Feb. 22, 1955 R. M. EIDAL 2,702,576

ROD BENDING MACHINE

Filed Oct. 12, 1953 3 Sheets-Sheet 1

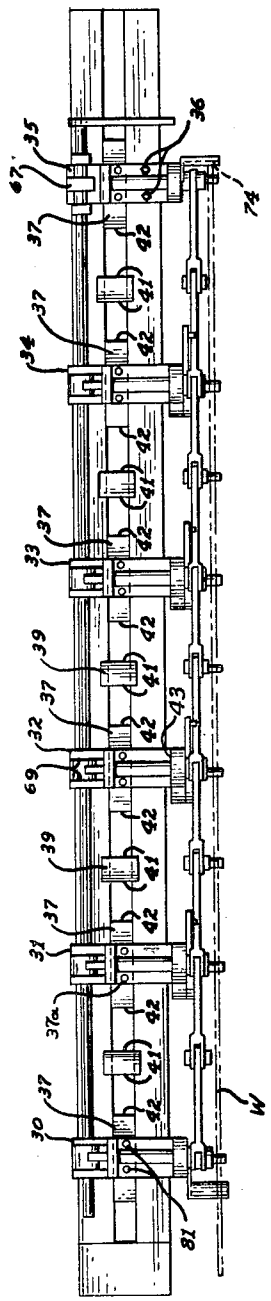


Fig. 1

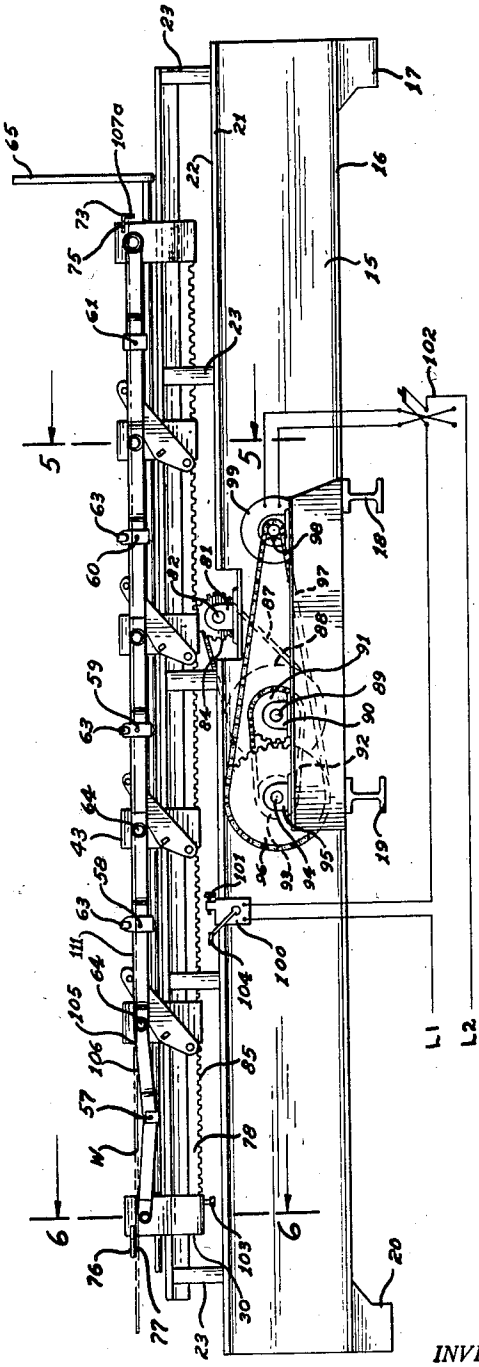


Fig. 2

INVENTOR.
ROY M. EIDAL.
BY
Willard S. Brown
ATTORNEY.

