Oct. 23, 1956 J. A. HENRICKSON 2,767,602

CLUSTER TYPE EDGE ROLLING MILL

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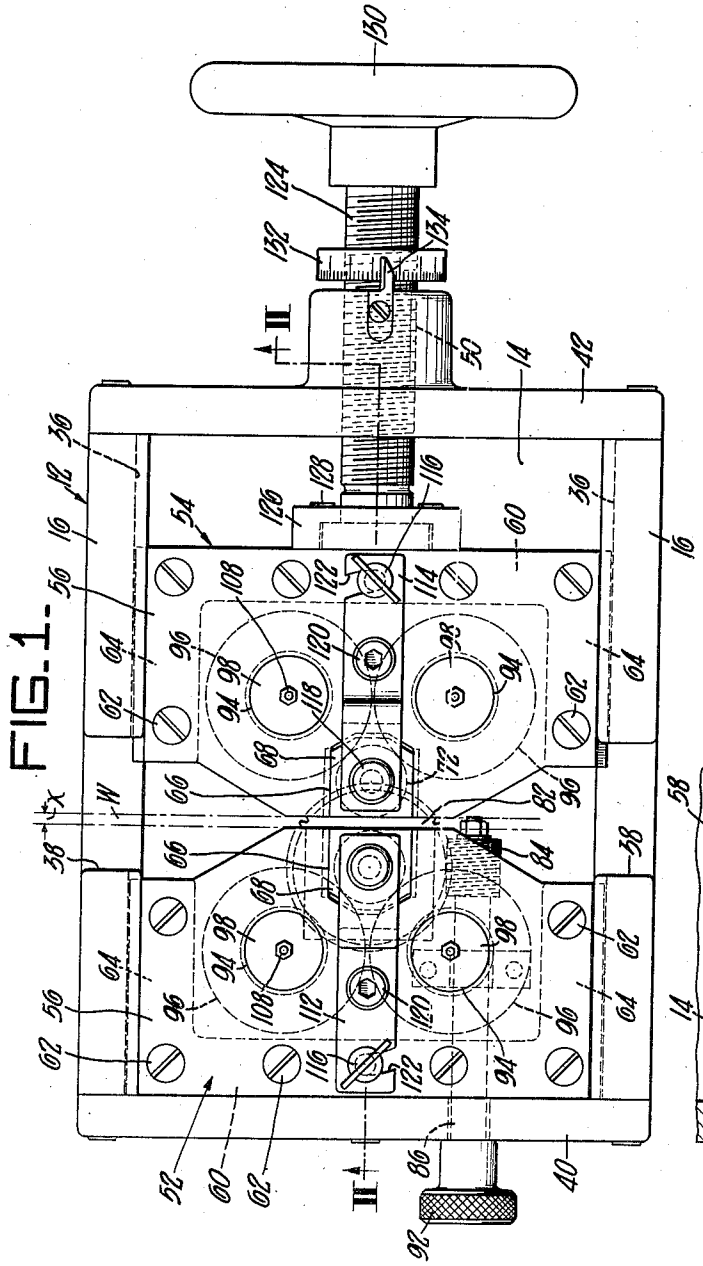


FIG. 1.

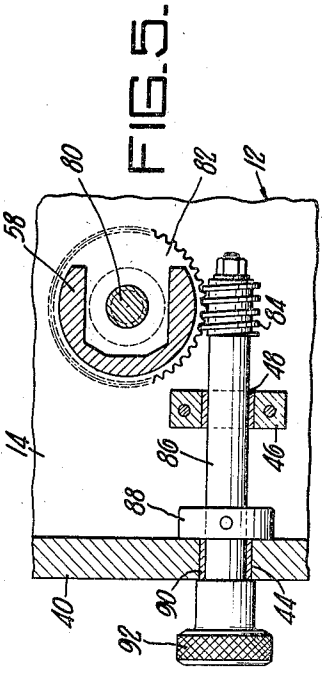


FIG. 5.

