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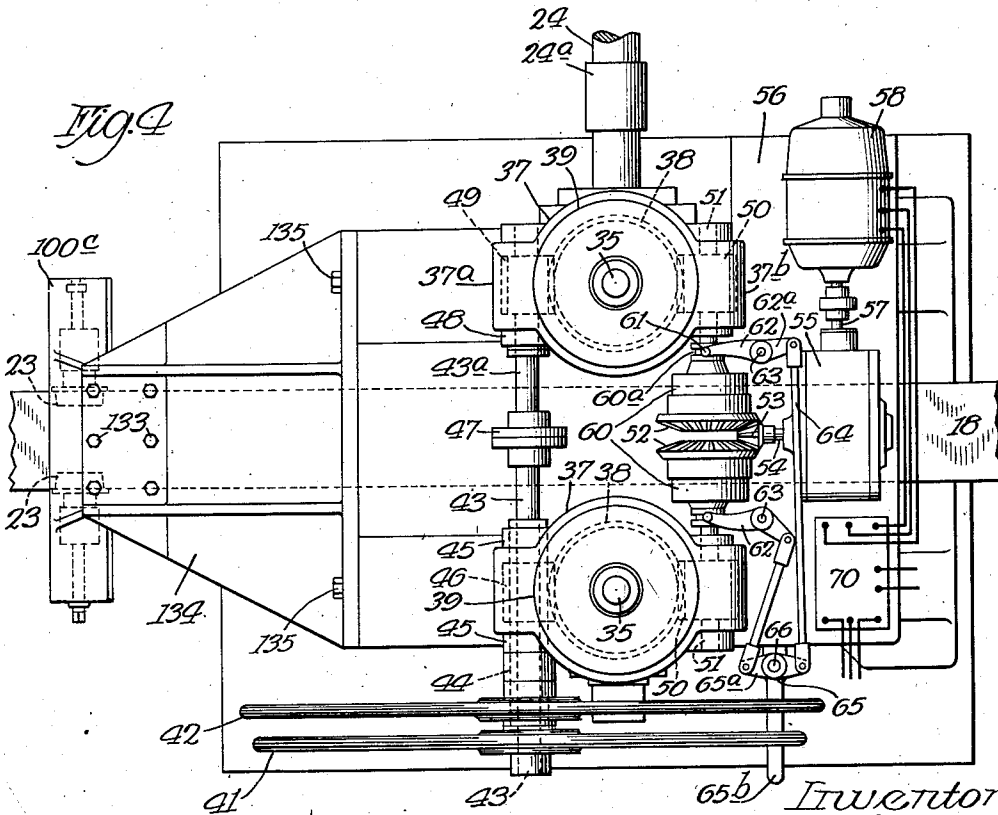
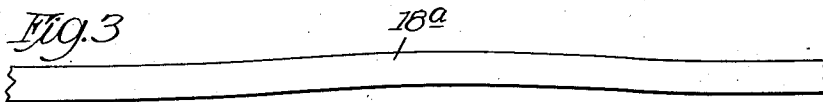
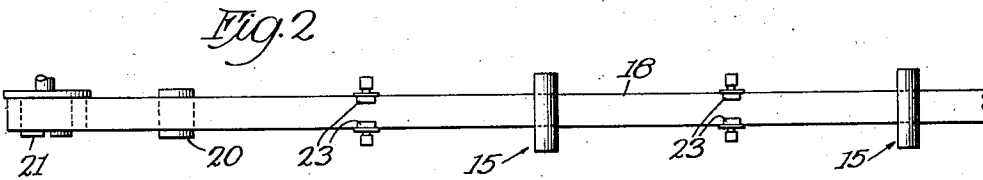
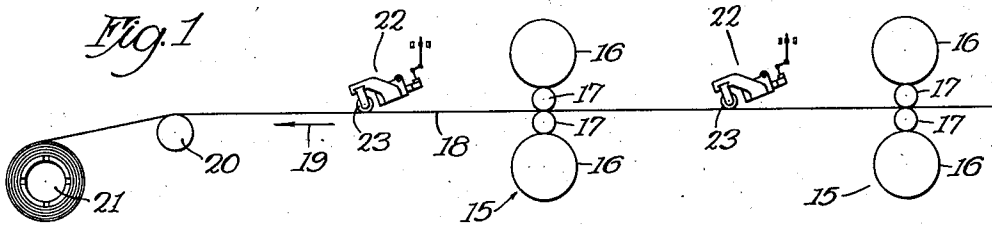
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2,292,535

STRIP ROLLING APPARATUS

Filed Aug. 19, 1938

5 Sheets-Sheet 1



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Aug. 11, 1942.

