* secured by suitable means to the bottom plate **31**, and a vertically extending flange **61***b* integral with the horizontally extending flange **6***a* and extending upwardly therefrom at the outer end thereof. A pair of bracing bolts are received through complementary openings at the opposite ends of the vertically extending flange **61***b* adjacent to the upper edge thereof, the bolts **62** extending substantially horizontally and parallel to each other and having the inner ends thereof threadedly engaged with the side plate **34**. An air motor **63** is also secured to the vertically extending flange **61***b* by suitable means, the air motor **63** having a piston rod **64** extending substantially horizontally through a complementary opening in the vertically extending flange **61**b and being coupled at the inner end thereof to a mounting block **65**. The mounting block **65** is in the form of a clevis and has a width approximately twice the width of the mounting blocks **55**. More particularly, the mounting block **65** includes a substantially horizontal lower flange **67** generally trapezoidal in shape and a substantially rectangular horizontal upper flange **67** *a*. Extending vertically between the flanges **67** and **67** *a* and journaled therein are a pair of parallel pivot pins **66**, each of the pins **66** having rotatably mounted thereon a guide roll **68**, the guide rolls **68** being identical in construction to the guide rolls and being disposed directly opposite the center two thereof. In operation, the roll assembly **60** is operated in the same manner as the roll assemblies **50** described above. Thus, after the metal strip **21** has been inserted in the conditioning machine **20**, the air motors **53** and **63** are all actuated to move the grooved guide rolls **58** and **68** into engagement with the inboard edge of the metal strip **21**, and moving the metal strip **21** laterally into engagement with the grooved guide rolls **48** on the outboard roll assemblies **40**. Thus, the roll assemblies **40**, **50** and **60** all cooperate to securely and accurately position the metal strip **21** in a predetermined straight datum path, as will be described in greater detail below, the side edges of the strip **21** being received in the grooves **49**, **59** and **69** of the guide rolls **48**, **58** and **68**, respectively, to prevent flattening of the side edges of the strip **21**.

The upper carriage **70** is disposed immediately above the lower carriage **30** and includes a pair of substantially horizontally disposed rectangular top plates **71**, spaced apart longitudinally of the machine **20**. A pair of side plates **72** and **74** are also provided, identical in construction to and respectively disposed in vertical alignment with the side plates **32** and **34** of the bottom carriage **30**, each of the side plates **72** and **74** being secured to the top plates **71** by bolts **73**. Each of the side plates **72** and **74** is provided with recesses **75** and **76** in the lower edge thereof, respectively identical to the recesses **35** and **36** in the side plates **32** and **34**, and disposed in facing relationship therewith. Thus, the recesses **75** and **76** respectively cooperate with the recesses **35** and **36** to accommodate the guide rolls of the roll assemblies **40**, **50** and **60**. A plurality of spacers **77** are also provided along the side plates **32** and **34** of the bottom carriage **30**, each of the spacers **77** being in the form of an angle bracket having a horizontal flange **78** overlying the upper edge of the associated side plate **32** or **34** and a vertical flange **79** extending downwardly from the outer end of the horizontal flange **78** along the outer surface of the associated side plate **32** or **34**. Each of the spacers **77** is secured to the associated side plate **32** or **34** by a bolt **79***a* extending through a complementary opening in the vertical flange **79** and threadedly engaged with the associated side plate. Thus, in use, the spacers **77**, which are preferably spaced apart longitudinally of the lower carriage **30**, serve to separate the lower carriage **30** from the upper carriage **70** by a predetermined distance equal to the thickness of the horizontal flanges **78**, all for a purpose to be described hereinafter. It will be noted that, when the upper carriage **70** is disposed in place on the spacers **77** above the lower carriage **30**, the opposite ends of the upper carriage **70** are received within the upper ends of the end retainers **38** for preventing longitudinal or lateral movement of the upper carriage **70** with respect to the lower carriage **30**.

Each of the carriages **30** and **70** is provided with a plurality of longitudinally spaced-apart guide roll assemblies, generally designated by the numeral **80**. The guide roll assemblies **80** are so arranged that those in the upper carriage **70** are staggered with respect to those in the lower carriage **30**. The guide roll assemblies **80** are all identically constructed, whereby the same reference numerals have been applied to like parts of each and only one will be described in detail. Referring, e.g., particularly to FIGS. **7** and **10** of the drawings, one of the guide roll assemblies **80** on the lower carriage **30** is illustrated, the assembly **80** including three spaced-apart clevis brackets **81** aligned transversely of the associated carriage **30** between the side plates **32** and **34** thereof, each of the clevis brackets **81** having the bight portion thereof secured to the inner surface of the bottom plate **31** by a suitable fastener. An axle shaft **83** extends transversely through complementary aligned openings in the legs of the three clevis brackets **81** and through complementary openings in the side plates **32** and **34**, the axle shaft **83** being in the form of a bolt having a head disposed along the outer surface of the side plate **34** and being provided at the other end thereof with a nut **85** and a washer **85***a* along the outer surface of the side plate **32**. Mounted for rotation about the axial shaft **83** are three guide rolls **85** respectively mounted between the legs of the clevis brackets **81**, the guide rolls **85** all being identically constructed. The guide rolls **85** on the lower carriage **30**