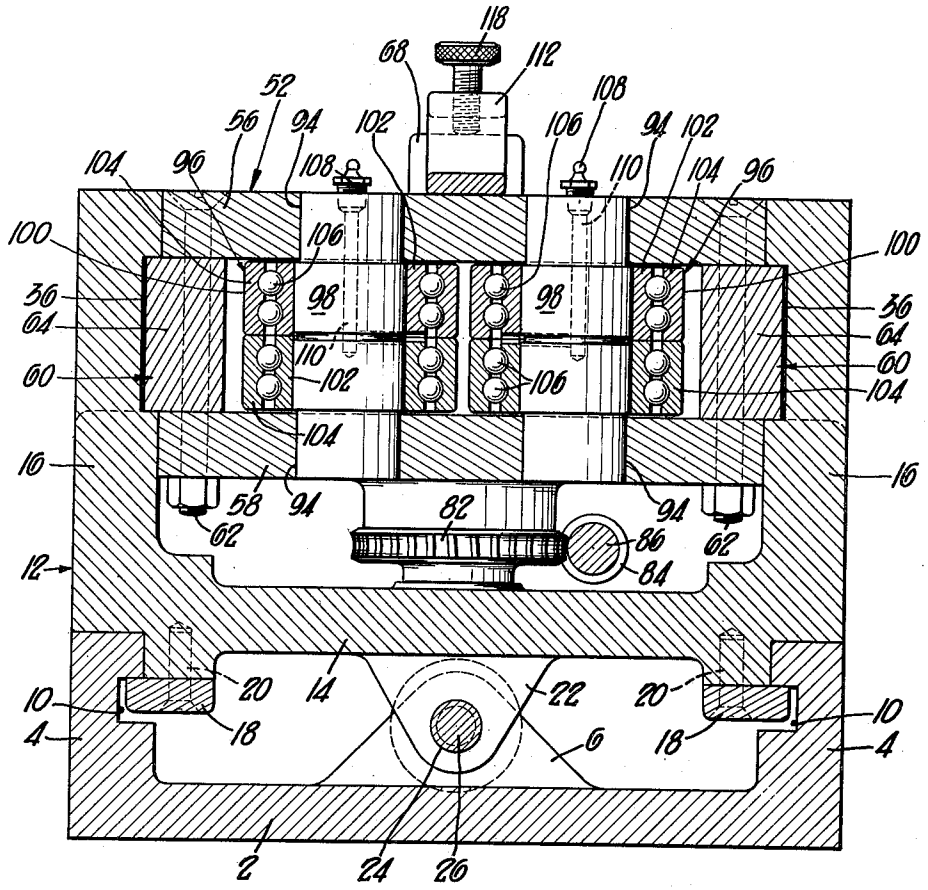
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FIG. 3.