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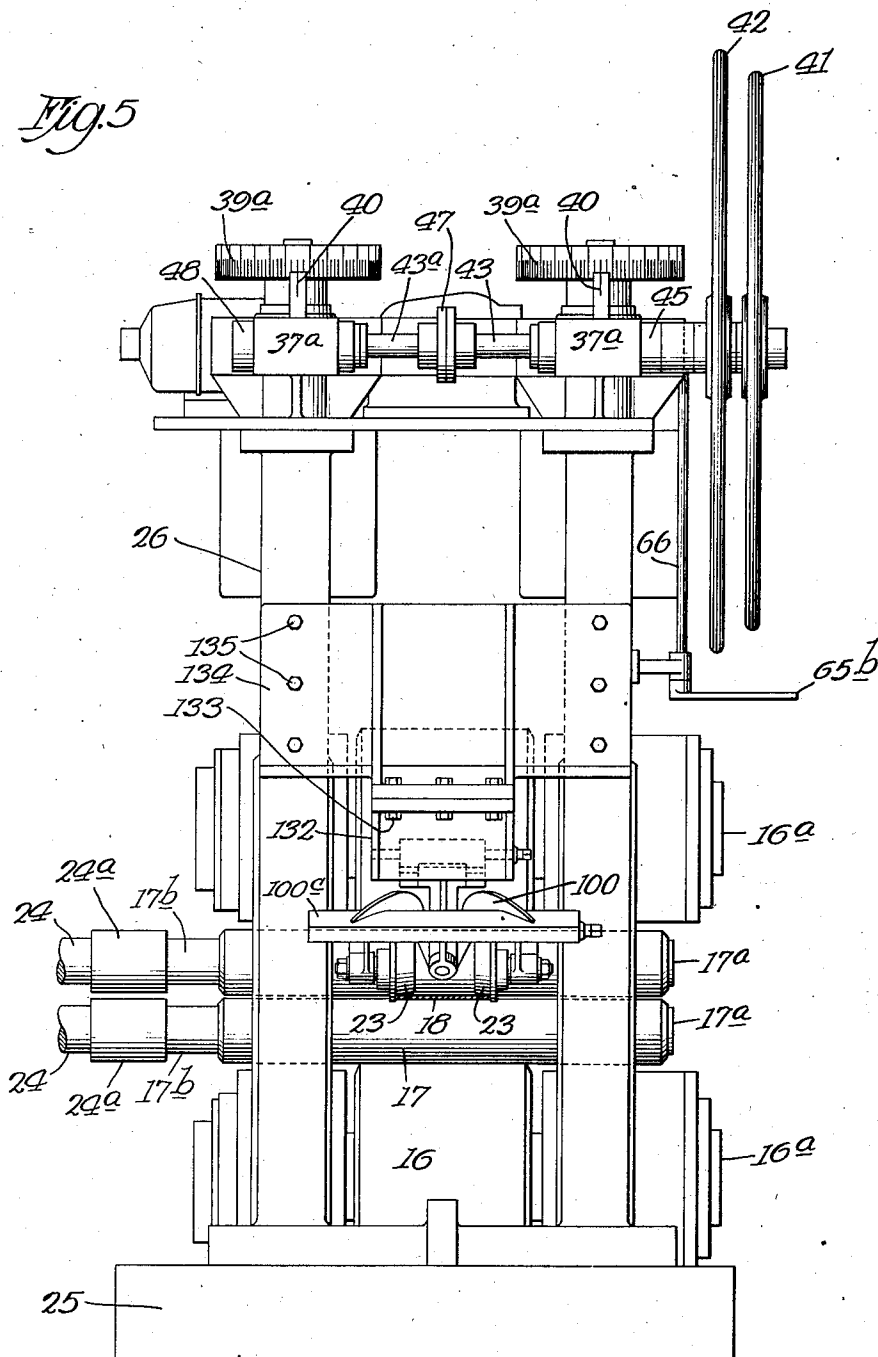
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STRIP ROLLING APPARATUS

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Fig. 5



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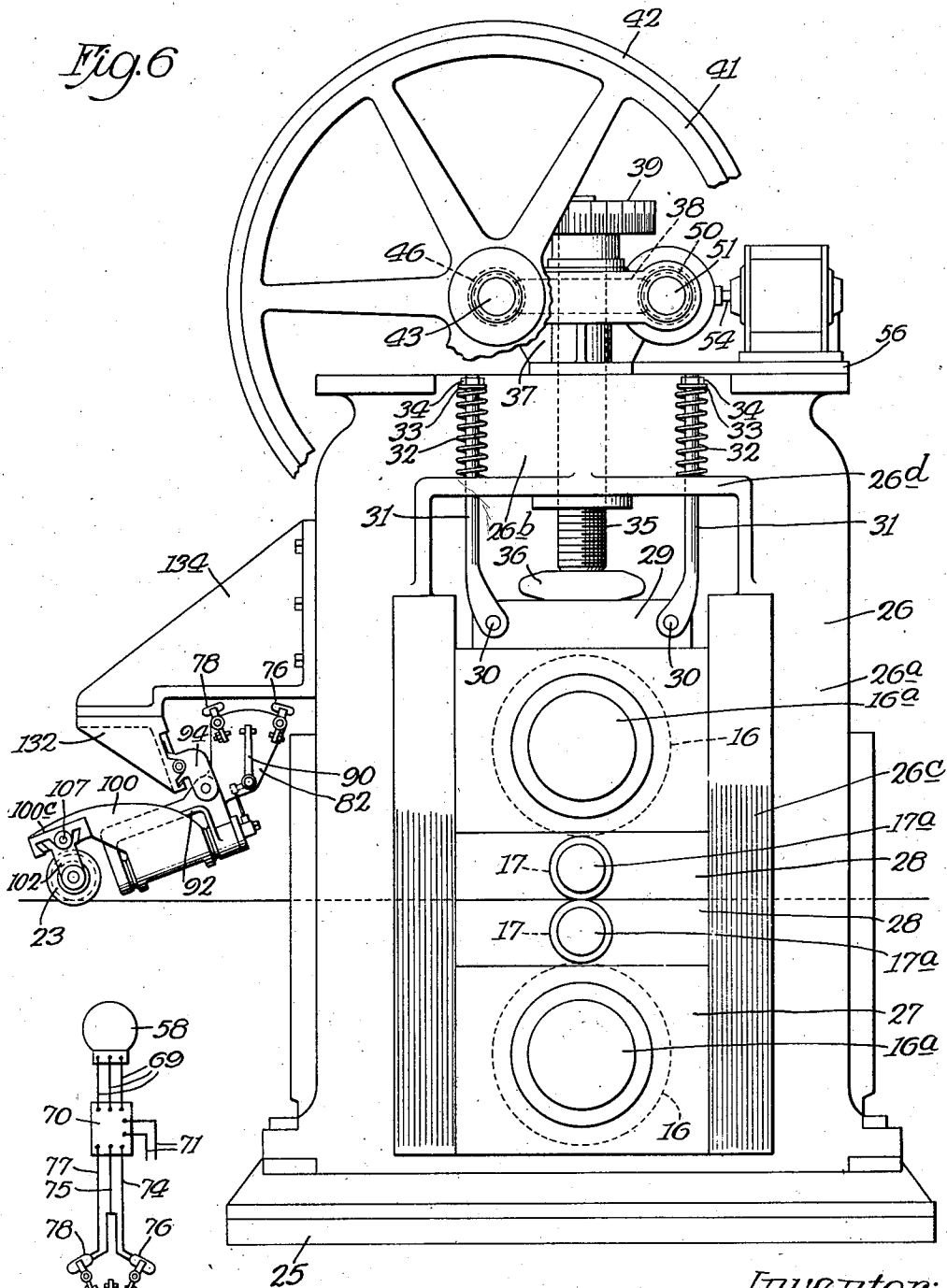