are all dimensioned and positioned so that the upper edges of the circumferential surfaces thereof all lie in a common horizontal plane; similarly, the guide rolls **85** on the upper carriage **70** are dimensioned and positioned so that the lower edges of the circumferential surfaces thereof all lie in a common horizontal plane spaced above the horizontal plane of the bottom carriage guide rolls **85** by a distance substantially equal to the thickness or gauge of the metal strip **21** to be worked. Thus, the guide rolls of the upper and lower carriages **30** and **70** cooperate to define a substantially horizontal planar datum path for the metal strip **21**.

Each of the top plates **71** of the upper carriage **70** is also provided with a carriage positioning assembly, generally designated by the numeral **90**, the carriage positioning assemblies **90** cooperating to firmly hold the upper carriage **70** in position with respect to the lower carriage **30**. The carriage positioning assemblies **90** are identically constructed, whereby the same reference numerals have been applied to like parts of each. Referring in particular to FIGS. **3**, **4** and **7** of the drawings, the carriage positioning assembly **90** includes four vertically extending support posts **91**, with two of the posts **91** being arranged on the inboard side of the machine **20** and two of the posts **91** being disposed on the outboard side of the machine **90**. Each of the posts **91** is threadedly engaged at the lower end thereof with the adjacent side edge of the bottom plate **31**, the upper ends of the posts **91** being respectively secured in complementary openings in the four corners of a substantially rectangular mounting plate **92**. Mounted on the upper surface of the mounting plate **92** is an air motor **95** provided with a piston rod **94** extending vertically downwardly through a complementary opening in the mounting plate **92**, and threadedly engaged at the lower end thereof with the associated top plate **71** of the upper carriage **70**.

A pair of suspension rods **96** are respectively disposed through complementary openings adjacent to the opposite sides of the mounting plate **92**, approximately midway between the adjacent pair of support posts **91**. Each of the suspension rods **96** is threadedly engaged at the lower end thereof with the associated top plate **71** of the upper carriage **70** and extends vertically upwardly therefrom a substantial distance above the upper surface of the mounting plate **92** and is provided with a coil compression spring **97** disposed in surrounding relationship therewith. Each of the compression springs **97** is held under compression against the upper surface of the mounting plate **92** by a washer **98** and a nut **98***a*. The compression springs **97** are so adjusted that they normally urge the suspension rods **96** upwardly for holding the upper carriage **70** suspended above the lower carriage **30** out of contact with the spacers **77** for facilitating the replacement of the spacers **77** and the threading of the metal strip **21** into the conditioning machine **20**. After the metal strip **21** has been positioned in the conditioning machine **20**, the air motors **90** are actuated to move the piston rods **94** thereof downwardly for thereby moving the upper carriage **70** downwardly into engagement with the spacers **77**. The air motors **90** are held in this actuated condition during the operation of the conditioning machine **20** for applying a high pressure to the upper carriage **70** for securely holding it in position with respect to the lower carriage **30**.

