Feb. 27, 1940. G. P. LESSMANN 2,192,044

TENSIOMETER FOR STRIP MILLS

Filed June 9, 1937 2 Sheets-Sheet 1

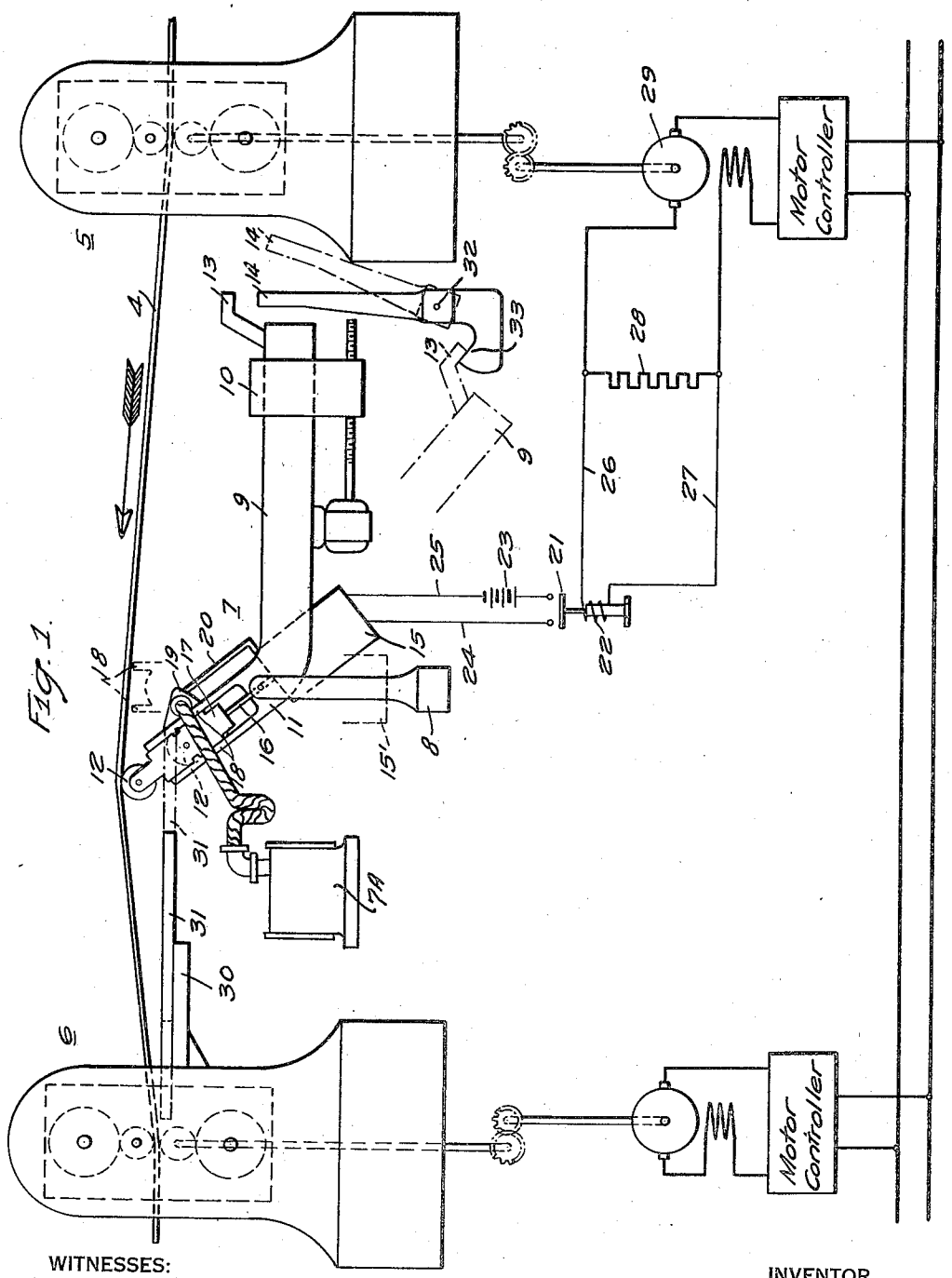


Fig. 1.