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ROD BENDING MACHINE

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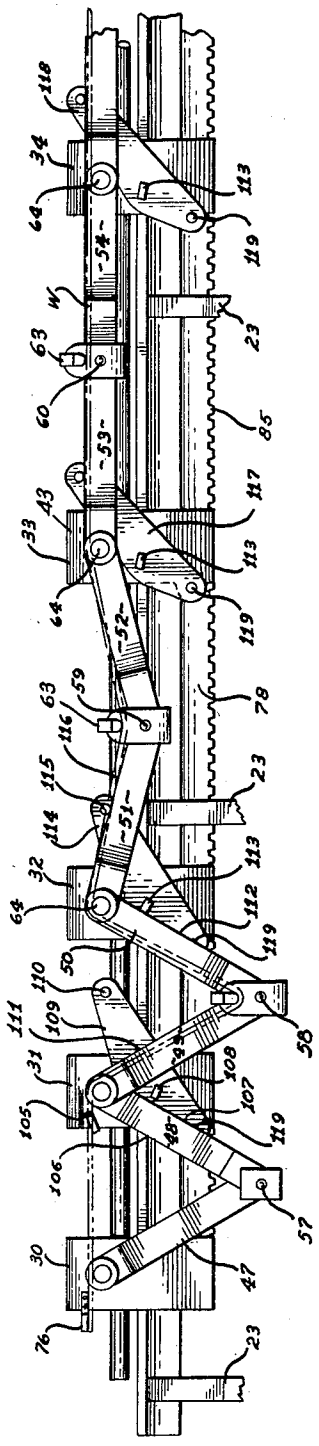


Fig. 3

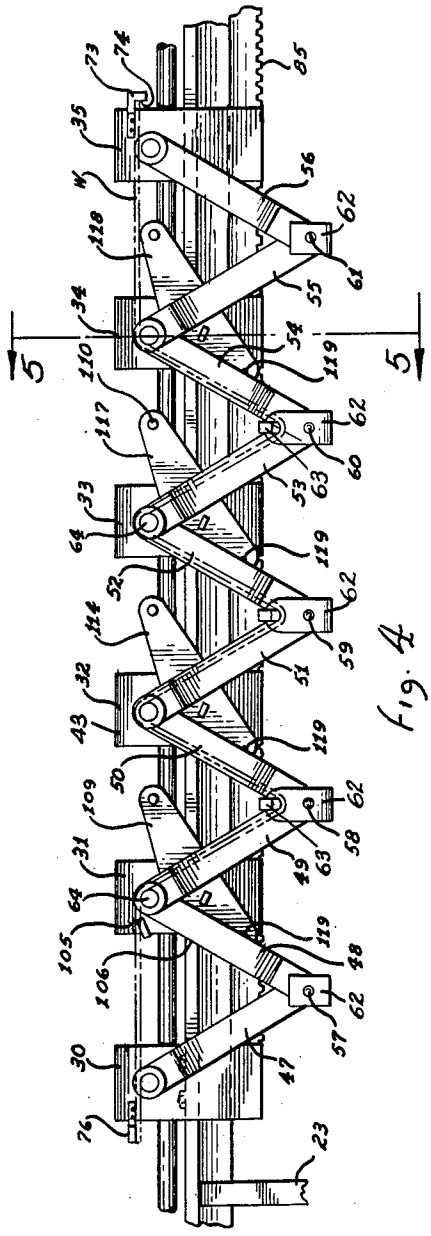


Fig. 4

INVENTOR.
ROY M. EIDAL.
BY
Willard S. Grove
ATTORNEY.