The inner ends **101** of the top plates **71** are separated by a predetermined distance and define therebetween a work section **102** of the upper carriage **70**, the work section **102** being coextensive with and immediately overlying a corresponding work section **103** of the lower carriage **30**. Disposed between the inner ends **101** of the top plate **71** is a flat, substantially rectangular work platen **110**, provided with four openings **111** respectively disposed therethrough adjacent to the four corners thereof. The work platen **110** is secured to the side plates **72** and **74** of the upper carriage **70** by means of four drive assemblies, generally designated by the numeral **115**. The drive assemblies **115** are all identically constructed, whereby the same reference numerals have been applied to like parts of each. Each of the drive assemblies **115** includes a bolt **112** extending through a corresponding one of the openings **111** and threadedly engaged in a complementary threaded opening **112***a* in the upper edge of the associated side plate **72** or **74**. Each of the bolts **112** has an enlarged head **113** having a diameter greater than the diameter of the opening **111**, whereby the head **113** is supported on the upper surface of the work platen **110**. Diametrically received through a complementary opening in the head **113** substantially normal to the longitudinal axes thereof is a lever pin **114** which serves as a handle for turning the bolt **112**. The head **113** is also provided with an annular collar **116** disposed in surrounding relationship therewith and secured thereto by means of set screws **116***a*, the collar **116** being provided with a flared flange or skirt **117** extending around approximately one half of the circumference thereof and disposed toward the center of the work platen **110**. Each of the flanges **117** has a graduated scale thereon adapted for cooperation with an indicating pointer **118** on the upper surface of the work platen **110**. Thus, as the bolt **112** is turned, the graduated scale rotates with respect to the pointer **118** and cooperates therewith to indicate the angular position of the bolt with respect to a reference position. A compression spring **119** is also provided in a complementary recess **119***a* in the upper edge of the associated side plate **72** or **74** adjacent to each of the threaded bolt openings **112***a*, the upper end of the compression spring **119** being disposed in engagement with the lower surface of the work platen **110** for urging the adjacent corner thereof upwardly away from the side plates **72** and **74**. Thus, the rotation of the bolts **112** cooperate with the associated compression springs **119** to provide a controlled upward or downward movement of the associated corner of the work platen **110**, the relative vertical position of the associated corner of the work platen **110** with respect to the side plates **72** and **74** being indicated by the graduated scale on the flange **117**.

Mounted on the lower carriage **30** in the work section **103** thereof is a lower deflecting roll assembly, generally designated by the numeral **120**, and comprising a plurality of deflecting or work rolls and guide rolls. More particularly, referring to FIG. **10** of the drawings, the deflecting roll assembly **120** comprises nine roll units of like construction, including an inboard edge front guide roll unit **121**, an inboard edge work roll unit **122**, an inboard edge rear guide roll unit **123**, an outboard edge front guide roll unit **124**, an outboard edge work roll unit **125**, an outboard edge rear guide roll unit **126**, a center front guide roll unit **127**, a

center rear guide roll unit **128** and a center work roll unit **129**. The roll units **121** to **129** are all arranged as illustrated in FIG. **10**, with the roll units **121** to **123** being disposed in longitudinal alignment adjacent to the inboard edge section of the strip **21**, with the roll units **124** to **126** being disposed in longitudinal alignment adjacent to the outboard edge section of the strip **21** and with the roll units **127** to **129** being disposed in longitudinal alignment adjacent to the longitudinal center line of the strip **21**. It will be noted that the edge-working roll units **122** and **125** are disposed adjacent to the front end of the work section **103**, while the center-working roll unit **129** is disposed adjacent to the rear end of the work section **103**. Each of the work roll units **121** to **129** extends upwardly from the bottom plate **31** toward the planar datum path for the strip **21** defined by the guide roll assemblies **80**, as described above.

Similarly, the work platen **110** has mounted thereon an upper deflecting roll assembly, generally designated by the numeral **130**, and including a plurality of work roll units and guide roll units, respectively identical in construction to the roll units **121** to **1229** and arranged in a like pattern. However, the upper work roll assembly **130** is offset a slight distance rearwardly of the lower work roll assembly **120** by a distance substantially equal to the radius of one of the roll units **121** to **129**. More particularly, the upper work roll assembly **130** comprises nine roll units including an inboard edge work roll unit **131**, an inboard edge front guide roll unit **132**, an inboard edge rear guide roll unit **133**, an outboard edge work roll unit **134**, an outboard edge front guide roll unit **135**, an outboard edge rear guide roll unit **136**, a center front guide roll unit **137**, a center work roll unit **138** and a center rear guide roll unit **139**. It will be noted that the arrangement of the work roll assembly **130** is substantially identical to the arrangement of the work roll assembly **120**, with the exception that the positions of the inboard edge front guide roll unit and work roll unit have been interchanged, the positions of the outboard edge front guide roll unit and work roll unit have been interchanged, and the position of the center front guide roll unit and work unit have been interchanged. Each of the roll units **131** to **139** is secured to the inner surface of the work platen **110** and extends downwardly therefrom toward the planar datum path of the strip **21** defined by the guide roll assemblies **80**.