WITNESSES:
E. A. McCloskey
Joe Weber

INVENTOR
Gerhard P. Lessmann
BY
W. R. Coley
ATTORNEY

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Fig. 2.

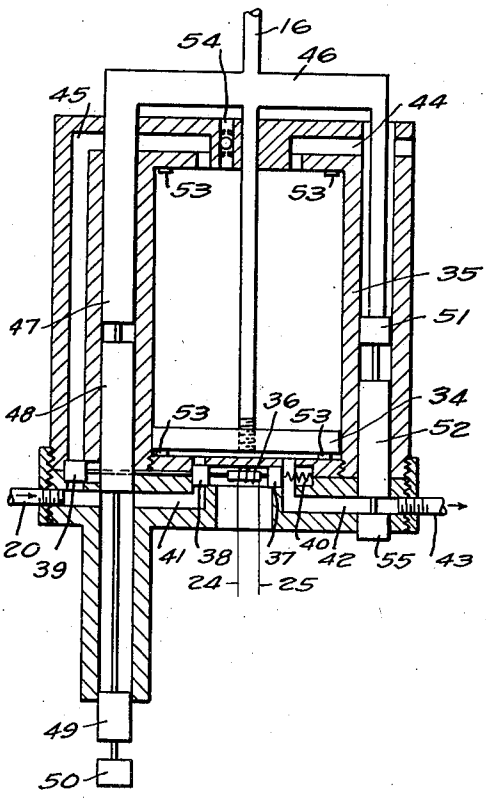
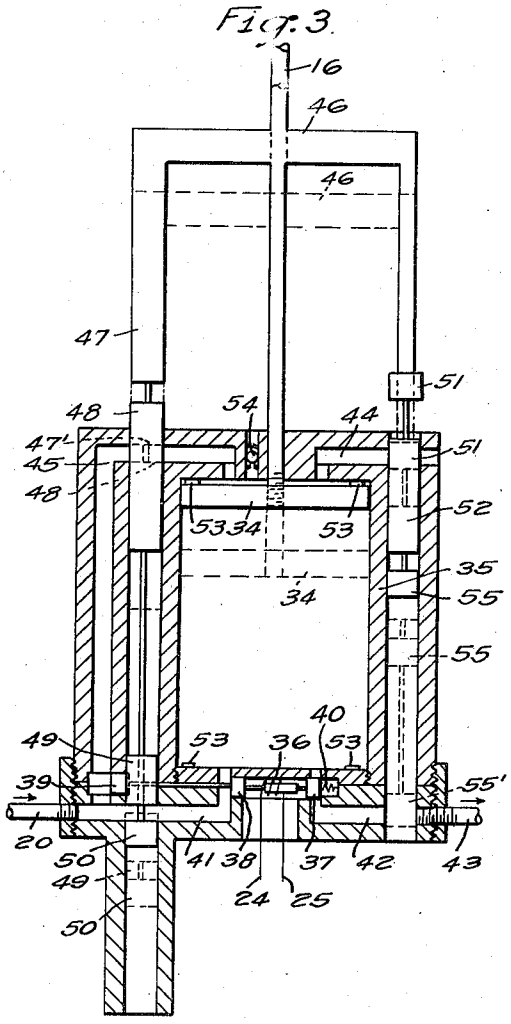


Fig. 3.



WITNESSES:

E. A. McCloskey

Joe Weber

INVENTOR

Gerhard P. Lessmann

BY

W. R. Coley

ATTORNEY

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TENSIOMETER FOR STRIP MILLS

Gerhard P. Lessmann, Forest Hills, Pa., assignor to Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., a corporation of Pennsylvania

Application June 9, 1937, Serial No. 147,308

10 Claims. (Cl. 80—35)

My invention relates, generally, to tension control systems and, more particularly, to the manipulation of a tensioning device or tensiometer which operates to maintain a substantially constant tension on material as it is being passed through work devices such as rolling mills.

