

Dec. 27, 1932.

B. R. SHOVER

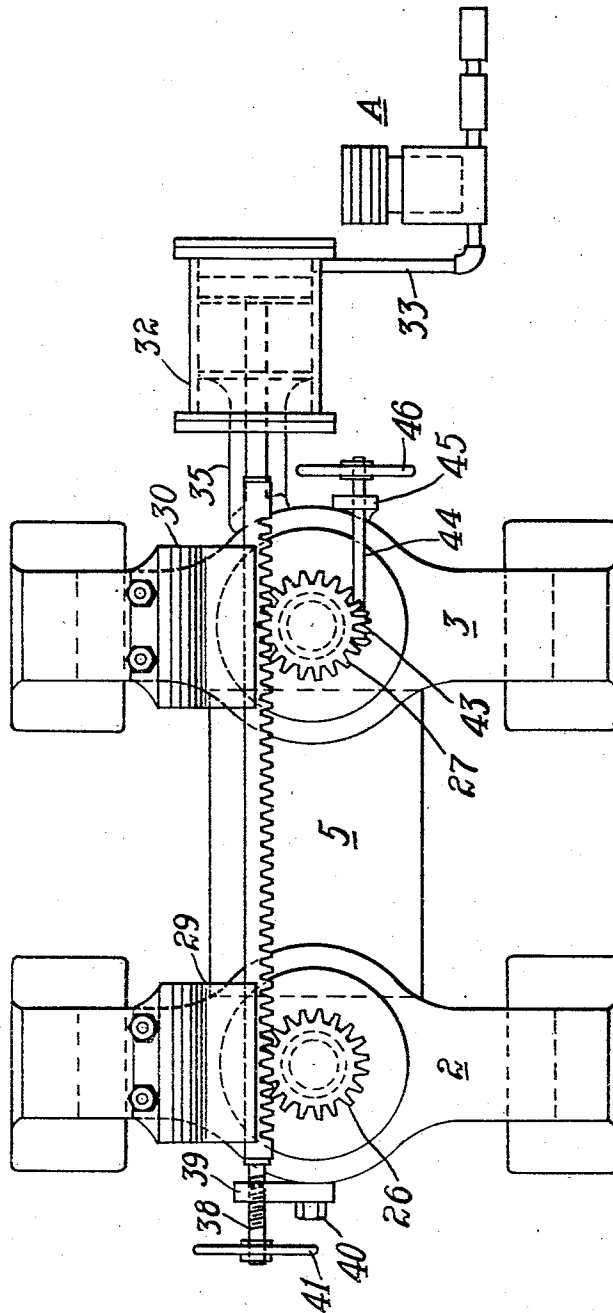
1,891,955

ROLLING MILL

Filed Nov. 23, 1929

3 Sheets-Sheet 1

Fig. 1.



INVENTOR

Barton R. Shover
By Green & McCallister
His Attorneys

Dec. 27, 1932.