As indicated above, the roll units **121** to **129** and **131** to **139** are all of like construction, whereby only one will be described in detail. Referring, e.g., to FIGS. **8** of the drawings, it will be seen that the center front guide roll unit **137** includes a clevis mounting bracket **141** having the bight thereof secured by a bolt **142** to the inner surface of the work platen **110**. Extending between the arms of the clevis **141** and journaled in complementary openings therein is a stub shaft **143** having the axis thereof disposed substantially horizontally, transversely of the upper carriage **70**. A guide roll **145** is mounted between the legs of the clevis **141** for rotation about the axis of the shaft **143**, the guide roll **145** having a hub **146** disposed in surrounding relationship with and secured to the shaft **143**. Secured to the outer surface of the hub **146** is an annular inner race **147** cooperating with an annular outer race **148** for confining a circular array of ball bearings **149** therebetween. The rolls in the assemblies **120** and **130** disposed along one side edge of the strip **21** are, respectively, arranged coaxially with the corresponding rolls of the same assembly disposed along the opposite side edge of the strip **21**.

Each of the guide roll units **121**, **123**, **124**, **126**, **127** and **128** is so arranged that the upper edge of the circumferential surface thereof lies in the horizontal plane defined by the upper edges of the lower guide rolls **85**. On the other hand, each of the work roll units **122**, **125** and **129** is so positioned that the upper edge of the circumferential surface thereof extends upwardly beyond the horizontal plane defined by the lower guide rolls **85**, whereby the work rolls **122**, **125** and **129** will serve to deflect the adjacent portions of the metal strip **121** upwardly out of the datum path thereof. In like manner, the work platen **110** is normally positioned so that the lower edges of the circumferential surfaces of the guide rolls **132**, **133**, **135**, **136**, **137** and **139** all lie in the horizontal plane defined by the upper guide rolls **85**, while the lower edges of the circumferential surfaces of the work rolls **131**, **134** and **138** extend downwardly below the horizontal surface defined by the upper guide rolls **85**, thereby to deflect the adjacent portion of the metal strip **21** downwardly out of the datum path thereof. Thus, referring to FIGS. **11** and **12** of the drawings, it will be seen that the lower work rolls **122**, **125** and **129** cooperate with the upper work rolls **131**, **134** and **138** to deflect the adjacent edge and center sections of the strip **21** alternately upwardly and downwardly out of the datum path in a sinuous manner for plastically working these sections of the strip **21**. The guide rolls **127** and **137** serve fundamentally to hold the center section of the strip **21** in the datum path, while the inboard and outboard edge sections thereof are being worked by the work rolls **122**, **125**, **131** and **134**. Similarly, the guide rolls **123**, **126**, **133** and **136** serve fundamentally to hold the edge sections of the metal strip **21** in the datum path while the center section thereof is being worked by the work rolls **129** and **138**.

It should be observed that, while the upper guide rolls **132**, **133**, **135**, **136**, **137** and **139** are normally disposed as described above, whereby they cooperate to define the datum path of the metal strip **21**, if the work platen **110** is moved downwardly from this normal position, the lower edges of these guide rolls will be disposed below the datum path, whereby these guide rolls will also deflect and work the adjacent sections of the metal strip **21**, thereby enhancing the operation of the machine **20**.

The operation of the conditioning machine **20** will now be described in detail. The conditioning machine **20** will normally be used in conjunction with other strip processing equipment, such as a strip leveler and a roll former. The assembled carriages **30** and **70** are inserted in position in the strip processing line with suitable mounting pins inserted through the openings **29** in the base members **27**. Air conduits are then connected from a suitable source of pressurized air through a main supply valve and appropriate pressure gages to the various air motors **53**, **63** and **90** for pneumatic operation thereof. With the air motors all deactuated, the upper carriage **70** is suspended by the suspending rods **96** above the lower carriage **30**, as described above. The

proper size spacers **77** are then fixed to the side plates **32** and **34** of the lower carriage **30**, a plurality of different size spacers normally being provided for use with different gauges of strip metal to be processed. At this point, the air valve may be closed and the air motors actuated for checking the spacers **77** for proper setting of the upper and lower carriages **70** and **30** with respect to each other and for checking the air pressure in the air motors **53** and **63**. After deactuating of the air motors, the leading end of the metal strip **21** is then threaded between the upper and lower carriages **70** and **30** in the direction of the arrow in FIG. **3**. The leading end of the metal strip **21** may then be threaded into the adjacent processing apparatus on the line, which processing apparatus will normally be used to pull the metal strip **21** through the strip conditioner **20**. At this point, the air valve is again closed, thereby actuating the air motor **53**, **63** and **90** for laterally positioning the metal strip **21** between the edge guide rolls of the roll assemblies **40**, **50** and **60** and for positioning the upper and lower carriages **70** and **30** with respect to each other so that the guide rolls **85** thereof cooperate to define the planar datum path for the metal strip **21**. Preferably, the drive assembly **115** of the work platen **110** will have been previously set to experimentally determined settings for the particular gauge and width of strip being conditioned. Normally, each of the drive assemblies **115** will be adjusted to the same setting so that the work platen **110** is perfectly level to effect the proper combination of edge section and center section working of the metal strip **21**.