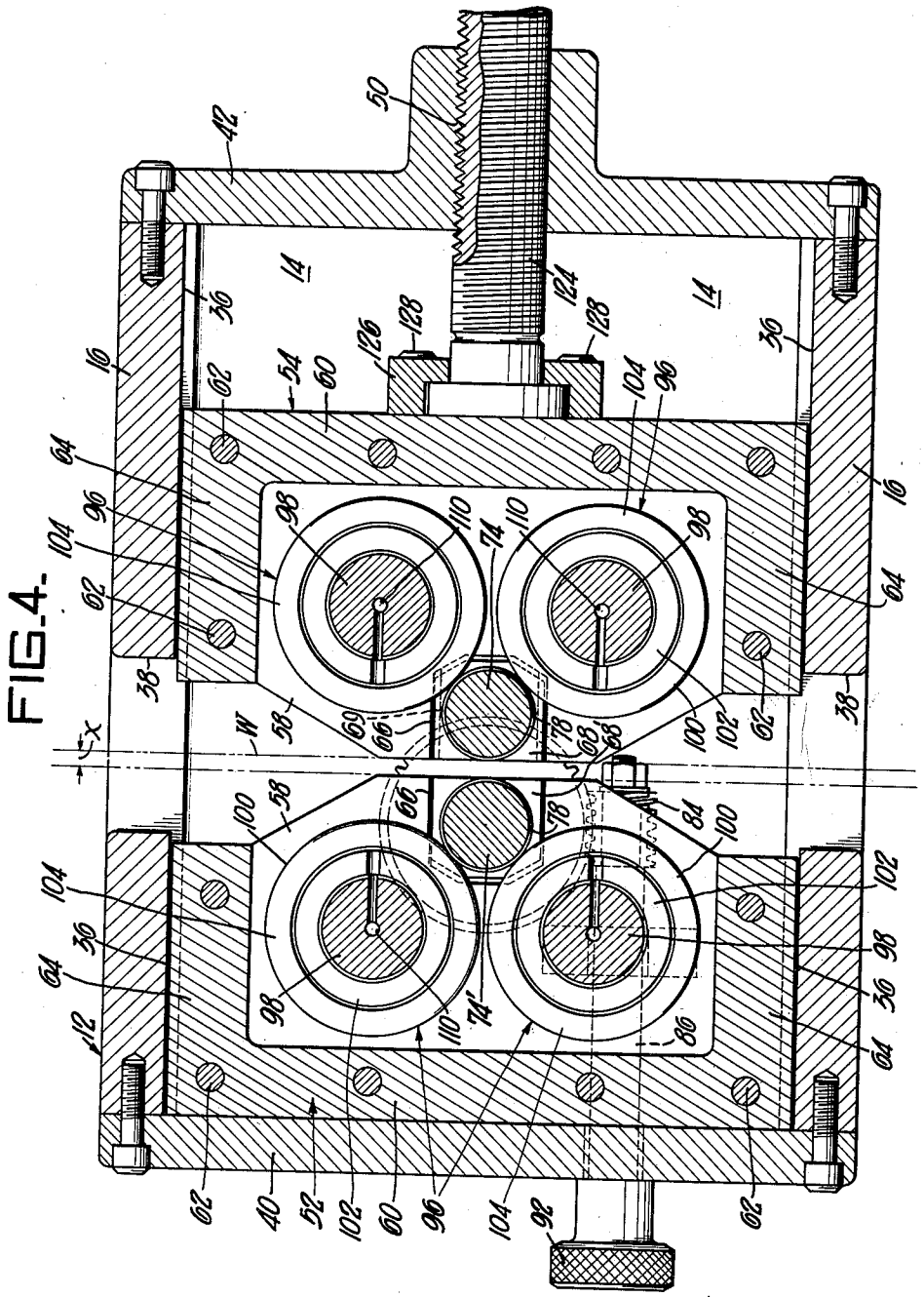
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FIG. 4.



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CLUSTER TYPE EDGE ROLLING MILL

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Application March 13, 1952, Serial No. 276,305

2 Claims. (Cl. 80—38)

This invention relates to rolling mills and more particularly to an improved cluster type mill for edge rolling moving strip.

During the surface rolling of flat metal products such as steel strip through most types of hot or cold mills, some distortion or increase in width occurs as the material is being rolled. When it is desired to accurately control the width of the strip being processed or to form a particular shape edge on the strip it is edge rolled as it enters or emerges from the surface rolling mill.

Up to the time of my invention conventional edge rolling equipment consisted essentially of a roll housing installed at the entrance or exit end of the surface rolling mill and two work rolls which were rotatably disposed in the housing with their axes vertically normal to the horizontal plane in which the strip moved. The work rolls were properly grooved to effect the desired shape on the edges of the strip. Ball, roller or babbit bearings were used around the roll necks to absorb the rolling pressures. This type of equipment was not fully adequate to produce the accuracy desired in width and edge control. Frequently inaccurate widths and misshapened edges were rolled and production interrupted when the neck bearings became overheated and required replacement. The down time that resulted from the frequent failures caused considerable loss of production and increased operating costs excessively.

It is well known that pressures encountered for a given reduction in width during edge rolling increase as the work roll diameter is increased, so that it is most practical to use as small a work roll diameter as possible to effect the greatest reduction with the least roll bearing pressure. However, in edge rolling equipment of the type used heretofore small roll diameters would have necessarily meant smaller roll necks and smaller bearings on these roll necks to absorb roll pressures or more frequent bearing failures would have resulted.

In order to realize maximum reduction with minimum roll pressure and uniform distribution of the rolling pressure over an area many times the bearing surface which could heretofore be provided on the work roll necks alone, I propose the use of relatively large diameter anti-friction bearings to back up relatively small diameter work rolls, thereby achieving the benefits of small work roll diameters without the attendant disadvantages cited above.

It is accordingly an object of my invention to provide an improved edge rolling mill wherein work rolls of relatively small diameter are backed up by at least two relatively large diameter back-up rolls which are in the form of anti-friction bearings;

It is a further object of my invention to provide a cluster type edge rolling mill which is easily and readily adjustable to edge roll moving strips of various widths; and

It is still another object of my invention to provide a cluster type edge rolling mill wherein the work rolls are so arranged as to be speedily changed with a minimum of effort.