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ROD BENDING MACHINE

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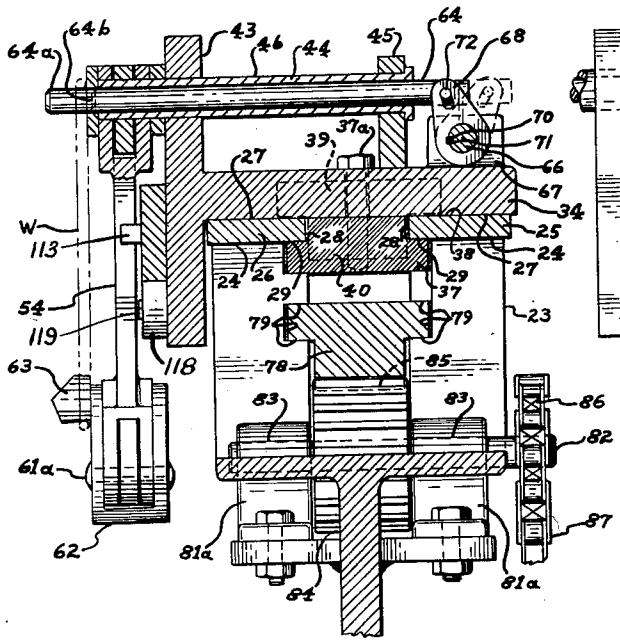


Fig. 5

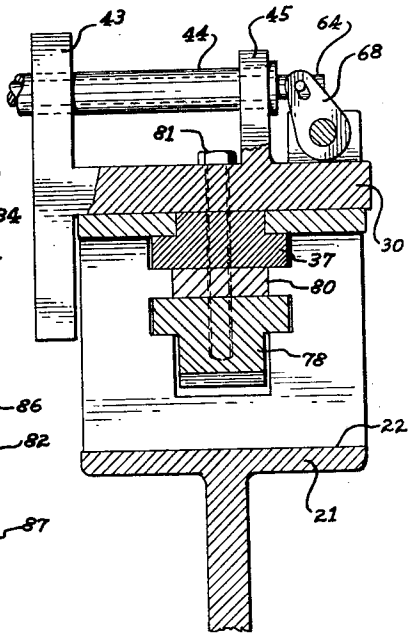


Fig. 6

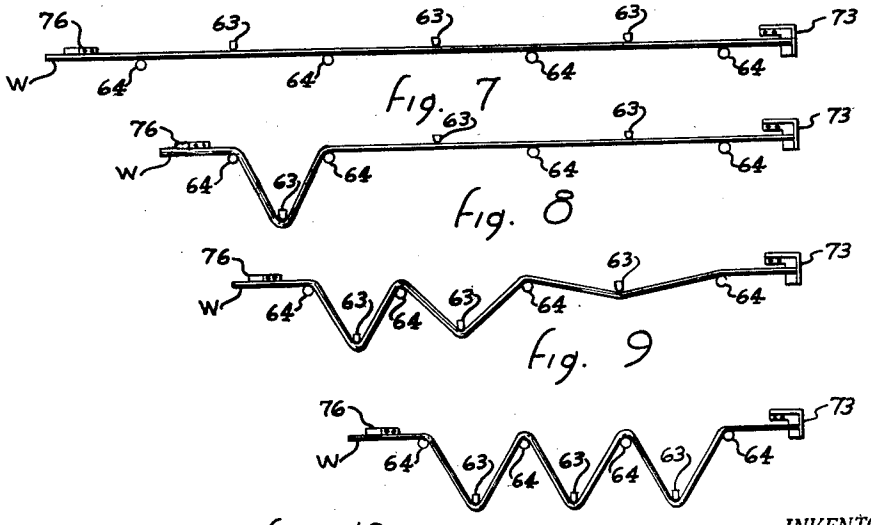


Fig. 7

Fig. 8

Fig. 9

Fig. 10

INVENTOR.
ROY M. EIDAL
BY
Willard S. Grant
ATTORNEY

United States Patent Office

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ROD BENDING MACHINE

Roy M. Eidal, Albuquerque, N. Mex., assignor to Eidal Manufacturing Company, Albuquerque, N. Mex., a corporation

Application October 12, 1953, Serial No. 385,529

8 Claims. (Cl. 153—20)

This invention pertains to improvements in rod bending machines and is particularly directed to a machine for forming a series of kinks or bends in a straight rod so as to form an element for bar joist structures.