B. R. SHOVER

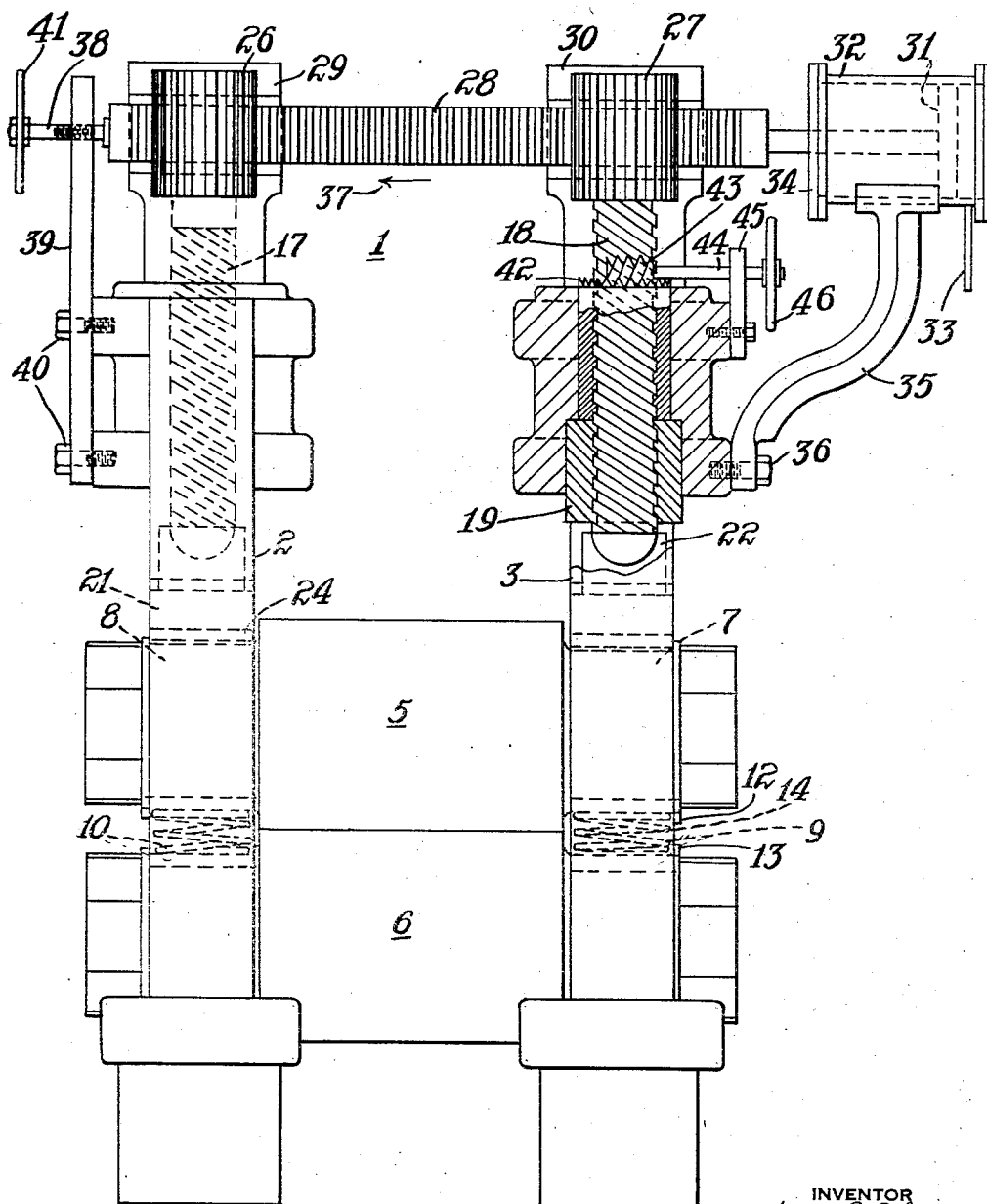
1,891,955

ROLLING MILL

Filed Nov. 23, 1929

3 Sheets-Sheet 2

Fig. 2.



INVENTOR
Barton R. Shover
By Green & McCallister
His Attorneys

Dec. 27, 1932.