These and other objects will become more apparent after referring to the following specification and attached drawings, in which:

Figure 1 is a top plan view;

Figure 2 is a sectional view taken on the line II—II of Figure 1;

Figure 3 is a sectional view taken on the line III—III of Figure 2;

Figure 4 is a sectional view taken on the line IV—IV of Figure 2; and

Figure 5 is a sectional view taken on the line V—V of Figure 2.

Referring more particularly to the drawings, reference numeral **2** indicates the base member of my apparatus which is provided with two up-turned sides **4** and an upwardly projecting guide flange **6**, having a hole **8** therethrough, adjacent one end intermediate the up-turned sides. Each of the up-turned sides is provided with a longitudinal slot **10** on the inner surface extending along its length. A housing, which I have designated generally by the reference numeral **12**, is slidably mounted on the base member **2** and is shaped with a bottom **14** and two side walls **16** which extend vertically upwardly from two edges of the bottom. A pair of elongated cleats **18** are fastened to the underside of the housing along the two longitudinal edges thereof by means of screws **20**. The cleats **18** project into the longitudinal slots **10** of the base to hold the housing in position and guide it when it is moved along the base as will be described below. A flange **22**, which has a threaded opening **24** therethrough, depends from approximately the mid-section of the bottom of the housing with the threaded opening **24** in alignment with the opening **8** of the guide flange **6**. Guide flange **6** and flange **22** cooperate with an adjusting screw **26** to move the housing along the base **2**. Screw **26** has a threaded end portion **28** which is threaded through the opening **24** of flange **22**. The other end of screw **26** is rotatably supported by the guide flange **6** and projects outwardly therefrom. A circumferential enlargement **30** is provided on the adjusting screw adjacent the inner surface of the guide flange **6** and a retaining collar **32** is provided adjacent the outer surface for the purpose of preventing longitudinal movement of the screw when it is being rotated. A bearing **33** is fitted in the opening of guide flange **6** to facilitate the rotation of the screw **26**. A screw operating knob **34** is attached on the projecting end of the screw in order that it may be easily rotated. Rotation of the screw **26** functions to move the housing relative to the base member.

A longitudinal groove **36** extends along the inner surface of each of the walls **16** to provide slideways for roll assemblies which will be described in detail hereinafter. A pair of aligned cut-out openings **38** are provided in the side walls **16** for the passage of strip W through the housing. End plates **40** and **42** are affixed to the ends of the housing to enclose the space between the side walls **16**, as shown in Figures 1, 2 and 4. End plate **40** is provided with an opening **44** immediately above the bottom of the housing. A bearing bracket **46** having a hole **48** therethrough projects upwardly from the bottom of the housing spaced from end plate **40** with its hole **48** in alignment with the opening **44**. End plate **42** is provided with a threaded center opening **50**. The purposes of the bracket **46** and the openings in the end plates will become apparent as the description progresses.

A pair of oppositely disposed roll assemblies **52** and **54** are slidably mounted within the housing **12** with a space designated as X therebetween. As best seen in Figures 1 and 4, space X is in line with the aligned openings **38** in the side walls **16**. Each of the roll assemblies include angularly formed top plates **56** and bottom plates **58** and a substantially squared C-shape spacer **60** there-

between all held together by means of bolts **62**. The spacer **60** is longer than the top and bottom plates so that its parallel legs **64** project from the roll assemblies and fit slidably into the longitudinal grooves **36** in the side walls of the housing. The top and bottom plates of each assembly are provided with aligned cut-out portions **66** in the edge adjacent the space X. A roll neck bearing housing or box **68** having a bearing **70** therein is fitted into the cut-out portions of each top and bottom plate to support the roll necks **72** of a pair of relatively small diameter works rolls **74** and **74'**. Thrust bearings **76** are also provided in the housings **68** to absorb the end thrust forces during rolling. The work rolls are oppositely positioned astride the space X with their axes vertically normal to the horizontal plane in which the strip W moves.