It has been found desirable in the operation of strip rolling mills to maintain a substantially constant tension upon the strip as it passes through the mill. In the copending application of Charles P. Croco, Serial No. 8,781, filed February 28, 1935, now Patent No. 2,185,836, issued January 2, 1940, there is disclosed a system for performing this function in which the tensioning is provided by a roller which bears upon the strip as it passes between the roll stands, the roller being pressed against the strip by a weight-actuated lever arm.

The object of my invention, generally stated, is to provide an improved tensioning device and system which shall be more flexible in operation and which may be readily and economically manufactured and installed.

Another object of my invention is to provide a tensioning device for a strip mill wherein the tension roller may be moved into engagement with the strip in response to the loading on the mill motor which drives the preceding rolls.

Another object of the invention is to provide a control system for a weight-arm-operated tensioning device which shall function to move the roller carrying arm to a position where it will not obstruct movement of parts of the roll stand while maintenance work is being done on these parts.

A further object of the invention is to provide a system which shall function to move the tensioning roller of a weight-arm-operated tensioning device along the arm which carries the roll from a retracted position below the pass line to the tensioning position.

Another object of the invention is to provide a fluid operated device which shall function to control the positioning of the tensioning roller of the tensioning device.

Another object of the invention is to provide a system which shall function to move the tension roller of a weighted-arm-operated tensioning device to and from operating position by moving the roller along its supporting arm.

Another object of the invention is to provide a mechanism for moving the roller of a weighted-arm-operated tensioning device to and from operating position by means of a fluid operated piston.

A further object of the invention is to provide a fluid operated piston which shall function to move the tensioning roller of a strip tensioning device for a strip rolling mill from the retracted to the operating position and which may be decelerated by the fluid as it approaches the operating position.

Another object of the invention is to provide a fluid reservoir for the fluid operated piston of a strip tensioning device and for so shaping and positioning said reservoir as to make it serve as a guide for the strip as it is threaded through the mill.

These and other objects and advantages of the invention will be apparent from the following detailed description taken in connection with the accompanying drawings, in which:

Figure 1 is a diagrammatic representation of two stands of a strip mill and the tensioning device of my invention showing the relative positions and cooperative relationships of the several parts of the apparatus;

Fig. 2 is a diagrammatic illustration of the electrically controlled fluid actuated cylinder and piston for moving the tension roll of my device with the piston in the position corresponding to the retracted position of the tension roll; and

Fig. 3 is a diagrammatic illustration of the cylinder and piston shown in Fig. 2, with the parts of the device in the positions corresponding to the extended position of the tension roll.

In carrying out my invention, I provide a pivoted arm normally disposed at an angle to the pass line of a strip mill and carrying a roller member which is adapted to bear upon the strip. A second arm carrying a weight which may be moved along the arm is secured to the first arm.

The roll may be moved along its supporting arm from a retracted position in which it is below the pass line of the rolls to normal operating position where it pushes upwardly against the strip to supply a tension between the two rolls. The movement of the roll is controlled by a fluid-actuated piston which operates to move the roll to, and hold the roll in, its operating position.

The flow of fluid to and from the piston cylinder is controlled by an electrically operated valve. This valve is so connected to a relay which is controlled by the loading of the preceding mill motor as to cause the tension roller to move to and reach its operating position at approximately the same time as the strip reaches the succeeding roll stand as it is threaded through the mill in starting the rolling operation.

The tensioning roller arm in its normal operating position is disposed at an angle of approximately 51° with the pass line and in this position would obstruct the movement of the guide plate which must be moved back from the roll stand to permit changing the rolls. To make room for this movement of the guide plate, provision is made for allowing the weighted arm to move the roller arm to a vertical position.