B. R. SHOVER

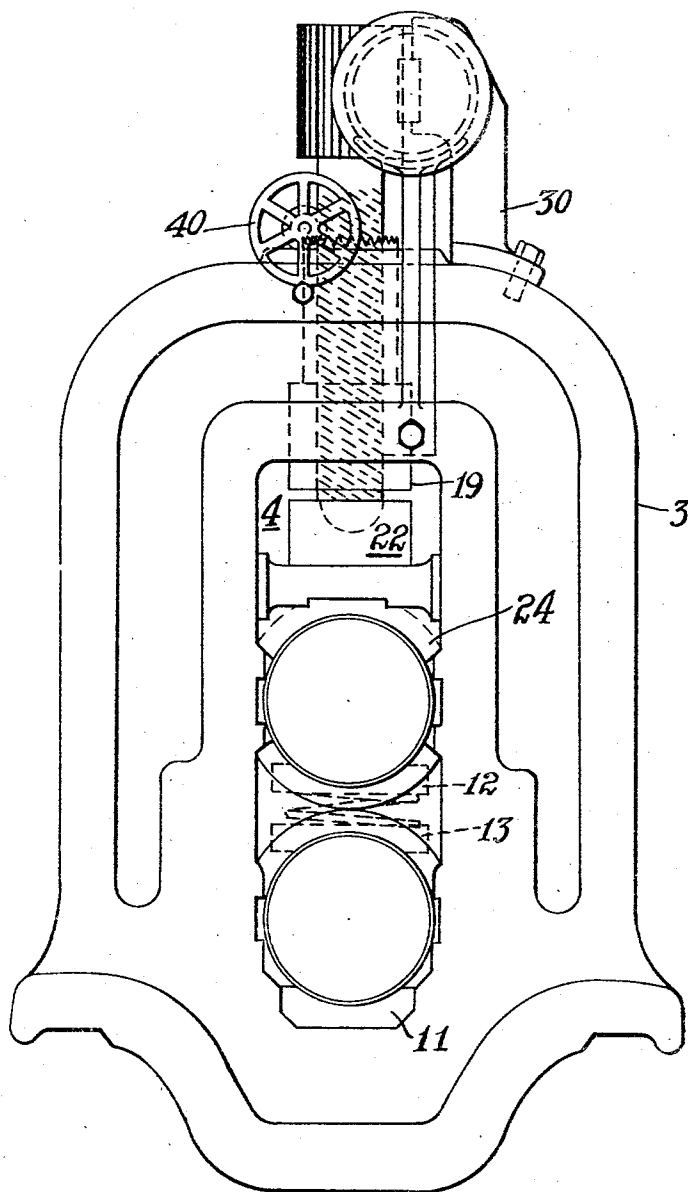
1,891,955

ROLLING MILL

Filed Nov. 23, 1929

3 Sheets-Sheet 3

Fig. 3



INVENTOR
Barton R. Shover
By *Green & McCallister*
His Attorneys

UNITED STATES PATENT OFFICE

BARTON R. SHOVER, OF PITTSBURGH, PENNSYLVANIA, ASSIGNOR TO ALLEGHENY
STEEL COMPANY, A CORPORATION OF PENNSYLVANIA

ROLLING MILL

Application filed November 23, 1929. Serial No. 409,240.

This invention relates to rolling mills and particularly to mills for rolling metal sheets, strips, plates and the like.

An object of this invention is to control the rolling pressures to which sheets are subjected during the rolling operations.

Another object of the invention is to provide a rolling mill that shall be particularly adapted to the method, disclosed in the United States Letters Patent No. 1,367,015, granted to V. B. Browne, of controlling the grain growth in magnetic alloy sheets.

A still further object of the invention is to provide an improved rolling mill of the type shown in the patent to Browne No. 1,367,015 and employed for carrying out the method disclosed in said patent.

As stated in the aforesaid patent to Browne No. 1,367,015, the pressure to which the alloy sheets are subjected during the rolling operations, is controlled in accordance with the degree of heat used in obtaining a certain grain structure, so that the strain produced in the sheets is such that the grain in the finished sheet after annealing is of a size predetermined to be the proper size to give to such sheets the desired permeability with permissible hysteresis and eddy current losses.

The invention herein disclosed comprises the novel arrangement and combination of parts substantially as set forth, and is particularly adapted to control the pressures to which magnetic alloy sheets, strips, plates and the like are subjected during the rolling operations.

For a better understanding of the invention, reference may be had to the following description taken in conjunction with the accompanying drawings in which:

Figure 1 is a top plan view of a rolling mill arranged and constructed in accordance with the invention;

Fig. 2 is a front view in elevation, partly in section, of the mill shown in Fig. 1; and

Fig. 3 is a side view in elevation of the mill shown in Figs. 1 and 2.