Fig. 7

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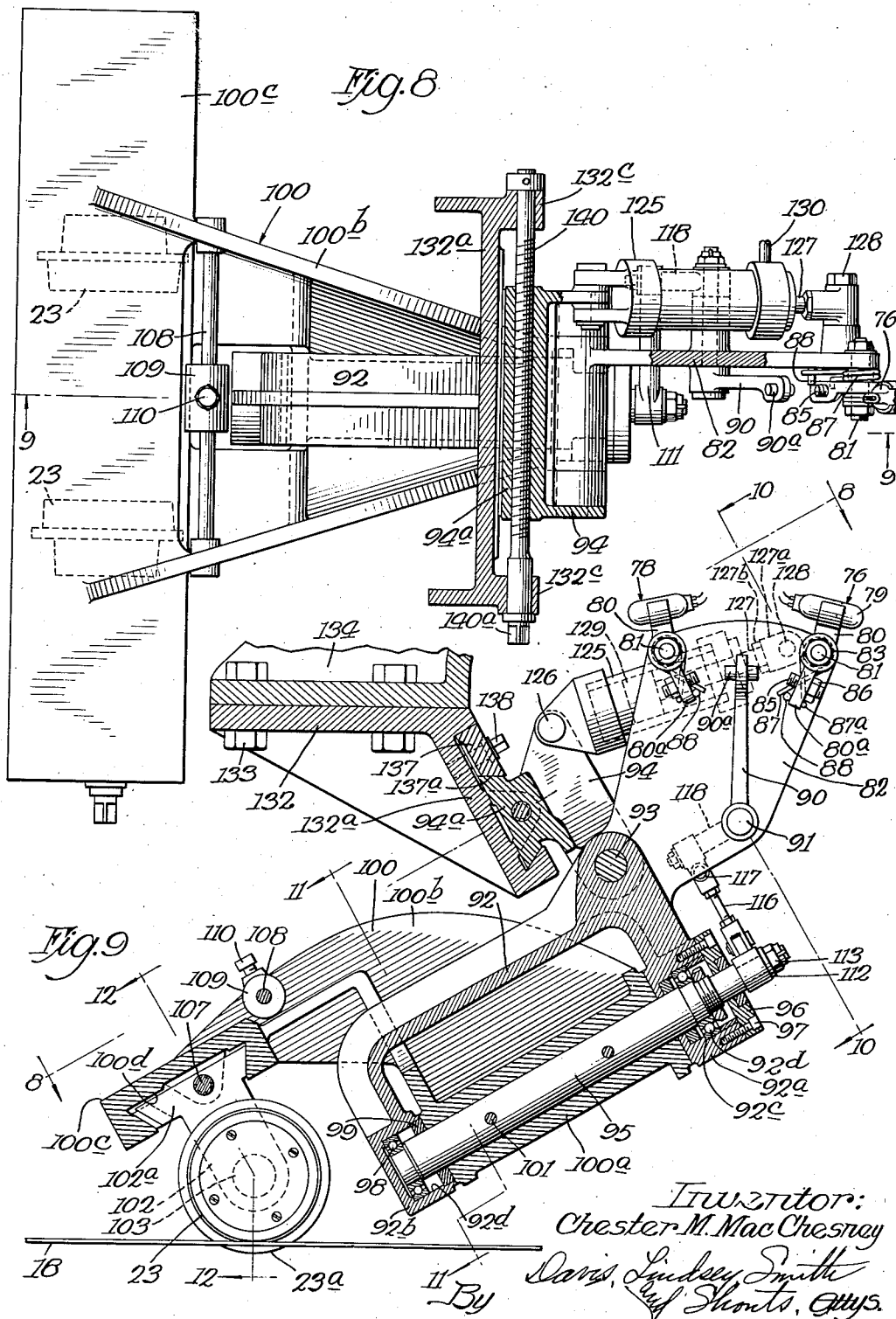
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STRIP ROLLING APPARATUS

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Aug. 11, 1942.

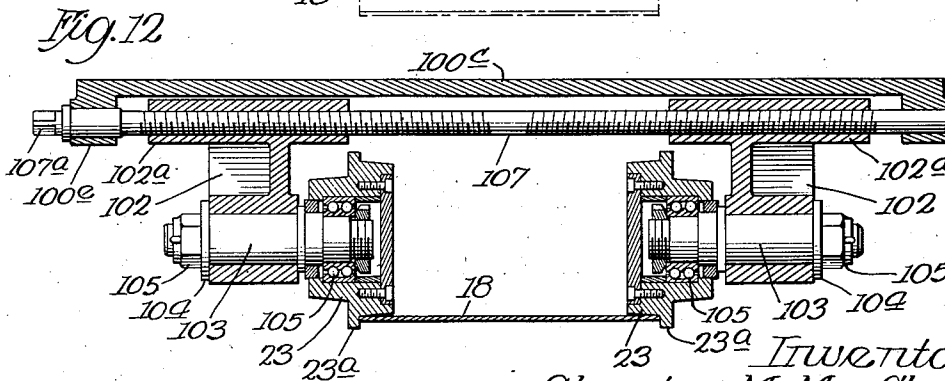
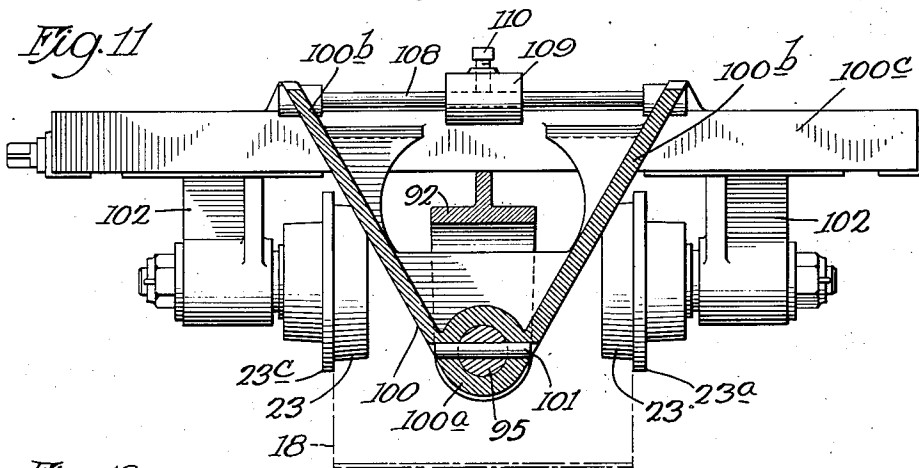
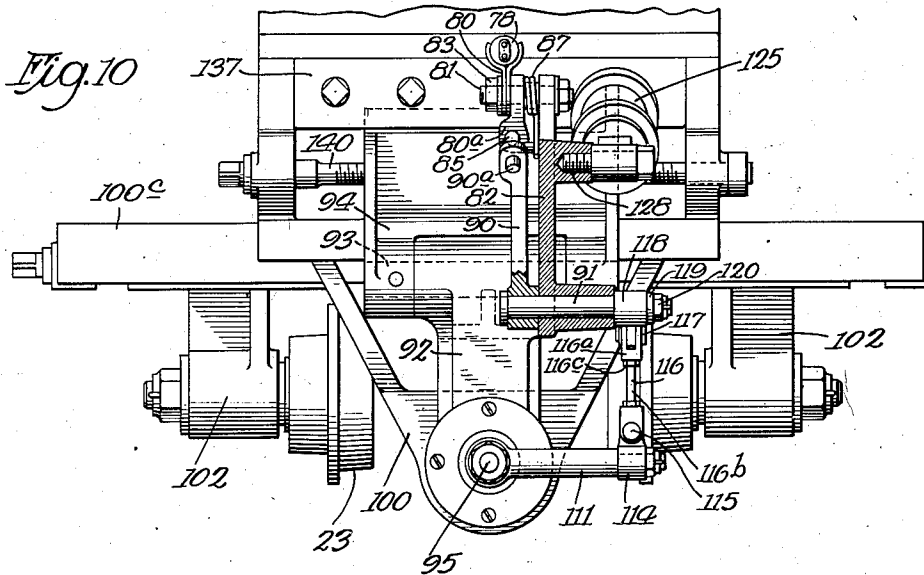
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STRIP ROLLING APPARATUS