To properly operate the fluid pressure piston, it is necessary that a fluid reservoir be provided near the piston cylinder. Such a reservoir is mounted on the roller arm and it is so shaped and positioned as to form a guide for the strip.

Referring to Fig. 1 of the drawings, the strip 4 is being worked or reduced by passing it through the roll stands 5 and 6 in the direction indicated by the arrow. As the strip passes between the two roll stands tension is placed on the strip by the tensioning device 7.

The tensioning device 7 comprises a base 8 on which is pivotally mounted an arm 9 which carries a weight 10 to produce a turning moment around its pivot point. The extension 11 of arm 9 carries a roller 12 which bears against the strip with a force depending upon the turning moment of the arm 9.

The tensioning arm is shown in operative position. In its inoperative position the roller 12 is retracted to the position shown by the dotted lines in the drawings and the arm 9 is held in a position nearer to its operating position by engagement of the stop element 13 with the stop 14.

The tensioning roller is moved from its retracted to its operating position by a fluid pressure operated piston contained in the casing 15, the details of the operation of which will be discussed hereinafter. This piston is connected through rod 16 with a sliding member 17 which supports roller 12 and which slides to and from the operating position in guides 18.

The fluid pressure operated piston is supplied with fluid pressure from a reservoir 19 which is positioned near the normal pass line of the strip and is so shaped as to provide a guide for the strip in passing between the roll stands and over the tensioning roller. This reservoir 19 is connected by a fluid conductor 20 with the fluid operated piston, and may be supplied with fluid pressure from any well known fluid pressure generating means 7a.

The fluid operated piston is controlled by the electro-magnetic valve means to be hereinafter described. This electro-magnetically operated valve is connected in circuit with contact element 21 of relay 22, source of electrical energy 23 and conductors 24 and 25. Relay 22 is retarded in its operation so that its contacts will be closed only after a predetermined time after it is energized. Relay 22 is connected by conductors 26 and 27 across the resistance 28 which is connected in series with the driving motor 29 for the rolls of roll stand 5, so that the relay will be energized when the motor 29 is energized to drive the rolls of roll stand 5, and its contact element 21 will close the circuit to the electromagnetic valve means which controls the fluid operated piston contained in casing 15, a predetermined time after the strip is fed through roll stand 5. The time-delay of relay 22 is so adjusted as to permit the strip 4 to pass to and be engaged by the rolls of roll stand 6 before the tensioning roller 12 engages the strip.

Roll stand 6 supports a shelf member 30 which has a guide member 31 slidably mounted thereon. Normally this guide member 31 is in the position shown but when it is necessary to perform maintenance work on the rolls of roll stand 6 this guide member 31 must be slid to the dotted line position. It will be seen that when it is necessary to slide the guide member 31 to the dotted line position, the arm 11 would interfere with the movement of guide 31 if it should be allowed to remain in its position of rest with stop members 13 and 14 engaging. For this reason, provision is made for moving the elements of the tensioning device 7 so that the guides 18 will occupy the vertical dotted line position and will thus permit guide 31 to move to the dotted line position. To permit this positioning of the tensioning device, stop 14 is moved around pivot 32 to the dotted line position to permit the arm 9 to move to the dotted line position with stop member 13 in engagement with stop 33.

The fluid operated piston for controlling the movement of roller 12 to and from operating position is illustrated diagrammatically in Fig. 2. The piston is shown in the position corresponding to the retracted position of the roller 12 in this figure. Rod 16 is connected to piston 34 which moves in cylinder 35. The electromagnetic valve operator 36 moves valve members 37, 38 and 39 against spring 40 which holds these valve elements in the position shown when the relay 36 is deenergized.

The flow of fluid from the reservoir 19 through connection 20 (Fig. 1) and passage 41 to the cylinder 35 is controlled by valve member 38. Valve member 37 controls the flow of fluid from the cylinder 35 through passage 42 to the exhaust pipe 43.