Throughout the drawings and the specification like characters of reference indicate like parts.

In the drawings a rolling mill designated

generally by the reference character 1 is shown that comprises housings 2 and 3 each having windows 4 therein and upper and lower rolls 5 and 6.

The rolls 5 and 6 are provided with the usual necks 7—8 and 9—10, respectively, that extend through the windows 4 of the housings. In accordance with usual practice, the necks 9 and 10 of the lower roll 6 are mounted on bearing blocks 11 (only one of which is shown—see Fig. 3); also the rolls 5 and 6 are yieldingly held apart by means of upper and lower bearing blocks 12 and 13 and a coil spring 14 located between the blocks (see Figs. 2 and 3).

In order that the roll 5 may be adjusted to any predetermined position with respect to the lower roll 6, the usual screw-downs 17 and 18 are provided, the screw-downs being employed to force the roll 5 to any predetermined position with respect to the roll 6 against the force of the resilient and yieldable means or springs 14 tending to separate and hold them in a normal operating relation or position. As shown the screw-down 17 passes through the upper part of the housing 2 and has screw thread engagement therewith, such construction being common and well known.

In rolling magnetic alloy sheets the sheets are heat treated prior to the rolling operations in order to obtain a predetermined grain structure characteristic as set forth in the patent to Browne, No. 1,367,015.

As set forth in the specification of this patent, it is necessary to control the pressure imposed on the sheets by the rolls 5 and 6 at a substantially constant value during the rolling operation for the reason that if the sheets are heated to a predetermined temperature prior to the rolling operations and if during the rolling operations the pressure imposed on the sheets by the rolls is maintained at a substantially predetermined value, the grain structure of the finished sheets will be such as is conducive to high permeability with permissible hysteresis and eddy current losses.

As pointed out in the patent to Browne No. 1,367,015, the alloy sheets are heat treated and rolled at a predetermined tem-

perature. However, it often happens that the sheets may not be of uniform temperature throughout and as a consequence of which certain sections of the sheets will be relatively soft and others will be relatively hard. Because of the variations in hardness of the sheets, the rolling pressures will vary. Also, it frequently happens that the temperature of the entire sheets drops below the predetermined value at which they should be rolled thereby causing the sheets to be harder than they would be if rolled at the proper temperature. This increased hardness causes the rolling pressures to be increased above the value which will give the proper grain growth characteristic. The grain structure characteristic of the sheets will be uniform if the rolling pressures are maintained constant throughout.

Therefore, in order to so control the rolling pressure that the finished sheets shall acquire the proper grain structure during the rolling operations, the upper part of the housing 3 is provided with an internally screw threaded bushing 19. As shown the screw-down 18 has screw-thread engagement with the internally screw-threaded bushing 19. For best results the pitch of the screw threads in the bushing 19 is relatively steep or of such a pitch as will permit the screw down 18 to automatically turn in response to an upward force being imposed on the lower end thereof by the upper roll 5. This upward force varies in accordance with the changes or variations in the rolling pressure.

At this point it is to be noted that thrust blocks 21 and 22 are interposed between the lower end of the screw-downs 17 and 18 and the necks 7 and 8 of the roll 5, the blocks being provided with arcuate bearing members 23 and 24, respectively, (see Figs. 2 and 3) which ride on the necks of the roll 5.

In order that the upward force of the roll 5 against the screw-down 18, which causes it to turn to permit upward movement of the roll, may also cause the screw-down 17 to turn simultaneously with the screw-down 18, the screw-downs 17 and 18 are provided with pinions 26 and 27 that mesh with a rack 28. The rack 28 may be guided and held in meshing relation with the pinions 26 and 27 by means of guide brackets 29 and 30 that are mounted on the top of the respective housings 2 and 3 and secured thereto by means of bolts or other suitable means. The mechanism comprising the rack and the pinions on the screws is well known in the art.