However, it will be appreciated that in certain circumstances it may be desirable to vary the amount of work done on the different sections of the strip **21**. It is an important feature of the present invention that the work platen **110** is adapted for quick, easy and accurate adjustment of the combination of edge and center working to be done on the strip **21**. For example, if it is desired to increase the amount of work done on the center section of the strip **21**, it is only necessary to rotate the rear ones of the bolts **112** to lower the rear end of the work platen **110** and, thereby, lower the center work roll **138** a sufficient distance to achieve the desired additional deflection of the center section of the strip **21** to perform the desired additional work thereon. Similarly, the amount of center working done on the strip **21** may be decreased by raising the rear end of the work platen **110**. In like manner, the amount of edge working on the center strip **21** may be increased or decreased by respectively lowering or raising the front end of the work platen **110** for thereby altering the positions of the edge working rolls **131** and **134** with respect to the datum path.

Normally, when one end of the work platen **110** is adjusted, both of the drive assemblies **115** at that end of the work platen will be adjusted to the same setting. However, in rare circumstances, the operator may wish to work one edge of the strip more than the other edge in order to compensate for some unilateral curvature or camber in the strip **21**. This can be accomplished by simply making the appropriate adjustment in the drive assemblies on the side of the machine **20** in question. For example, if it is desired to increase the work done on the inboard edge of the strip **21**, it is only necessary to move the inboard side of the work platen downwardly with respect to the datum path. It will be noted that in making such adjustments, it normally will be necessary to maintain the differential between the settings at the front and rear ends of the work platen **110**. Thus, the front and rear drive assemblies **115** on the side of the work platen affected should be adjusted by the same amount.

It will be noted that, in making any desired adjustment in the amount of work to be done on the strip **21**, it is only necessary to rotate the bolts **112** of the drive assemblies **115** to the desired setting, an operation which can be performed by an operator in a matter of seconds. Further, it will be noted that the graduated scales on the flanges **117** of the drive assemblies **115** provide the operator with a ready reference for indicating the exact setting of the work platen **110**. Thus, if the machine **20** is changed from a first setting to a second setting, and it is later desired to return to the first setting, this latter adjustment can readily be made, since the settings are all clearly indicated on the graduated scales. Furthermore, the effect of the setting adjustments is readily apparent to the operator, since they simply involve moving one end or the other of the work platen **110** upwardly or downwardly with respect to the datum path.

In addition, it will be appropriate that the centralized location of all of the work rolls of the present invention facilitates the removal and servicing thereof. Thus, access to all of the work rolls in the work roll assemblies **120** and **130** may be had by simply removing the work platen **110**. This is an important advantage, since the work rolls are the ones which normally require the most frequent servicing and replacement, and this servicing and replacement can thus be effected without having to disassemble the whole machine.

The exact degree of adjustment necessary to correct a specific condition of the strip may easily be experimentally determined. However, there is presented below a chart indicating, in general, the direction of adjustment which must be made in each of the drive assemblies **115** for correcting a number of commonly experienced undesirable conditions in the strip **21**. In this chart, the front or edge-adjusting drive assemblies have been respectively designated "E.I." for the inboard drive assembly and "E.O." for the outboard drive assembly, and the rear or center-adjusting drive assemblies have been respectively designated as "C.I." for the inboard drive assembly and "L.O." for the outboard drive assembly. For each condition, the chart indicates the direction of change in the amount of work which must be done on each section of the strip to correct the indicated condition, it being appreciated that a lowering of the work platen by the drive assemblies will effect an increase in the work done in the corresponding section of the strip while a raising of the work platen by the drive assemblies will effect a decrease in the amount of work done on the corresponding section of the strip.

Condition	EI	EO	CI	CO
Bowing down	Less	Less	More	More
Bowing up			Less	Less
Bowing right	More	More		
Bowing left	More	More		
Right-hand twist	Less OR	More	More	More
Left-hand twist	More OR	Less	More	More

It will be appreciated that the conditioning machine **20** is usable for conditioning metal strips having widths which lie in a relatively narrow range of widths. If it is desired to condition the strips having widths outside of this narrow range, it will be necessary to utilize a different set of upper and lower carriages **30** and **70**. Accordingly, there will preferably be provided a series of different size sets of upper and lower carriages **30** and **70** for use with different widths of metal strip **21**. Thus, while three rows of work rolls are shown in the preferred embodiment of the invention, different numbers of rows of work rolls may be provided for use with different widths of metal strip.