One of the objects of this invention is to provide an improved rod bending machine in which the work may be easily placed and automatically discharged from the machine with a minimum of effort and skill on the part of the operator.

Another object of this invention is to provide an improved rod bending machine wherein the work piece may be subjected to the bending operation and easily released from the machine without effort being required on the part of the operator in lifting or prying the work piece from the machine at the completion of the bending operation.

Still another object of this invention is to provide an improved rod bending machine in which the kinks are bent in the rod in a substantially vertical plane and in which machine there is provided means to release the bent rod from the machine and allow it to drop free by gravity from working position.

Still another object of this invention is to provide an improved rod bending machine in which certain of the bending anvils and work contacting elements may be moved out of the plane of bending of the rod work piece to release the work piece automatically from working position in the machine.

Still another object of this invention is to provide a rack and pinion actuating mechanism or equivalent fluid pressure cylinder or other apparatus of the like, for actuating the machine.

Still another object of this invention is to provide an improved rod bending machine in which a series of links are progressively kinked from dead center position to effect the rod bending operation.

Still another object of this invention is to provide an automatic control mechanism for arresting the bending operation at any desired point in cycle so as to limit the bends in the work to the desired number or character automatically.

Further features and advantages of this invention will appear from a detailed description of the drawings in which:

Fig. 1 is a plan view of a rod bending machine incorporating the features of this invention.

Fig. 2 is a front elevation of the rod bending machine shown in Fig. 1 including the electric control circuit for the machine.

Fig. 3 is an enlarged fragmentary front elevation of the machine showing the beginning stages of the rod bending operation.

Fig. 4 is an enlarged fragmentary front view similar to Fig. 3 showing the position of the machine elements at the conclusion of the rod bending operation.

Fig. 5 is a section on the line 5—5 of Fig. 2.

Fig. 6 is a section on the line 6—6 of Fig. 2.

Fig. 7 is a diagram showing the condition of the work contacting elements upon placement of the straight rod in the machine ready for the bending operation.

Fig. 8 is a diagram showing the first bend made in the work piece rod.

Fig. 9 shows further stages in the bending operation.

Fig. 10 is a diagram showing the completion of the bending operations on the work.

As exemplary of one embodiment of this invention

there is shown a rod bending machine having a bed **15** comprising an H-beam having a lower flange **16** supported on suitable legs **17, 18, 19** and **20**. The top of the beam has a top flange **21** having the top surface **22** upon which is rigidly mounted upright supports **23**. On the top surfaces **24** of the upright supports **23** are fixed the rectangular longitudinally extending bar members **25** and **26** forming guideway surfaces **27, 28** and **29** as best seen in Figs. 5 and 6. A series of carriage members **30, 31, 32, 33, 34** and **35** are provided on the bar members **25** and **26**. The carriage member **35** is rigidly bolted by suitable screws **36** to the top surfaces **27** of the bar members **25** and **26**. The remaining carriage members **30** through **34** inclusive are each slidably mounted on the guide surfaces **27, 28** and **29** by a downwardly depending inverted T-shape portion **37** secured by screws **37*a*** to the underside **38** of the carriage members **30–34** inclusive. Thus, the carriage members **30–34** inclusive are accurately and positively guided for longitudinal movement along the guideways **27, 28** and **29**. A series of loose upright T-shaped stop blocks **39** resting on the top surfaces **27** of the bar members **25** and **26** and having a depending portion **40** nicely sliding between the surfaces **28** of the bar members **25** and **26** have side abutment faces **41** which engage the end abutment faces **42** of the members **37** during the bending operation to determine the extent of the bend produced in the rod or work piece W.

