

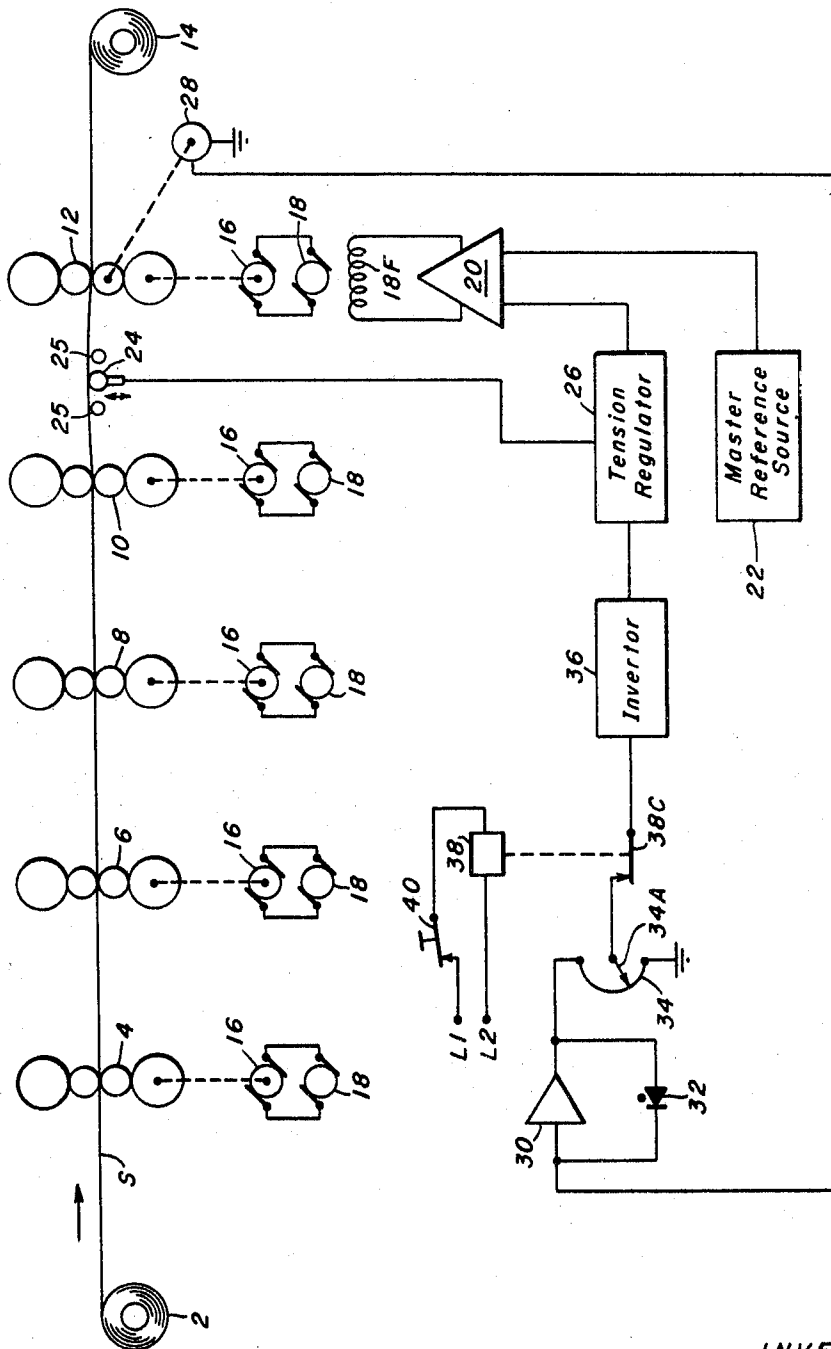
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APPARATUS FOR MAINTAINING THE GAUGE OF STEEL STRIP

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1

2

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APPARATUS FOR MAINTAINING THE GAUGE OF STEEL STRIP

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9 Claims

ABSTRACT OF THE DISCLOSURE

A cold rolling mill including means for automatically varying the tension on the strip between the last two stands inversely proportional to variations in strip speed. Means are also provided to prevent further tension decrease above a predetermined speed. Additional means are provided to vary the amount of change according to the gauge and width of the strip being rolled.

This invention relates to apparatus for cold rolling strip and more particularly to apparatus for maintaining the gauge of steel strip constant, regardless of variations in mill speed. The tension of strip in modern cold rolling mills is maintained constant between the last two stands by means of a tension regulator. However, it has been found that the thickness of the strip varies in proportion to variations in speeds below a predetermined speed which on certain mills is 1,000 ft. per minute. This variation in thickness is particularly noticeable in the trailing and leading ends of the strip. Various means have been provided to compensate for the variation in gauge at the ends of the strip such as shown in Michel Patent No. 2,544,467 dated Mar. 6, 1951; and Holman et al. Patent No. 3,151,508 dated Oct. 6, 1964. However, these controls do not take into account the variations in speed as the mill is brought up to its maximum speed or lowered to its minimum speed.

It is therefore an object of my invention to provide apparatus for automatically varying the tension of the strip between the last two stands of a cold rolling mill inversely proportional to variations in strip speed below a predetermined speed.

This and other objects will be more apparent after referring to the following specification and attached drawing, in which:

The single figure is a schematic diagram of the apparatus of my invention.