From the foregoing, it will be seen that there has been provided an improved strip conditioning machine providing readily adjustable work rolls centralized in a single location in the conditioning machine. More particularly, there has been provided an adjustable strip conditioner including upper and lower deflecting roll assemblies, the upper deflecting roll assemblies being mounted on a movable platen having the position thereof easily adjustable.

There has also been provided novel drive assemblies for the work platen comprising screw-type mechanisms respectively disposed adjacent to the corners of the work platen for effecting a simple and accurately controlled movement of the work platen with respect to the datum path of the strip to be conditioned. Finally, there has been provided a simplified adjustable strip conditioner permitting quick and easy access to the work roll assemblies for facilitating the servicing or replacing thereof.

While there has been described what is at present considered to be the preferred embodiment of the invention, it will be understood that various modifications may be made therein, and it is intended to cover in the appended claims all such modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. Apparatus for conditioning an elongated metal strip comprising guide means for supporting a metal strip for longitudinal movement along a predetermined planar datum path, said guide means including a plurality of surface guide rolls spaced apart longitudinally of said datum path and engaging the opposite planar surfaces of the strip for vertically positioning the strip in the datum path and a plurality of edge guide rolls spaced apart longitudinally of the datum path and engaging the opposite side edges of the strip for horizontally positioning the strip in the datum path, a work platen disposed adjacent to said guide means and having the position thereof adjustable with respect to said guide means throughout a range of strip-working positions, and a plurality of deflecting members carried by said work platen and adjustable therewith in directions substantially normal to the plane of the datum path, said deflecting members engaging the strip and cooperating with said guide means for deflecting the strip out of the plane of the datum path plastically to work the strip, adjustment in the position of said platen relative to said guide means serving to change the amount of deflection of portions of the strip in registry with said work platen by deflecting members for thereby adjusting the amount of work done on the strip.

2. The apparatus set forth in claim **1**, wherein said work platen is disposed substantially parallel to the plane of the datum path intermediate the ends of said guide means.

3. The apparatus set forth in claim **1**, wherein each of said deflecting members comprises a roll mounted for rotation about an axis substantially parallel to the plane of the datum path, the circumferential surface of the roll extending into the datum path for deflecting the strip therefrom.

4. The apparatus set forth in claim **1**, wherein said work platen is disposed above and substantially parallel to the plane of the datum path, each of said deflecting members extending downwardly into the datum path for deflecting the strip downwardly out of the datum path.

5. Apparatus for conditioning an elongated metal strip comprising guide means for supporting a metal strip for longitudinal movement along a predetermined planar datum path and having a strip-working section, a plurality of first deflecting members carried by the strip-working section of said guide means, a work platen disposed adjacent to the strip-working section of said guide means and having portions thereof independently adjustable with respect to said guide means throughout a range of strip-working positions, and a plurality of second deflecting members carried by said work platen and adjustable therewith in directions substantially normal to the plane of the datum path, said first and second deflecting members respectively engaging the strip along the opposite planar surfaces thereof and cooperating to effect deflection thereof out of the plane of the datum path plastically to work the strip, adjustment of the position of the portions of said platen relative to said guide means serving to change the amount of deflection of the strip in registry with said work platen by said deflecting members for thereby adjusting the amount of work done on the strip.

6. The apparatus set forth in claim **5**, wherein each of said first and second deflecting members comprises a roll mounted for rotation about an axis substantially parallel to the plane of the datum path.

7. The apparatus set forth in claim **5**, wherein each of said first and second deflecting members comprises a roll mounted for rotation about an axis substantially parallel to the plane of the datum path, said first deflecting members being equal in number to said second deflecting members and respectively disposed adjacent to corresponding ones thereof, each of said first deflecting members being disposed above and slightly forwardly of the corresponding one of said second deflecting members and cooperating therewith to deflect the strip alternately upwardly and downwardly out of the datum path.

8. The apparatus set forth in claim **5**, wherein each of said first and second deflecting members comprises a roll mounted for rotation about an axis substantially parallel to the plane of the datum path, the axes of rotation of said first deflecting rolls being disposed above the datum path and the axes of rotation of said second deflecting rolls being disposed below the datum path.

9. The apparatus set forth in claim **5**, wherein each of said first deflecting members is fixedly secured to the guide means and fixedly positioned on the guide means with respect to the datum path.