Fluid is allowed to flow from the cylinder 35, as the piston moves upward, through the passage 44. Passage 45 is provided for supplying fluid pressure to the upper side of the piston as the piston moves the roller 12 to operating position to provide a decelerating force for the piston as it approaches the end of its upward travel. Fluid flow to this passage 45 is controlled by valve member 39.

An arm 46 which is connected to move with rod 16 carries valve members 47, 48, 49, 50, 51 and 52 which so govern the flow of fluid in the passages 41, 42, 44 and 45 as to permit movement of the piston 34 to and from operating position and to permit the necessary discharge of fluid from the cylinder 35 to secure this movement.

Cushioning stop members 53 are provided to absorb the shock of the movement of the piston to its extreme positions. A one-way valve 54 is provided in the cylinder 35 to permit the flow of air into the cylinder while the piston is moving from its extended to its retracted position but to prevent flow of fluid from this end of the cylinder while the piston is being moved from the retracted to the extended position.

In Fig. 3, the elements of the piston and its control valves are shown in the position which they occupy when they are moved and are holding the roller 12 in its operating position and the movable members of the device are shown in dotted lines in a position which they occupy during movement of the piston from the fully retracted to the operating positions.

In the operation of the device, before the strip is passed through the rolls, the tension roller 12 and piston 34 are in the retracted posi-

tion and stop member 13 is in engagement with stop 14 to hold arm 9 in a position which is very close to its operating position. At this time relay 22 is deenergized and valve members 37, 38 and 39 occupy the position shown in Fig. 2. When the strip 4 passes through roll stand 5 the loading of motor 29 increases and this increased flow of current through resistance 28 increases the potential acting on relay 22 to cause it to close contact element 21 at a predetermined time after it is energized. The closure of contact element 21 will cause energization of coil 36 which will move valve elements 37, 38 and 39.

The movement of valve elements 38 and 39 will permit fluid flow into cylinder 35 and passage 45 and this fluid flow to the cylinder will cause upward movement of the piston 34. The movement of valve member 37 will prevent the flow of fluid from the cylinder 35 through passage 42.

As the piston 34 moves upward valve member 47 will prevent fluid flow from passage 45 to cylinder 35 and the air in cylinder 35 above the piston will be discharged through the cylinder in passage 44. When the piston reaches the dotted line position shown in Fig. 3, the position of valve members 47 and 48 will be such as to permit fluid flow from passage 45 into the cylinder 35 on the upper side of the piston 34, and valve member 51 will be so positioned in passage 44 as to prevent discharge of fluid from the cylinder 35 on the upper side of piston 34. This increase in pressure above the piston will cause a rapid deceleration of the piston as it approaches the end of its travel. At this same time, valve member 49 will occupy the dotted line position and will be acting to shut off fluid flow from the source of fluid pressure to the cylinder below the piston 34.

The piston 34 will travel by its own momentum to move valve member 49 to completely shut off the flow of fluid to its lower side until the piston has moved to its extended position when the valve member 49 will occupy its solid line position shown in Fig. 3. The valve member 48 will occupy its solid line position as shown in Fig. 3 to prevent the flow of fluid from the passage 45 to the cylinder 35 above the piston 34.

When the piston has moved to its fully extended position it will rest against the upper stop members 53, valve member 52 will prevent flow of fluid from the cylinder above the piston through the passage 44, thus providing a final cushioning of the piston as it comes to rest at its fully extended position, and the position of valve members 49 and 50 will be such as to provide fluid pressure to act on the lower side of the piston to hold it in the extended or operative position.

At this stage of the operation of the device, the roller 12 has moved to and is held in position where it bears against the strip 4 as the strip passes between roll stands 5 and 6 and the force between the roll and the strip 4 has raised the arm 9 to the position shown in Fig. 1 with stop members 13 and 14 disengaged. In the meantime, relay 22 is held energized by the continued load on the motor of roll stand 5 and valve operating coil 36 is held energized to permit the continuous application of fluid pressure to the lower side of the piston 34 to hold the roll in the fully extended operative position.