Filed Aug. 19, 1938

5 Sheets-Sheet 5



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UNITED STATES PATENT OFFICE

2,292,535

STRIP ROLLING APPARATUS

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Application August 19, 1938, Serial No. 225,662

16 Claims. (Cl. 80—56)

This invention relates to improvements in strip rolling apparatus and its purpose is to provide improved means for rolling strip steel and the like and producing a strip having straight parallel edges and substantially uniform thick-
ness or gauge.

In the rolling of steel strip and the like, as heretofore practiced, the long metal strip moves endwise through successive mills which effect a gradual reduction of the strip to the desired gauge and, because of irregularities in the spacing of different portions of the same rolls, or for other reasons, the strip often assumes a lateral curvature in its own plane, known as "camber," due to variations in the length of the metal between the opposite edges of the strip arising from variations in thickness or other causes. The presence of camber interferes with the proper winding of the strip on a reel and interferes with its subsequent use.

The principal object of the present invention is to overcome the aforesaid difficulty by providing improved rolling apparatus adapted to detect and correct any tendency of the rolls to produce camber in the strip being rolled. A further object is to provide means engaging a metal strip being rolled for detecting any variation in the length of the opposite edge portions of metal and immediately adjusting the rolls of the adjacent mill to restore the desired uniformity of length throughout the width of the strip. Another object is to provide an improved strip rolling apparatus comprising a plurality of successive mills and means engaging the strip between each mill and the next following mill for detecting any variation in the length of the metal between its edges and immediately actuating certain apparatus by which the rolls of the next adjacent mill, in advance of the point of said engagement with the strip, are automatically adjusted to correct the existing condition of the strip being rolled. Still another object is to provide a rolling mill in combination with apparatus comprising devices resting upon opposite edge portions of a metal strip, after it has passed through the mill, and responsive to variations in length of said opposite edge portions, for adjusting the rolls of the mill to restore a condition wherein opposite edge portions of the strip emerging from the mill are of substantially equal length. A further object is to provide an improved rolling apparatus comprising electrically operated means responsive to variations in the length and thickness of a metal strip between its edges for automatically adjusting the spaced

relation of the rolls of a mill to maintain a substantially uniform length of the longitudinal elements of the strip throughout its width. Other objects relate to various features of construction and arrangement of the apparatus which will appear more fully hereinafter.

The nature of the invention will be understood from the following specification taken with the accompanying drawings in which one embodiment is illustrated.

In the drawings:

Figure 1 shows a somewhat diagrammatic side elevation of a portion of a rolling mill embodying the present invention, illustrating a strip being rolled and wound on a reel and the location of the correcting devices of the present invention following each mill;

Fig. 2 shows a top plan view of the apparatus illustrated in Fig. 1;

Fig. 3 shows an enlarged top plan view of a portion of a metal strip having lateral curvature or camber therein;

Fig. 4 shows a top plan view of one of the mills embodied in the rolling apparatus illustrated in Figs. 1 and 2;

Fig. 5 shows a front elevation of the rolling mill illustrated in Fig. 4;

Fig. 6 shows an enlarged end elevation of the mills illustrated in Figs. 4 and 5 with portions thereof broken away;

Fig. 7 shows a diagrammatic view of the electric circuit connections of the correcting apparatus of the present invention and the motor by which the rolls of the mill are adjusted;

Fig. 8 shows an enlarged horizontal sectional view on the line 8—8 of Fig. 9, illustrating the apparatus which contacts the metal strip and actuates the mechanism by which the spacing of the rolls is adjusted;

Fig. 9 shows a vertical section taken on the line 9—9 of Fig. 8;

Fig. 10 shows an enlarged sectional view on the line 10—10 of Fig. 9;

Fig. 11 shows an enlarged sectional view taken on the line 11—11 of Fig. 9; and

Fig. 12 shows a sectional view taken on the line 12—12 of Fig. 9.