10. Apparatus for conditioning an elongated metal strip comprising guide means for supporting a metal strip for longitudinal movement along a predetermined planar datum path, a work platen disposed adjacent to said guide means and having portions thereof independently adjustable with respect to said guide means throughout a range of strip-working positions, a drive assembly coupled to said work platen for effecting controlled and independent movement of the portions thereof toward and away from said guide means to adjust the position of said work platen, and a plurality of deflecting members carried by said work platen and adjustable therewith in directions substantially normal to the plane of the datum path, said deflecting members engaging the strip and cooperating with said guide means for deflecting the strip out of the plane of the datum path plastically to work the strip, adjustment of the position of the portions of said platen relative to said guide means serving to change the amount of deflection of the strip by said deflecting members for thereby adjusting the amount of work done on the strip.

11. The apparatus set forth in claim 10, wherein said drive assembly includes a screw coupling said work platen to said guide means, rotation of said screw in one direction effecting movement of said work platen toward said guide means and rotation of said screw in the opposite direction effecting movement of said work platen away from said guide means.

12. The apparatus set forth in claim 10, wherein said drive assembly includes bias means coupled to said guide means and to said work platen for urging said work platen away from said guide means, and a screw coupling said work platen to said guide means, rotation of said screw in one direction causing movement of said work platen toward said guide means and rotation of said screw in the opposite direction accommodating movement of said work platen away from said guide means under the urging of said bias means.

13. The apparatus set forth in claim 12, and further including an indicating gauge coupled to said screw and responsive to rotation thereof for indicating the position of said work platen relative to a predetermined reference position.

14. Apparatus for conditioning an elongated metal strip comprising guide means for supporting a metal strip for longitudinal movement along a predetermined planar datum path, a generally rectangular work platen disposed adjacent to said guide means and extending longitudinally thereof and having the position thereof adjustable with respect to said guide means throughout a range of strip-working positions, four drive assemblies coupled to said work platen for respectively effecting independent and controlled movement of the four corner sections thereof toward and away from said guide means to adjust the position of said work platen, a pair of edge deflecting members carried by said work platen adjacent to one end thereof and adjustable therewith in directions substantially normal to the plane of the datum path, said edge deflecting members respectively engaging the strip adjacent to the opposite side edges thereof and cooperating with said guide means for deflecting the strip out of the plane of the datum path plastically to work the edge sections of the strip, and a center deflecting member carried by said work platen adjacent to the other end thereof and adjustable therewith in directions substantially normal to the plane of the datum path, said center deflecting member engaging the strip adjacent to the center thereof for deflecting the center section of the strip out of the plane of the datum path plastically to work the center section of the strip, each of said drive assemblies being independently operable for adjusting the position of the associated corner of the work platen to effect different combinations of deflections of the edge and center deflecting members for thereby adjusting the amount of work done on the edge and center sections of the strip.

15. The apparatus set forth in claim 14, wherein each of said edge and center deflecting members comprises a roll mounted for rotation about an axis disposed substantially parallel to the plane of the datum path.

16. The apparatus set forth in claim 14, wherein each of said drive assemblies includes a screw coupling the associated corner of said work platen to said guide means, rotation of said screw in one direction effecting movement of the associated corner section of said work platen toward said guide means, rotation of said screw in the opposite direction effecting movement of the associated corner section of said work platen away from said guide means.

17. The apparatus set forth in claim 16, wherein each of said drive assemblies includes an indicator gauge responsive to rotation of said screw for indicating the position of the associated corner section of said work platen with respect to a predetermined reference position.

18. Apparatus for conditioning an elongated metal strip comprising guide means for supporting a metal strip for longitudinal movement along a predetermined planar datum path and having a strip working section, a pair of first edge deflecting members carried by the strip-working section of said guide means adjacent to one end thereof and respectively engaging one planar surface of the strip adjacent to the opposite side edges thereof, a first center deflecting member carried by the strip-working section of the guide means adjacent to the other end thereof and engaging said one planar surface of the strip adjacent to the center thereof, a generally rectangular work platen disposed adjacent to the strip-working section of said guide means and substantially coterminous therewith and having the position thereof adjustable with respect to said guide means throughout a range of strip-working positions, four drive assemblies coupled to said work platen for respectively effecting controlled movement of the four corner sections thereof toward and away from said guide means to adjust the position of said work platen, a pair of second edge deflecting members carried by said work platen adjacent to said first edge deflecting members and adjustable with said work platen in directions substantially normal to the plane of the datum path, said second edge deflecting members respectively engaging the other planar surface of the strip adjacent to the opposite side edges thereof and cooperating with said first edge deflecting members to effect deflection of the strip alternately in opposite directions out of the plane of the datum path plastically to work the edge sections of the strip, and a second center deflecting member carried by said work platen adjacent to said first center deflecting member and ad-

justable with said work platen in directions substantially normal to the plane of the datum path, said second center deflecting member engaging the other planar surface of the strip adjacent to the center thereof and cooperating with said first center deflecting member to effect deflection of the strip alternately in opposite directions out of the plane of the datum path plastically to work the center section of the strip, each of said drive assemblies being independently operable for adjusting the position of the associated corner of the work platen to effect different combinations of deflections of the edge and center deflecting members for thereby adjusting the amount of work done on the edge and center sections of the strip.