Referring more particularly to the drawing, reference numeral 2 indicates an uncoiler from which strip S passes through roll stands 4, 6, 8, 10 and 12 to a coiler 14. Associated with roll stand 12 is a drive motor 16 which receives power from a generator 18. The output of generator 18 is controlled by means of a field 18F. Flow of current through field 18F is controlled by means of a magnetic or summing amplifier 20. This is a standard device such as No. 4511-E-1193, manufactured by Magnetics, Inc. The output of amplifier 20 is controlled by voltage from master reference source 22 and other auxiliary circuits, not shown. Master reference source 22 is also a standard device such as No. DL232X601B14D01, manufactured by General Electric. The stands 4, 6, 8 and 10 are provided with similar motor generator sets and controls. The voltage provided by the master reference 22 for the various stands is set so that the speeds of the stands are brought up and down in the same ratio. A tensiometer 24 is provided between roll stands 10 and 12 to measure the tension between these stands. There is a fixed roll 25 on each side of movable tensiometer roll 24. The tensiometer 24 produces an electrical signal which is con-

nected to a tension regulator 26, the output of which is connected to amplifier 20 so as to maintain a constant tension on the strip S between roll stands 10 and 12. The regulator 26 may be a General Electric No. DL257X975B01000. The parts so far described are conventional and may be used either with or without gauge control.

According to my invention the output of a tachometer generator 28 connected to be driven at a speed proportional to that of roll stand 12 is connected to an amplifier 30. Connected across amplifier 30 is a Zener 32. The output of amplifier 30 is connected to a potentiometer 34 having a movable arm 34A which is connected to an inverter 36, the output of which is connected to tension regulator 26. A relay coil 38 connected to power supply L1, L2 through mill start switch 40 has a normally open contact 38C connected between arm 34A and tension regulator 26.

A value of Zener 32 is selected which will limit the output voltage of amplifier 30 to that corresponding to a selected speed of roll stand 12. For certain mills this speed has been selected as 1,000 ft. per minute since higher speeds have little or no effect on strip gauge. The operator also sets arm 34A of potentiometer 34 to adjust the proportion of the output of amplifier 30 which will pass to regulator 26. This adjustment is set according to the width and gauge of the strip being rolled.

When the mill is started by closing of switch 40, relay 38 will be energized to close its contact 38C. As the speed of the strip S rises, the output of tachometer generator 28 will increase proportionately. As the speed increases, the output of amplifier 30 will increase and the output of tension regulator 26 will decrease proportional to the increase in speed until the speed reaches 1,000 ft. per minute. The output of amplifier 30 will then remain constant regardless of increase in speed since current will flow through Zener 32. The output of amplifier 30 is inverted prior to being impressed on tension regulator 26 to obtain this inverse proportional relationship. When strip speed decreases below 1,000 ft. per minute, the input to tension regulator 26 will increase, thus causing increased tension on the strip S between roll stands 10 and 12, with the increase in tension being proportional to decrease in speed.

While one embodiment of my invention has been shown and described, it will be apparent that other adaptations and modifications may be made without departing from the scope of the following claims.

I claim:

1. Apparatus for continuously rolling strip comprising a plurality of roll stands through which the strip passes under tension and compression, means for measuring the strip tension between the last two roll stands, and means for varying the tension on the strip inversely proportional to variations in strip speed.

2. Apparatus according to claim 1 in which said means for varying the tension on the strip includes a motor for driving said last stand, a generator connected to energize said motor, a field for said generator, a summation amplifier having its output connected to said field, a master reference voltage supply connected to said amplifier, a tension regulator connected to said amplifier, means connecting the output of said tension measuring means to said tension regulator, means providing a signal proportional to the speed of said last stand, and means operable by said signal to vary the output of said tension regulator.

3. Apparatus according to claim 2 including means for varying the output of said means operable by said signal according to the width and gauge of the strip being rolled.

4. Apparatus according to claim 1 in which said means for varying the tension on the strip includes a motor for

3

driving said last stand, a generator connected to energize said motor, a field for said generator, a summation amplifier having its output connected to said field, a master reference voltage supply connected to said amplifier, a tension regulator connected to said amplifier, means connecting the output of said tension measuring means to said tension regulator, means providing a signal proportional to the speed of said last stand, an amplifier connected to the output of said last named means, means for inverting the output of said last named amplifier, and means connecting said last named means to said tension regulator.

5. Apparatus according to claim 4 including means for limiting the output of said last named amplifier.

6. Apparatus according to claim 4 including means for varying the proportion of said name last named amplifier output impressed on said tension regulator according to the width and gauge of the strip being rolled.

7. Apparatus according to claim 6 including means for limiting the output of said last named amplifier.

8. Apparatus according to claim 1 in which said means for varying the tension on the strip includes a motor for driving said last stand, a generator connected to energize said motor, a field for said generator, a summation amplifier having its output connected to said field, a master reference voltage supply connected to said amplifier, a tension regulator connected to said amplifier, means con-

4

necting the output of said tension measuring means to said tension regulator, means providing a signal proportional to the speed of said last stand, an amplifier connected to the output of said last named means, a potentiometer connected to the output of said last named amplifier, said potentiometer having an arm connected to said tension regulator, and means between said last named amplifier and tension regulator for inverting the output of said last named amplifier.

9. Apparatus according to claim 8 including means for limiting the output of said last named amplifier.

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72—17, 205

U.S. DEPARTMENT OF COMMERCE

PATENT OFFICE

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**UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION**

Patent No. 3,440,846

April 29, 1969

Jay R. Scott

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

Column 3, line 15, cancel "name". Column 4, line 3, before "stand" insert -- named --.

Signed and sealed this 14th day of April 1970.

(SEAL)

Attest:

Edward M. Fletcher, Jr.

Attesting Officer

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Commissioner of Patents