The work rolls **74** and **74'** are provided with a plurality of spaced circumferential grooves **78** which when aligned form passes for the moving strip W. The roll neck bearing housing designated **68'** has an integral externally threaded end projection **80** with a worm gear **82** fitted therearound with its bore threaded to operate in conjunction with projection **80**. A worm drive **84** is operatively engaged with the gear **82**. A shaft **86** is fitted into the worm drive at one end and extends therefrom to pass through the bracket **46** in the bottom of the housing and through the opening **44** in the end plate **40** for turning the worm drive and worm gear for adjusting work roll **74'** vertically to align the circumferential grooves **78** in the rolls. A collar **88** is fitted around the shaft **86** adjacent the inner surface of the plate **40** and the portion of the shaft projecting from the opposite surface of the plate has a diameter greater than that of the opening **44** to prevent longitudinal movement of the shaft. A bushing **90** is fitted into the opening **44** to facilitate smooth rotation of the shaft. The projecting free end of the shaft **86** is formed in the shape of a knurled wheel **92** so that the shaft may be readily rotated.

The top and bottom plates of each assembly have a pair of aligned openings **94** therethrough, one on each side of the cut-out portion **66**. A pair of ball bearing type back-up rolls **96** of relatively large diameter are mounted in each of the roll assemblies with the ends of the non-rotatable shafts **98** thereof fitted into the aligned openings **94** parallel to the axes of the work rolls **74** and **74'**. The back-up rolls in each assembly are in peripheral contact with the work roll therein. The back-up rolls **96** are each made up of a pair of ball bearings **100** mounted on a common stationary shaft **98**. The inner race portion **102** of each of the bearings is pressed on, or otherwise fixedly mounted around, the shaft **98**. The outer race portion **104** of each bearing rotates on the bearing balls **106** which are interposed in the conventional manner between the inner and outer race portions. Although it is possible to use a single ball bearing of greater width on each shaft I have found it preferable to use two narrow width bearings as shown in order to minimize the possibility of disarrangement due to uneven wear. It will be noted that other forms of anti-friction type bearings may be used if desired. Conventional grease fittings **108** and grease feed lines **110** may be provided for lubrication purposes.

Clamps **112** and **114** hold the work roll assemblies in place. The clamp in each assembly is detachably connected at one end to the top plate **56** by means of a thumb screw **116** while the other end is detachably mounted on the roll neck bearing housing in the top plate by means of a screw **118**. Each clamp is pivotally attached at a point intermediate its ends to the top plate **56** by means of a stud bolt **120**. With this arrangement the work rolls may be easily removed by loosening the screws **116** and **118** and turning the clamp about the stud bolt **120**. Each of the clamps is slotted at its outer end as at **122** so as to permit rotation of the clamp

without the necessity of completely removing the thumb screw **116**. It is necessary only to loosen the thumb screw **116** and move the clamp out from engagement therewith.

Means are provided for moving the roll assembly **54** relative to the assembly **52** so as to vary the space X between the work rolls **74** and **74'** to adjust for the size of the strip being edge rolled. This means includes an adjusting screw **124** which is operatively attached at one end to the outer end of the roll assembly **54** by means of a bracket **126** and two pairs of stud bolts **128** which hold the bracket in connection with top and bottom plates of the roll assembly **54**. The other end of the screw passes through the threaded opening **50** in end plate **42**. The screw has a hand wheel **130** attached to its projecting end so that it may be readily turned manually. The wheel **130** is rotated to increase or decrease the space X between the work rolls to accommodate strips of various widths. A disc **132** having measuring indicia thereon may be circumferentially disposed around the portion of the screw **124** outside of the end plate **42** and a cooperating indicating point **134** may be attached to the outer surface of the end plate **42** so that the space X may be adjusted more accurately.