When the end of the strip passes through the roll stand 5 or when it is desired to shut the mill down and the motor 29 is deenergized, relay 22 will be deenergized by the removal of the load from the motor 29 and this, in turn, will cause deenergization of the valve operating coil 36 and spring 40 will move the valve members 37, 38 and 39 to the positions shown in Fig. 2.

The movement of valve member 37 by the spring will permit discharge of fluid from the cylinder 35 below piston 34 through passage 42 and at the same time, valve members 38 and 39 will be moved to a position where they prevent fluid flow from the source of fluid pressure to the cylinder below the piston 34 and to passage 45. This will permit downward movement of the piston 34 under the weight of slide member 17 and roller 12 and the valve 54 will permit air to flow into the cylinder 35 above the piston 34.

As the valve member 55 moves downward with the piston near the end of its travel, it will shut off the flow of fluid from the lower end of the piston through passage 42 and will thus serve to decelerate the piston in its downward movement. The position of this valve member to perform this function is shown at 55' in Fig. 3. When the piston has moved to its fully retracted position, it will occupy the position shown in Fig. 2 and roller 12 will occupy the dotted line position shown in Fig. 1.

The release of the pressure between strip 4 and roller 12 will cause weight 10 to move arm 9 downwardly until stop member 13 engages stop 14.

If now it is desired to perform maintenance operations on the rolls of roll stand 6, the stop 14 will be moved about pivot 32 to its dotted line position shown in Fig. 1 and the arm 9 will be permitted to turn about its pivot until stop 13 occupies the dotted line position against stop 33. In this position, the roll and the guides 18 will occupy the dotted line position of Fig. 1 and the guide 31 may be slid on the shelf 30 to the dotted line position.

It will be seen that I have provided a simplified and effective means for governing the positioning of the tension roller of a strip tensioning device for a tandem stripmill wherein the positioning of the roller in operative and inoperative position is under control of the loading of one of the roll stands, and wherein the tension roll carrying frame may be moved from its normal position to provide clearance for maintenance work on the roll stands.

In compliance with the requirements of the patent statutes, I have shown and described herein a preferred embodiment of my invention. It is understood, however, that the invention is not limited to the precise construction shown and described, but is capable of modification by one skilled in the art, the embodiments herein shown being merely illustrative of the principles of my invention.

I claim as my invention:

1. In a strip tensioning device for a strip rolling mill, an arm having a stationary pivot, a member supported by said arm over which the strip may travel in passing from one roll stand to another, means for moving said member along said arm to and from a position in engagement with the strip, and means tending to rotate said arm about its pivot to cause said member to bear against the strip and to thus produce tension in the strip.

2. In a strip tensioning device for a strip rolling mill, an arm having a stationary pivot, a

member supported by said arm over which the strip may travel in passing from one roll stand to another, means for moving said member along said arm to and from a normally operative position where it may engage the strip, said moving means comprising a fluid-operated device, and means tending to rotate said arm about its pivot to cause said member to bear against the strip and to thus produce tension in the strip.

3. In a strip tensioning device for a strip rolling mill, a pivoted arm, a member supported by said arm over which the strip may travel in passing from one roll stand to another, said arm being disposed at an angle with the pass line of the mill so that rotation of the arm to increase this angle will cause said member to bear upon and tension the strip, means tending to rotate said arm in a direction to increase its angle with the pass line, a first stop means for limiting the rotation of the arm, a second stop means positioned to limit the rotation of the arm to a second position in which the arm is substantially normal to the pass line, and means for rendering said first stop means ineffective so that the arm may rotate to said second position.