As illustrated in Figs. 1 and 2 of the drawings, the invention is embodied in a strip mill comprising a plurality of four-high mills which are spaced apart in the usual manner, each mill comprising two large pressure rolls 16, each of which engages one of two smaller work rolls 17 arranged to receive between them the elongated metal strip 18 being rolled. The strip 18 passes

in the direction of the arrow 19, being supported beyond the last mill of the series by a roller 20 and being wound up beyond this roller on a reel 21 which may be power-driven to supply the motive power for the strip beyond the last mill of the series. The strip 18 should normally be of uniform thickness throughout its width so that its lateral edges are parallel to each other and of the same length, thereby facilitating the winding of the strip on the reel 21 so that it may be supplied in proper condition for the market and subsequent use. Due to the instability of the work rolls of the mills, and other causes, the strip 18 tends, at intervals, to be rolled in such a manner that one edge of the strip is longer than the other and it assumes a lateral curvature 18^a, as shown in Fig. 3, and this camber may extend in either direction laterally of the longitudinal axis of the strip. In order to compensate for and correct this tendency of the strip to assume a camber, the present invention provides means actuated by the strip for correcting the adjustment of the rolls of each mill to bring about a change in the thickness of different parts of the strip and a corresponding relative change in the length of its longitudinal elements, and, for this purpose, a correcting device 22 is located on the following side of each mill. Each correcting device 22 has a pair of flanged wheels 23 which engage opposite edge portions of the strip and as the strip advances in the direction of the arrow 19, any inequality in the length of the longitudinal elements of the strip between its edges will cause the wheels 23 to actuate the adjacent correcting device 22 to effect an automatic relative adjustment of the rolls of the next preceding mill 15.

Each mill 15 comprises a base 25 adapted to be secured upon a floor or other support and having mounted thereon two upwardly extending yoke-shaped frames or standards 26. The opposite arms 26^a of each frame are connected at their upper ends by an integral transverse portion 26^b, and the inner faces of the arms 26^a are provided with guides 26^c in which are slidably mounted bearing blocks 27 having journaled therein the trunnions 16^a which are formed on the ends of the pressure rolls 16, and also intermediate bearing blocks 28 which have journaled therein the trunnions 17^a formed on the ends of the work rolls 17. In this way the bearings at both ends of the rolls 16 and 17 are adjustably mounted and are capable of relative movement with respect to each other. As shown in Fig. 5, the work rolls 17 have extensions 17^b at one end which are connected through couplings 24^a with driving shafts 24 driven in opposite directions from a suitable source of power, so that both work rolls are positively driven and the pressure rolls are actuated merely by frictional contact therewith.

The bearing blocks 27 in which are journaled the ends of the upper pressure rolls 16 of each mill have secured thereto auxiliary blocks 29 which are pivotally connected at 30 to upwardly extending bars 31 having a sliding engagement with apertures formed in the flanges 26^d of the cross members 26^b of the frames or yokes. Coil springs 32 are mounted about these bars 31 above the flanges 26^d and the upper ends of the bars are threaded and engaged by washers 33 and nuts 34 so that the normal compression of the springs 32 may be varied as desired to regulate the tendency of these springs to elevate the upper bearing blocks 27 and the upper pressure rolls 16.

In order to regulate the action of the springs 32 and to vary the spaced relation of the work rolls 17 due to the position of and pressure exerted by the upper pressure roll 16, means are provided for effecting a downward adjustment of the blocks 27 and both ends of the upper work roll 17 independently of each other and also simultaneously with each other but in opposite directions. For this purpose, adjusting screw 35 is mounted in a vertical position in threaded engagement with an aperture formed in the cross member 26^b of each frame. The lower ends of these adjusting screws 35 are rotatably mounted in collars 36 secured to the auxiliary box 29 and the upper portions of these adjusting screws extend into housings 37, carried by the frame members 26, which have mounted therein worm wheels 38. Each worm wheel has a splined connection with one of the adjusting screws 35 so that when it is rotated the screw moves upwardly or downwardly, depending upon the direction of the rotation, thus varying the position of the upper bearing blocks 27 to regulate the gauge of the metal being rolled. This adjustment may be indicated by graduated indicating wheels 39 which are mounted on the upper ends of the adjusting screws 35 and which have graduations 39^a adapted to move in proximity to stationary index marks 40.

In order to effect a manual adjustment of the two screws 35 independently of each other, two hand wheels 41 and 42 are provided at one end of the mill. The hand wheel 41 is secured upon a shaft 43 which is journaled in a hollow shaft 44 on which the hand wheel 42 is secured. The hollow shaft 44 is journaled in bearings 45 carried by a lateral extension 37^a of one of the housings 37 and a worm 46 is secured on the hollow shaft 44 within this housing extension to mesh with the worm wheel 38 having a splined engagement with one of the adjusting screws so that when the hand wheel 42 is rotated this worm wheel having a threaded engagement with the frame will be actuated to effect a longitudinal movement of that adjusting screw. The inner shaft 43 is extended beyond the housing extension in which the worm 46 is located and is connected through a coupling 47 with an extension shaft 43^a which is journaled in bearings 48 in the housing extension 37^a of the other housing. This other housing extension has located therein a worm 49 fixed on the shaft 43^a and meshing with the worm wheel 38 which is splined on the other adjusting screw 35, which may thus be manually adjusted by rotating the hand wheel 41. These hand wheels may be employed to adjust opposite ends of the rolls independently of each other and to secure the desired gauge at the commencement of the operation or at any stage of the operation during rolling.

For the purpose of automatically correcting for camber during the operation of the mill, the worm wheels 38 are connected to actuating mechanism which is automatically operated by two of the wheels 23, previously referred to, which rest upon opposite edge portions of the strip 18. These connections include two worms 50, each of which is mounted on a shaft 51 journaled in bearings carried by an extension 37^b of one of the housings 37, the extensions 37^b being located on the opposite sides of the housings from the extensions 37^a. The shafts 51 project beyond the housing extensions 37^b and have bevel gears 52 rotatably mounted on their inner ends, facing each other and meshing with a common driving

pinion 53 secured on a transverse shaft 54. This shaft 54 is journaled in the housing of a speed reducing gear transmission 55 mounted on a plate 56 which is carried by the frame members 26. The gear transmission 55 is actuated through a shaft 57 by an electric motor 58 controlled by the movement of the wheels 23 on the moving strip 18 so that, when the motor is operated, the bevel pinion 53 actuates the two bevel gears 52 simultaneously in opposite directions.