The movement of the rack 28 in response to a turning movement of the screw-down 18 is yieldingly opposed by a piston 31 which is mounted in a cylinder 32, the piston operating against the pressure of a fluid entering the cylinder through a pipe connection 33. The pressure of the fluid entering the cylinder 32 through the pipe 33 is preferably

maintained at a constant value by an accumulator or other pressure controlling device and at such a value that the piston 31 will be biased towards the end 34 of the cylinder.

The accumulator A may be of the type shown in the patent to Browne No. 1,367,015, as indicated in Fig. 1. The cylinder 32 may be mounted on a bracket 35 which is secured to the upper portion of the housing 3 by bolts 36 or other suitable means.

The movement of the rack 28 in the direction indicated by the arrow 37 may be limited by an adjustable stop member 38 which has screw-thread engagement with a bracket or standard 39 as shown in Figs. 1 and 2. The bracket or standard 39 may be secured to the upper portion of the housing 2 by means of bolts 40 or other suitable means. The adjustable stop member 38 may be adjusted to any predetermined position by means of a hand wheel 41.

In order that adjustment of the screw-down 18 may be made so that the ends of the roll 5 may be brought into exact alignment, the bushing 19 is provided with an annular gear 42 at its upper end, a construction also well known in the art, (see Figs. 1 and 2) that meshes with a worm 43. The worm 43 is mounted on a shaft 44 that extends through a bracket 45 secured to the housing 3. The shaft 44 may be turned by means of a hand wheel 46 secured to the outer end of the shaft. By turning the hand wheel 46 in the proper direction, the screw-down 18 may be moved up or down until the ends of the roll 5 are equally spaced with reference to the ends of the roll 6.

In the rolling of steel sheets of the character set forth in the patent to Browne, No. 1,367,015 it frequently happens that the sheets are not of uniform hardness throughout their lengths, that is, certain sections of the sheets will be relatively softer than other sections. Therefore, when the sheets pass between the rolls an upward force will be imposed on the upper roll 5 when the hard sections of the sheets are between the rolls. If provision were not made for permitting the roll 5 to automatically move upwardly when the hard sections of the sheets pass between the rolls, the hard sections would be subjected to a greater strain than the softer sections. Therefore, as stated in the above patent to Browne, the grain structure of the harder sections of the sheets will not be the same as the grain structure of the softer sections because the rolling pressures will not be equal or uniform through the lengths of the sheets.

As the alloy sheets pass between the rolls 5 and 6, the roll 5 will be forced upwardly when the rolling pressure exceeds a predetermined value. Since the upward force will cause the screw-down 18 to turn in such a direction that the pressure will be relieved, the screw-down 17 will also turn because the pin-

ions of the screw-downs are mechanically connected by means of the rack 28. Since the upward movement of the roll 5 is yieldingly opposed by the piston 31 acting against the fluid pressure in the cylinder, upward movement of the screw-downs will be gradual rather than abrupt.

When the rolling pressure has been relieved, the screw-downs will be automatically operated to their adjusted positions by virtue of the fact that the pressure of the cylinder biases the piston 31 towards the end 34 of the cylinder.

By controlling the rolling pressure imposed on the sheets to be rolled in the manner set forth above and by the apparatus employed for that purpose, the grain structure of the sheets will be uniform and of the desired value. Since the grain structure is of the desired value, the permeability of the sheets will be of the proper predetermined value, which permeability may be obtained without sacrificing that quality of the alloy sheets which tend to maintain the hysteresis and the eddy current losses at permissible values.

While various modifications and changes may be made in the mill herein shown and described without departing from the spirit and the scope of the invention, it is to be understood that only such limitations shall be placed on the invention as are imposed by the prior art and the appended claims.