19. The apparatus set forth in claim **18**, wherein each of said first and second edge and center deflection members comprises a roll mounted for rotation about an axis disposed substantially parallel to the plane of the datum path, said first deflecting rolls being equal in number to said second deflecting rolls and respectively disposed adjacent to corresponding ones thereof, each of said first deflecting rolls being offset longitudinally a slight distance from the corresponding one of said second deflecting rolls and cooperating therewith to alternately deflect the adjacent section of the strip in first and second directions out of the datum path.

20. The apparatus set forth in claim **18**, wherein each of said first and second edge and center deflecting members comprises a roll mounted for rotation about an axis disposed substantially parallel to the plane of the datum path, the axis of rotation of said first guide rolls are disposed above the plane of the datum path and the axes of rotation of said second guide rolls are disposed below the plane of the datum path, said first and second guide rolls cooperating to deflect the adjacent sections of the strap alternately upwardly and downwardly out of the datum path.

21. Apparatus for conditioning an elongated metal strip comprising guide means for supporting a metal strip for longitudinal movement along a predetermined planar datum path, a work platen disposed adjacent to said guide means and extending longitudinally thereof and having the position thereof adjustable with respect to said guide means throughout a range of strip-working positions, a pair of edge deflecting members carried by said work platen adjacent to one end thereof and adjustable therewith in directions substantially normal to the plane of the datum path, said edge deflecting members respectively engaging the strip adjacent to the opposite side edges thereof and cooperating with said guide means for deflecting the strip out of the plane of the datum path plastically to work the edge sections of the strip, center guide means for holding the center longitudinal section of the strip in the datum path at points disposed transversely of said edge deflecting members, a center deflecting member carried by said work platen adjacent to the other end thereof and adjustable therewith in directions substantially normal to the plane of the datum path, said center deflecting member engaging the strip adjacent to the center thereof for deflecting the center section of the strip out of the plane of the datum path plastically to work the center section of the strip, and edge guide means for holding the edge sections of the strip in the datum path at points disposed transversely of said center deflecting member, adjustment in the position of said platen relative to said guide means serving to change the amount of deflection of the strip by said deflecting members for thereby adjusting the amount of work done on the strip.

22. The apparatus set forth in claim **21**, wherein each of said center guide means and said edge guide means includes a pair of rolls respectively disposed on opposite sides of the plane of the datum path, each pair of guide rolls cooperating fundamentally to vertically position the adjacent section of the strip therebetween in the datum path.

23. The apparatus set forth in claim **21**, and further including a plurality of auxiliary guide members respectively disposed adjacent to said edge and center deflecting members substantially in longitudinal alignment therewith for facilitating the working of the strip by the deflecting members.

24. Apparatus for conditioning an elongated metal strip comprising guide means for supporting a metal strip for longitudinal movement along a predetermined planar datum path, a generally rectangular work platen disposed adjacent to said guide means and extending longitudinally thereof and having the position thereof adjustable with respect to said guide means throughout a range of strip-working positions, four drive assemblies coupled to said work platen for respectively effecting controlled movement of the four corner sections thereof toward and away from said guide means to adjust the position of said work platen, a pair of edge deflecting members carried by said work platen adjacent to one end thereof and adjustable therewith in directions substantially normal to the plane of the datum path, said edge deflecting members respectively engaging the strip adjacent to the opposite side edges thereof and cooperating with said guide means for deflecting the strip out of the plane of the datum path plastically to work the edge sections of the strip, means for holding the center longitudinal section of the strip in the datum path at points disposed transversely of said edge deflecting members, a center deflecting member carried by said work platen adjacent to the other end thereof and adjustable therewith in directions substantially normal to the plane of the datum path, said center deflecting member engaging the strip adjacent to the center thereof for deflecting the center section of the strip out of the plane of the datum path plastically to work the center section of the strip, and means for holding the edge sections of the strip in the datum path at points disposed transversely of said center deflecting member, each of said drive assemblies being independently operable for adjusting the position of the associated corner of the work platen to effect different combinations of deflections of the edge and center deflecting members for thereby adjusting the amount of work done on the edge and center sections of the strip.

* * * * *