In order to control the actuation of the shafts 51 and the worms 50 by the bevel gears 52, which are thus capable of being driven by the electric motor 58, each shaft 51 has a clutch member 60 slidably mounted thereon and having teeth to mesh with clutch teeth formed on the adjacent bevel gear 52. These clutch members are splined on the shafts 51 and are provided with annular grooves 60^a engaged by pins 61 carried by the operating levers 62. These levers are pivoted at 63 on the plate 56 and their opposite arms 62^a are pivotally connected to links 64. These links are pivotally connected to the opposite arms 65^a of a lever 65 which is pivoted at 66 on the plate 56 and which has a handle 65^b adapted to be engaged by the operator. Upon rocking the lever 65 about its pivot, toward the left as viewed in Fig. 4, the links 64 will be actuated to operate the levers 62 and thus move both clutch members 60 out of driving engagement with the bevel gears 52, thereby leaving the vertical adjusting screws 35 free to be manually adjusted by the hand wheels 41 and 42. When the lever 65 is restored to the position shown in Fig. 4, the clutch member 60 will be in driving engagement with the bevel gears 52 and, in that condition, the actuation of the bevel pinion 53 by the electric motor 58 will effect a simultaneous adjustment of the two screws 35, but in opposite directions, so that the work rolls will be separated at one end of the mill while they are brought closer together at the other end.

As shown in Figs. 4 and 7, the electric motor 58 is connected by three conductors 69 with a reversing switch 70 to which current is supplied through line conductors 71. The reversing switch 70 is connected through a conductor 74 and a common conductor 75 with a mercury tube switch 76 and the reversing switch is also connected through the common conductor 75 and another conductor 77 with another mercury tube switch 78. Each mercury tube switch is of the usual construction comprising a sealed tube or receptacle into which the two conductors lead, a quantity of liquid mercury being sealed in the tube so that when the tube is moved in the proper direction, the mercury connects the two conductors and thereby establishes a circuit through them. As shown particularly in Fig. 9, each of the two mercury tube switches 76 and 78 comprises a mercury tube 79, each mounted upon the upper end of a lever 80 which is pivoted upon a bolt 81 carried by vertical plate 82. Nuts 83 secure the levers 80 upon the bolts 81 and the lower arms 80^a of these levers are provided with threaded holes engaged by studs 85 adapted to be secured in adjusted position in the arms by nuts 86. Coil springs 87 are mounted around the bolts 81 adjacent the plate 82 with one end 87^a of each spring engaging the outer side of the arm 80^a of one of the levers and with the other thereof engaging a pin 88 mounted in the face of the plate 82. These springs serve normally to rock the switches about their pivots 81 until the edges of the arms 80^a engage the pin 88, in

which positions the tube 79 of the mercury tube switches are adapted to occupy such positions that the circuits thereof are open.

The switch levers 80 are adapted to be rocked about their pivots 81 by means of a switch arm 90 having lugs 90^a projecting therefrom to engage one of the studs 85 after a predetermined movement of the switch arm 90 has taken place in one direction or the other. The switch arm 90 is mounted on a short shaft 91 which is journaled in the plate 82 and this shaft is adapted to be moved angularly, as hereinafter described, when a difference of length of opposite edge portions of the metal strip 18 causes relative movement in a vertical plane of the two flanged wheels 23 which ride upon the strip.

Before describing the actuating connection between the wheels 23 and the switch arm 90, it will be well to refer to the construction and mounting of some of the intermediate connecting and supporting parts. The plate 82, upon which the mercury tube switches 76 and 78 and the switch arm 90 are mounted, is formed as a part of frame 92 which is pivoted at 93 upon a supporting bracket 94, the mounting and adjustment of which will be hereinafter described. The frame 92 has two depending arms 92^a and 92^b. The arm 92^a has a recess 92^c in which is mounted a ball bearing unit 92^d having journaled therein one end of a shaft 95. The outer end of the recess 92^c is closed by a cover plate 96 which is secured in place by screws 97. The other arm 92^b of the frame is similarly provided with a recess 92^d in which is mounted a ball bearing unit 98 having journaled therein the other end of the shaft 95. The end of this recess 92^d is closed by a plate 99. The shaft 95 has mounted thereon a bracket 100 having a hub 100^a which is fitted by the shaft and is secured thereto by pins 101. The bracket 100 has upwardly diverging arms 100^b which are formed integrally with a transverse bar 100^c and this bar has an under cut groove or channel 100^d in its under side to receive the under cut heads 102^a which are formed on the bearing brackets 102. These brackets have stub shafts 103 secured therein by washers 104 and nuts 105 and the inner ends of these stub shafts carry ball bearing units 105 on which are mounted the flanged wheels 23, previously described. These wheels are adapted to rest upon the metal strip 18 with the flanges 23^a extending downwardly at the edges of the strip, as shown in Fig. 12 and, in order that the two wheels may be adjusted longitudinally of their axes of rotation to engage metal strips 18 of different widths, the heads 102^a of the bearing blocks are adjustable longitudinally in the channel 100^d. This adjustment is effected by adjusting screw 107 which has its ends journaled in bearings 100^e carried by the bar 100^c and which has its opposite end portions threaded in opposite directions for threaded engagement with apertures formed in the heads 102^a. One end of the adjusting screw 107 is provided with a square portion 107^a for engagement by a wrench or the like to permit rotation of the screw and corresponding adjustment of the wheels 23 toward or from each other. It will be apparent that with the foregoing mounting of the bracket 100, the wheels 23 are adapted to oscillate about the axis of the shaft 95 and in order that the bracket 100 and the parts carried thereby may be precisely balanced when there is no camber in the strip 18, the bracket 100 is provided with a rod 108 extending between

the arms 100^b thereof, and this rod supports a slidably mounted weight 109 adapted to be secured in adjusted position by a set screw 110, as shown particularly in Figs. 9 and 11. This weight 109 may be adjusted on the rod to secure the proper balance of the bracket 100 and the parts carried thereby before the mill is put into operation.