In operation the edge rolling apparatus of my invention is installed on the table of a surface rolling mill, not shown, adjacent the entrance end thereof with the aligned openings **38** in line with the proper pass of the surface rolling mill. When the pass of the surface rolling mill is changed the edge rolling apparatus may be shifted to the new pass by merely turning the hand screw **26** so as to move the housing **12** laterally to the desired position. When the housing **12** is properly set in position in line with the pass of the surface rolling mill, the proper amount of reduction desired to be taken in adjusted by turning the hand wheel **130** to increase or decrease the roll pressure on the edges of the strip. The roll neck bearing housings **68** and **68'** fit slightly loosely in the cut-out portions **66** so that the works rolls are free to center themselves between the back-up bearings to distribute pressures equally. The lower roll neck bearing housing **68**, as shown on the right in Figure 2, is provided with integral laterally extending lugs which fit slidingly in grooves **69** which are provided in the walls of the lower cut-out portion **66** of plate **58**. This arrangement aids in preventing vertical displacement of the work roll **74**. The cluster type arrangement allows for the back-up bearings to take rolling pressure plus force in the direction of travel of the strip required to pull the strip through the work rolls. The worm gear **82**, worm drive **84** and shaft **86** provide means for adjusting the work roll **74'** relative to roll **74** to accurately align the circumferential grooves **78**. The grooves are shaped in accordance with the edge shape desired.

Drainage holes, not shown, are provided in the bottom of the housing for run-off of sludge, oil, grease accumulations, etc., from the strip being rolled and from the bearing lubricants.

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 edge rolling a strip advancing in a horizontal plane comprising a housing disposed in the pathway of said advancing strip, said housing having aligned openings through two sides thereof for the passage of said strip, a pair of oppositely disposed roll assemblies within said housing positioned with a space therebetween aligned with said openings in the sides of said housing, each of said roll assemblies including top and bottom plates with a spacer therebetween, the top and bottom plates of the assemblies each having aligned cut-out portions in the edge adjacent the other assembly, a work roll of relatively small diameter having a neck at

each end disposed vertically in each of said assemblies with its axis adjacent and normal to the pathway of the advancing strip, a bearing box having bearings therein at each end of each of said work rolls rotatively journaling the necks of said work rolls, said bearing boxes being received in said cut-out portions, the bearing box on the bottom end of one of said work rolls being received loosely in its respective cut-out portion for free axial movement, power multiplying means on the bottom of the roll assembly containing said one of said work rolls for moving the work roll therein axially, an elongated clamp member on each roll assembly extending from a detachable mounting on the top of the roll assembly at one end to a detachable connection on the upper roll neck bearing box at its other end, each of said detachable connections constituting an adjustable bearing means bearing against the upper roll neck bearing box axially of the work roll journaled therein for holding the upper roll neck bearing box in position in said cut-out portions, the adjustable bearing means on the clamp associated with said axially movable work roll limiting the axial movement of said last named roll in the direction away from said power multiplying means to thereby determine the position of said axially movable roll, each of said clamp members being pivotally connected to the top of a roll assembly at a point intermediate the ends of the clamp member, each of said work rolls having a circumferential groove therearound constituting a pass for said advancing strip, a pair of relatively large diameter anti-friction bearing type back-up rolls in each of said roll assemblies disposed parallel to and in peripheral contact with the work roll in the assembly, each of said back-up rolls including a vertically disposed stationary shaft and at least one roller bearing surrounding said shaft intermediate its ends, said shaft having its ends

supported in said housing, said roller bearing being disposed between the supported ends of said shaft and in peripheral engagement with one of said work rolls, said roller bearing having an inner sleeve and an outer sleeve, said outer sleeve bearing peripherally against one of said work rolls, and means for moving one of said roll assemblies relative to the other within said housing transversely of the path of travel of the strip to adjust the space between the work rolls.

2. Apparatus for edge rolling a strip as defined by claim 1 characterized by said housing having a bottom and two side walls extending vertically upward from said bottom, each of said side walls having a longitudinal groove on its inner surface extending along the length thereof, the top and bottom plates and spacer in each of said roll assemblies being fastened together, and said spacers projecting beyond the ends of said top and bottom plates and engaging the longitudinal grooves in the side walls of said housing.

References Cited in the file of this patent

UNITED STATES PATENTS

287,008	Daniels	Oct. 23, 1883
352,521	Daniels	Nov. 16, 1886
1,009,937	Stuting	Nov. 28, 1911
1,537,240	Lewis	May 12, 1925
1,910,148	Buckwalter	May 23, 1933
1,971,982	Holeton	Aug. 28, 1934
1,981,078	Shover	Nov. 20, 1934
2,010,211	Wood	Aug. 6, 1935
2,047,509	Iversen	July 14, 1936
2,195,502	Smitmans	Apr. 2, 1940
2,353,289	Bennewitz	July 11, 1944
2,353,290	Bennewitz	July 11, 1944