4. In a strip tensioning device for a strip rolling mill, a pivoted arm, a member over which the strip may travel in passing from one roll stand to another supported by said arm, said arm being disposed at an angle to the pass line of the mill, means tending to cause rotation of said arm to cause said member to tension the strip, a pivot stop means for limiting the displacement of the arm in the direction in which it tends to rotate to a position near its normal operating position, a guide plate extending from near the rolls of one stand to near the arm in its normal operating position, said guide plate being slidable toward said arm a greater distance than the normal clearance between said plate and said arm to permit maintenance of the roll stand, a second stop means positioned to limit the rotation of said arm to a position where the arm will not interfere with the necessary movement of said guide plate, and means for rendering said first stop means ineffective so that said arm may rotate to said second position.

5. In a tensioning device for a strip rolling mill, a pivoted arm, a member over which said strip may travel in passing from one roll stand to another supported by said arm, means for moving said member along said arm to and from a normally operative position where it may engage the strip, said moving means comprising a fluid-operated piston, automatic valve means for so controlling the flow of fluid to the piston cylinder as to cause the piston to move to an extended position, to cushion the piston to stop it at the end of its movement to the extended position, to hold the piston in its extended position, and to cushion the piston to stop it at the end of its movement to a retracted position, and means tending to rotate said arm about its pivot to cause said member to bear against the strip when in the extended position and to thus produce tension in the strip.

6. In a tensioning device for a strip rolling mill, a pivoted arm, a member over which said strip may travel in passing from one roll stand to another supported by said arm, means for moving said member along said arm to and from a normally operative position where it may engage the strip, said moving means comprising a fluid-operated piston, automatic valve means for so controlling the flow of fluid to the piston cylinder as to cause the piston to move to an extended position, to cushion the piston to stop it at the end of its movement to the extended position, to hold the piston in its extended position, and to cushion the piston to stop it at the end of its movement to a retracted position, an electrically controlled valve for governing the flow of fluid to and from the cylinder of said piston to control the movement of said piston to the extended and retracted positions, and means tending to rotate said arm about its pivot to cause said member to bear against the strip when in extended position and to thus produce tension in the strip.

7. In a tensioning device for a strip rolling mill, a pivoted arm, a member over which said strip may travel in passing from one roll stand to another supported by said arm, means for moving said member along said arm to and from a normally operative position where it may engage the strip, said moving means comprising a fluid-operated piston, automatic valve means for so controlling the flow of fluid to the piston cylinder as to cause the piston to move to an extended position, to cushion the piston to stop it at the end of its movement to the extended position, to hold the piston in its extended position, and to cushion the piston to stop it at the end of its movement to a retracted position, electrically operated valve means for governing the flow of fluid to and from the cylinder of said piston to control the movement of said piston to the extended and retracted positions, means responsive to the loading of the motor of a preceding mill stand for so controlling said electrically operated valve means as to cause said piston to extend said member to normal operating position in engagement with the strip while there is strip in the mill and to permit retraction of said member when there is no strip in the mill, and means tending to rotate said arm about its pivot to cause said member to bear against the strip when in extended position and to thus produce tension in the strip.

8. In a tensioning device for a strip rolling mill, a pivoted arm, a member over which the strip may travel in passing from one roll stand to another supported by said arm, fluid-operated means for moving said member along said arm to and from a normally operative position where it may engage the strip, a pressure storage container for the operating fluid for said fluid-operated means mounted on said arm, said container being so shaped and so positioned as to serve as a guide means for the strip as it passes between the roll stands in being fed through the mill, and means tending to rotate said arm about its pivot to cause said member to tension the strip.

9. In a tensioning device for a strip rolling mill, a tensioning bearing member for transmitting pressure to the strip, a first mechanism for applying pressure to said bearing member, and a second fluid pressure operated mechanism for moving said bearing member relative to said first mechanism to and from operative relation with the strip.

10. In a tensioning device for a strip rolling mill, a tensioning bearing member for transmitting pressure to the strip, a first mechanism for applying pressure to said bearing member, and a second mechanism for moving said bearing member relative to said first mechanism to and from operative relation with the strip.

GERHARD P. LESSMANN.