The tendency of one wheel 23 or the other to lower its position, when one side of the metal strip is elongated due to camber, with a resulting rocking of the bracket 100 about the axis of the shaft 95, is utilized for actuating the switch arm 90 through connections from the upper end of the shaft 95. For this purpose, the shaft 95 is extended beyond the end plate 96 and has a crank arm 111 secured thereon, as shown in Figs. 9 and 10. This crank arm is secured on the reduced end of the shaft, in non-rotative engagement therewith, by a washer 112 and a nut 113, and the free end of this crank 111 is secured to an arm 114 which is pivotally connected at 115 with a link 116 made up of end portions 116^a having threaded engagement with an intermediate portion 116^b held in fixed relation thereto by lock nuts 116^c, so that the effective length of this link 116 may be varied as desired. The member 116^a forming the upper end of the link 116 is pivotally connected by a pin 117 with a crank arm 118 secured on the shaft 91 on which the switch arm 90 is carried, a washer 119 and a nut 120 engaging the threaded end of the shaft or pin 91, as shown in Fig. 10. In this way, the angular movement of the bracket 100, caused by the presence of camber in the strip 18 will cause the shaft 95 to move angularly until one of the lugs 90^a carried by the switch arm 90 engages one of the studs 85 of one or the other of the mercury tube switches 76 or 78, thereby rocking one of the switch levers 80 about its pivot and closing the switch to cause the motor 58 to operate, thus rotating the pinion 53 and causing the two adjusting screws 35 to effect a relative separation of the rolls at one end of the mill while simultaneously bringing them closer together at the other end of the mill. The connections are so arranged that the rolls will be separated at that end of the mill where the metal strip has been elongated with a resulting lowering of the wheel 23 at that side of the strip and, at the same time, the ends of the rolls at the side of the strip, which was momentarily thicker than the other side, are brought closer together. Thus, by an automatic adjustment of the rolls, the normal condition is restored wherein the metal strip is rolled to the same gauge throughout its width and the wheels 23 will be restored to positions wherein their axes occupy a horizontal plane. It will be understood, of course, that the period of closing the switch will depend upon the extent of the camber and that the restoration of the wheels 23 to their normal positions will promptly close the circuit of the motor.

Due to the fact that the plate 82 and the bracket 92 are pivotally mounted at 93 on the bracket 94, with both of the switches and the switch arm carried by the plate 82, it will be apparent that a simultaneous lowering or raising of both wheels 23 to the same degree, due to the tightening of the strip 18 being rolled or to the production of slack therein, will have no effect upon the opening or closing of the mercury tube switches as the switches and switch arm move bodily with their supporting plate. It is only when there is a relative tilting motion of the

bracket 100 with respect to the frame 92 and the plate 82 that the switch arm 90 is actuated to close one of the switches.

In order that the wheels 23 may be pressed down against the upper surface of the strip 18 independently of the action of gravity, a compressed air cylinder 125 is connected between the upper part of the bracket 94 and the plate 82, one head of the cylinder being pivotally connected at 126 to the bracket 94 while the other head of the cylinder has fluid-tight sliding engagement with a piston rod 127 having an adjustably mounted head 127^a which is pivotally connected by a pin 128 with the plate 82. The length of the piston rod may be varied by adjusting it with respect to the head 127^a and securing it in adjusted position by a lock nut 127^b. A piston 129 is connected to the piston rod within the cylinder 125 and compressed air or other fluid is admitted to the cylinder, between the piston and the head through which the piston rod extends, through a pipe 130. The compressed fluid acting in the cylinder thus tends to rock the plate 82 and the frame 92 about the pivot 93 to force the wheels 23 downwardly against the metal strip.

The frame 92, plate 82 and bracket 100, together with the parts carried thereby, are supported by means of the bracket 94 on a plate 132 which is attached by means of bolts 133 to a bracket 134 extending longitudinally of the rolls between the frames 26 and attached thereto by studs 135. The plate 132 has a downwardly inclined portion 132^a provided on its upper side with an under cut groove slidably engaged by the head 94^a formed on the bracket 94. A locking member 137 is mounted in this groove at one side of the head 94^a and has an inclined surface 137^a engaging one of the inclined faces of the head 94^a. This locking bar 137 is secured to the portion 132^a of the plate by studs 138 which may be tightened to hold the bracket 94 rigidly in position after it has been adjusted longitudinally of the plate 132 for the purpose of positioning the bracket 100 and the wheels 23 longitudinally of the mill to a position corresponding to that occupied by the metal strip 18 being rolled. This adjustment of the head 94^a on the plate or bracket 132 is effected by an adjusting screw 140 having its ends journaled in bearings 132^c carried by the plate or bracket 132 and having a portion 140^a at one end thereof adapted to be engaged by a wrench or the like.

At the beginning of a rolling operation, the handles 65^b of each mill are operated to disengage the clutches 52-60 and the hand wheels 41 and 42 are then operated to set the rolls of each mill for reducing the strip to the desired gauge. Assuming a strip to be in place between the rolls of the mill, the bracket 94 of each is adjusted laterally by the screw 140 to locate the wheels 23 in alignment with the strip and, if necessary, the relative separation of the wheels of each mill is adjusted by the screw 107 to cause them to engage properly the edges of the strip, thus bringing all of the wheels of the various mills into proper alignment with the strip and with each other. The handles 65^b may then be again operated to engage the clutches 52-60 and the mills may then be started in operation. As the rolling continues, the wheels 23 resting on the strip will function continuously to effect an automatic adjustment of the rolls of each mill whenever camber is present in the strip between that mill and the next mill.

It will be observed that the arm 90, in addition to performing the function of actuating the brackets 80 which carry the switches 76 and 78, serves also as a moving pointer to indicate when there is camber in the strip following the mill on which it is mounted. This indicating means might be employed in conjunction with the hand wheels 41 and 42 to maintain a manual control and adjustment of the various mills if the automatic electrically-operated means were not present, but it is, of course, preferable to employ the complete apparatus and to utilize the movement of the arm 90 for maintaining an automatic adjustment of the rolls.

Although one form of the invention has been shown and described by way of illustration, it will be understood that the invention may be constructed in various other embodiments coming within the scope of the appended claims.

I claim:

1. The combination in rolling mill apparatus, of means for rolling a metal strip and means engaging only the upper side of said strip and resting freely by gravity on said strip for adjusting said rolling means when there is camber in the strip.