What I claim as new and desire to secure by Letters Patent is:

1. In a rolling mill having upper and lower rolls and a screw-down for each end of the upper roll, and means for simultaneously operating the other screw-down in response to operation of the first mentioned screw-down comprising a pinion on each screw-down, a rack disposed to mesh with said pinions and means for operating one of said screw-downs in response to an excessive vertical pressure against said upper roll, and means yieldably limiting the movement of said rack in one direction, and means positively limiting the movement of said rack in the other direction.

2. In a rolling mill having upper and lower rolls and a screw-down for each end of the upper roll, and means for simultaneously operating the other screw-down in response to operation of the first mentioned screw-down comprising a pinion on each screw-down, a rack disposed to mesh with said pinions, means for operating one of said screw-downs in response to an excessive vertical pressure against said upper roll, means positioned between said upper and lower rolls yieldably holding them in a normal operating relation, and means for yieldingly limiting the movement of said rack in one direction, and means for positively limiting the movement of said rack in another direction.

3. In a rolling mill having upper and lower rolls and a screw-down for each end of the

upper roll, and means for simultaneously operating the other screw-down in response to operation of the first mentioned screw-down comprising a pinion on each screw-down, a rack disposed to mesh with said pinions and means for operating one of said screw-downs in response to an excessive vertical pressure against said upper roll, means positioned between the necks of said rolls yieldingly holding them in a normal operating relation, and pressure responsive means for yieldingly controlling the movement of said rack in one direction, and means for positively limiting the movement of said rack in another direction.

4. In a rolling mill, opposed housings, an internally threaded bushing in one of said housings, a screw-down in the other housing, a screw-down having screw thread engagement with said bushing, pinions on each of said screw-downs, a rack meshing with said pinions, means for turning said bushing and thereby adjusting one screw-down with respect to the other, so that the ends of the upper roll may be brought into exact alignment, said bushing being provided with an annular gear at its upper end, said means including a worm gear mounted on a hand-wheel controlled shaft and cooperating with said annular gear, and a pressure control device for yieldingly opposing the movement of said rack in one direction, and means positively limiting the movement of said rack in another direction.

5. In a rolling mill having upper and lower rolls, and a screw-down for each end of the upper roll, means for operating one of said screw-downs in response to an excessive vertical pressure against one of said rolls and means for simultaneously operating the other screw-down in response to operation of the first mentioned screw-down, and means yieldably limiting the movement of said screw-downs in an upward direction and positively limiting the maximum movement of said screw-downs in the opposite direction.

6. In a rolling mill having upper and lower rolls, and a screw-down for each end of one of said rolls, and means for simultaneously operating one screw-down in response to operation of another screw-down comprising a pinion on each screw-down, means positioned between the upper and lower rolls yieldably holding them apart in a normal operating relation, a rack disposed to mesh with said pinions and means for operating one of said screw-downs in response to an excessive vertical pressure against said roll, and means yieldably limiting the movement of said rack in one direction, and means positively limiting the movement of said rack in another direction.

7. In a rolling mill, opposed housings, an internally threaded bushing in one of said housings, a screw-down in the other hous-

ing, a screw-down having screw thread engagement with said bushing, pinions on each of said screw-downs, a rack meshing with said pinions, and means for turning said bushing to adjust said screw-downs, means for yieldingly limiting the movement of said rack in one direction and means for positively limiting the movement of said rack in another direction.

8. In a rolling mill having upper and lower rolls and a screw down for each end of the upper roll, means for simultaneously operating one screw down in response to operation of another screw down, including a pinion on each screw down, a rack disposed to mesh with said pinions, means yieldably holding said rolls in a normal separated and operating relation, means automatically raising one or both of said screw downs in response to an excessive vertical pressure against the upper roll and lowering said screw downs when said upper roll is relieved from said excessive pressure, said lowering being limited by said resilient means, and means for yieldably limiting the movement of said rack in one direction, and for positively limiting the movement of said rack in another direction.

9. In a rolling mill having upper and lower rolls and a screw down for each end of the upper roll, means for simultaneously operating one screw down in response to an operation of the other screw down, including a pinion on each screw down, a rack disposed to mesh with said pinions, means for raising one or both of said screw downs in response to an excessive vertical pressure against the upper roll, means for aiding a lowering of said screw downs when said upper roll is relieved from said excessive pressure, means for yieldingly limiting the movement of said rack in one direction, and means for positively limiting the movement of said rack in another direction.

10. In a rolling mill having upper and lower rolls, and a screw-down for each end of the upper roll, means for operating one of said screw-downs in response to an excessive vertical pressure against the upper roll, means for simultaneously operating the other screw-down in response to operation of the first-mentioned screw-down, means positioned between said upper and lower rolls yieldably holding them in a normal operating relationship, and additional means for yieldably limiting the movement of said screw-downs in one direction and positively limiting the movement of said screw-downs in the opposite direction.

11. In a rolling mill having upper and lower rolls, and a screw-down for each end of the upper roll, means holding said rolls in a normal operating relationship, means for raising said screw-downs in response to an excessive vertical pressure against the upper roll and for lowering said screw-downs when said

upper roll is relieved of said excessive pressure, said lowering being limited by said holding means, and additional means for yieldably limiting the movement of said screw-downs in one direction and positively limiting the movement of said screw-downs in another direction.

12. In a rolling mill having a pair of rolls and suitable screw-down therefor, means normally holding said rolls in a given relationship with respect to each other, means for operating said screw-downs in response to an excessive pressure upon said rolls, and additional means for yieldably limiting the movement of said screw-downs in one direction and positively limiting the movement of said screw-downs in the opposite direction, said holding means being operative for returning said screw-downs to their original position when the excessive pressure upon said rolls has been relieved.

13. In a rolling mill having upper and lower rolls and a screw-down for each end of the upper roll, means for simultaneously operating one screw-down in response to the operation of another, said means including a pinion on each screw-down, a rack disposed to mesh with each pinion, means yieldably holding said rolls in a normal operating relation, means automatically raising one or both of said screw-downs in responsive to an excessive pressure against the upper roll and automatically lowering said screw-downs when said upper roll is relieved from said excessive pressure, said lowering being limited by said resilient means, a pressure-controlling device for yieldably opposing movement of said rack in one direction, and means positively limiting movement of said rack in another direction.

14. In a rolling mill having upper and lower rolls, the combination of means co-operating with the upper roll and yieldably holding it near its normal operating position and limiting upward movement thereof, said means including means for raising the upper roll when the pressure between said rolls reaches an excessive value and lowering the upper roll when said pressure reaches a normal value, additional means positively limiting the maximum lowering of the upper roll, and resilient means normally positioning the upper roll and being an intermediary between said yieldable means and said positive means, so that the rolls will be held in a normal relation when the pressure is at a normal value, and that a piece being rolled will be subjected to a constant rolling pressure irrespective of the hardness of a given portion thereof for imparting a uniform grain structure thereto.

15. In a rolling mill having upper and lower rolls, the combination of screw-downs for each end of the upper roll, said screw-downs having a relatively steep pitch, so that

they will rotate upon a pressure exerted axially thereof, and means cooperating with said screw-downs at right angles to the axes thereof for yieldably pressing said screw-downs in a roll-compressing direction, and means cooperating with the necks of said upper roll for holding it in a normal operating relation with respect to the lower roll, said upper roll being upwardly movable against said yieldable means when an excessive pressure is encountered during a rolling operation, and said roll being returnable to an original operating position when said excessive pressure is relieved, and additional means limiting the distance to which the upper roll is lowered, so that the rolls will be held in a normal relation when the pressure is at a normal value, and that a piece being rolled will be subjected to a constant rolling pressure irrespective of the hardness of a given portion thereof for imparting a uniform grain structure thereto.

In testimony whereof, I have hereunto subscribed my name this 22nd day of November, 1929.

BARTON R. SHOVER.

30

35

40

45

50

55

60

65