2. The combination in a rolling mill, of a plurality of mills through which a long metal strip passes in succession during the process of rolling, and means pivoted midway between the lateral edges of said strip and resting freely by gravity upon the upper side of said strip at opposite edges thereof for adjusting each mill when camber exists in the strip between that mill and the next following mill.

3. The combination in strip rolling apparatus, of a mill comprising relatively adjustable rolls, means for simultaneously effecting opposite adjustments of the spaced relation of opposite end portions of said rolls, and means comprising a unitary device mounted above said strip and having parts thereof resting upon the opposite edge portions of said strip for operating said adjusting means when there is a change in the relative lengths of the opposite edge portions of said strip.

4. The combination in strip rolling apparatus, of a mill comprising relatively adjustable rolls, means for effecting simultaneous and opposite adjustments of the opposite end portions of said rolls, a device mounted above said strip for pivotal movement about an axis extending longitudinally of said strip and having parts resting upon the opposite edge portions of said strip, and means actuated by the pivotal movement of said device for operating said adjusting means when there is a change in the relative lengths of opposite edge portions of the strip.

5. The combination in strip rolling apparatus, of a mill comprising relatively adjustable rolls, means for adjusting said rolls, electrically operated means including a unitary switching device for actuating said adjusting means, a unitary structure mounted for pivotal movement transversely of a strip being rolled, wheels carried by said unitary device and resting upon said strip at its lateral edges, and means actuated by the pivotal movement of said unitary device for actuating said switching device.

6. The combination in strip rolling apparatus, of a mill having relatively adjustable rolls, electrically operated means for adjusting said rolls, an electric circuit for controlling the operation of said adjusting means, a pair of switches connected in said circuit for effecting the actuation of said adjusting means in opposite directions, means

comprising devices adapted to rest by gravity upon and to be supported by opposite edge portions of the strip as it leaves said mill for effecting the independent closing of said switches, and means for adjusting the spaced relation of said devices.

7. The combination in strip rolling apparatus, of a mill having relatively adjustable rolls, electrically operated means for adjusting said rolls, an electric circuit for controlling the operation of said adjusting means, a pair of switches connected in said circuit for effecting the actuation of said adjusting means in opposite directions, means comprising devices adapted to rest upon opposite edge portions of the strip as it leaves said mill for effecting the independent closing of said switches, and means for adjusting said devices bodily in a direction laterally of and parallel to the plane of the strip.

8. The combination in strip rolling apparatus, of a mill having rolls between which the strip passes, means for adjusting the relative separation of opposite end portions of said rolls, means for actuating said adjusting means, means comprising parts resting on said strip and tiltable transversely thereof when there is camber in the strip for controlling said actuating means, and adjustable means for balancing said parts on said strip when there is no camber in said strip.

9. The combination in strip rolling apparatus, of a mill having rolls between which the strip passes, means for adjusting the relative separation of opposite end portions of said rolls, means for actuating said adjusting means, means comprising parts resting on and supported by the opposite edge portions of said strip and tiltable as a unit transversely thereof when there is camber in the strip for controlling said actuating means, and fluid pressure means for pressing said last named means against the strip.

10. The combination in strip rolling apparatus, of a mill having rolls between which the strip passes, means for adjusting the relative separation of opposite ends of said rolls, means for actuating said adjusting means, a frame mounted on the discharge side of said mill for movement about an axis extending transversely of and parallel to the plane of the strip, a bracket mounted on said frame for a tilting movement laterally of said strip about an axis located in a plane extending longitudinally of the strip, rollers carried by said bracket to rest upon the lateral edge portions only of said strip, and means actuated by the tilting movement of said bracket for controlling said actuating means.

11. The combination in strip rolling apparatus, of a mill having rolls between which the strip passes, means for adjusting the relative separation of opposite end portions of said rolls, means for actuating said adjusting means, a frame mounted to pivot about an axis extending parallel to the plane of the strip being rolled and transversely to its direction of movement, and means carried by said frame and comprising parts adapted to rest on said strip for controlling said actuating means.

12. The combination in strip rolling apparatus, of a mill having rolls between which the strip passes, means for adjusting the relative separation of opposite end portions of said rolls, means for actuating said adjusting means, a frame mounted to pivot about an axis extending parallel to the plane of the strip being rolled and transversely to its direction of movement, means carried by said frame and comprising

parts adapted to rest on said strip for controlling said actuating means, and means for adjusting said frame and parts carried thereby transversely to the direction of movement of the strip.

13. The combination in strip rolling apparatus, of a mill having rolls between which the strip passes, means for adjusting the relative separation of opposite end portions of said rolls, means for actuating said adjusting means, a frame mounted to pivot about an axis extending parallel to the plane of the strip being rolled and transversely to its direction of movement, means carried by said frame and comprising flanged wheels resting upon opposite edge portions of said strip and tiltable laterally of said strip when there is camber in the strip for controlling said actuating means, means for adjusting the spaced relation of said wheels, and means for moving said frame transversely to the direction of movement of the strip.

14. The combination in strip rolling apparatus, of a mill having rolls between which the strip passes, means for adjusting the relative separation of opposite end portions of said rolls, means for actuating said adjusting means, a unitary frame structure carrying wheels resting upon the opposite edge portions of said strip and mounted for tilting movement laterally of the strip for controlling the operation of said actuating means, and means for adjusting the spaced relation of said wheels.

15. The combination in strip rolling apparatus, of a mill having rolls between which the strip passes, means for adjusting the relative separation of opposite end portions of said rolls, means for actuating said adjusting means, means comprising wheels resting upon the opposite edge portions of said strip for controlling the operation of said actuating means, means for adjusting the spaced relation of said wheels, and means for adjusting said last named means and said wheels bodily transversely of said strip.

16. The combination in strip rolling apparatus, of a mill having rolls between which the strip passes, means for adjusting the relative separation of opposite end portions of said rolls, means for actuating said adjusting means, a frame mounted for pivotal movement about an axis extending transversely of and parallel to the strip, a bracket pivoted on said frame for a tilting movement laterally of said strip, rollers mounted on said bracket to rest upon the opposite edge portions of the strip whereby changes in length of the edge portions of the strip cause a lateral tilting movement of said bracket, means controlled by said tilting movement of said bracket for operating said actuating means, and means for adjusting said frame and the parts carried thereby transversely of said strip.

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