On each of the carriage members **30–35** inclusive there is provided an upstanding front portion **43** in which is rigidly supported the sleeve **44** which is also supported at its rear end in a support bracket **45** secured to each of the carriage members **30–35** inclusive, as best seen in Fig. 5. Upon the outer periphery **46** of the sleeve **44** is pivotally mounted a series of links **47–56** inclusive, links **47—48** being pivotally connected at **57** and their outer ends, links **49** and **50** being pivotally connected at **58**, links **51** and **52** being pivotally interconnected at **59**, and links **53** and **54** being pivotally interconnected at **60** and links **55** and **56** being pivotally interconnected at **61** by suitable pins **61*a***. At the pivotal connections **58, 59** and **60** there is provided a U-shaped anvil block **62** pivotally mounted on each of the pins **61*a*** at the pivotal connections **58, 59** and **60** and having at its upper front portion an integral anvil piece **63** for engaging the work piece W.

In each of the sleeves **44** in the carriage members **31, 32, 33** and **34** is slidably mounted the withdrawable anvil rod **64** which projects outwardly to a position **64*a*** to engage under the work piece rod W at the beginning and during the bending operation of the machine. At the conclusion of the bending operation the withdrawable anvil rods **64** are manipulated back to position **64*b*** by the release handle **65** fixed on the rockshaft **66** journaled in suitable supports **67** fixed to the various carriage members **30–35** inclusive. The rod is confined against axial movement with regard to the support **67** on the fixed carriage **35** but is free to slide and rock relatively in the remaining support **67** on the other carriages **30** to **34** inclusive. Arranged to be rocked by but slidable on the rockshaft **66** are the operating arms **68** which are confined against axial movement between the sides **69** of slots formed in the support **67** on the carriages **30, 31, 32, 33** and **34**. Suitable keys **70** are fixed in the operating arm **68** and slide relatively along in a mating slot **71** formed in the rockshaft **66** so that for any position of the carriages along the ways **27, 28,** and **29**, the lever **65** may be actuated to rock the shaft **66** to move the operating arms **68** which are connected through suitable pin means **72** to move the anvil rods **64** to either position **64*a*** or **64*b***.

Fixed to the fixed carriage member **35** is the end stop and positioning block **73** having an end stop abutment **74** and an abutment **75** over the top of the work piece rod W. On the outer movable carriage member **30** is also fixed a positioning block **76** having an abutment surface **77** over the top of the other end of the work piece rod W.

Power is applied for actuating the machine in the rod bending operation through a rack **78** which is accurately guided for longitudinal movement in the guideways **79** formed in the upright supports **23** as best seen

in Figs. 5 and 6. The outer end of the rack is rigidly fixed through the block 80 and screws 81 to the carriage member 30 only. In a suitable bearing support 81*a* there is journaled pinion shaft 82 on suitable bearings 83, and on which shaft 82 is formed a rack pinion 84 which meshes with the rack 85 formed on the underside of the rack 78.

The rack pinion shaft 82 has fixed on one of its outer ends the chain sprocket 86 over which operates the drive chain 87 which in turn operates over the sprocket wheel 88 fixed on a suitable intermediate shaft 89 journaled in the bearing support 90. A second sprocket wheel 91 is also fixed in driving relationship on the intermediate shaft 89 and over which operates a chain 92 driven by the sprocket pinion 93, the latter of which is fixed on a second intermediate shaft 94 carried on a suitable bearing support 95. The second intermediate shaft 94 carries a large sprocket wheel 96 which is driven through the chain 97 from the motor pinion 98 of the main drive motor 99. The electric motor 99 is energized from a suitable power source such as the lines L1 and L2, L1 having a limit switch 100 adjustably mounted along the upper flange 21 of the bed 15 by a thumb screw 101. Lines L1 connected through limit switch 100 and L2 are connected to a suitable motor reversing switch indicated generally at 102. Limit switch 100 is actuated by a trip dog 103 fixed on the movable carriage member 30 which engages the actuating arm 104 of the limit switch 100 to interrupt operation of the motor 99 at any desired stage of the bending operation. The motor 99 can therefore be reversably controlled by the switch 102 to move the rack 78 and the outer end carriage member 30 longitudinally in either direction along the bar members 25 and 26 of the machine.

The operation of the machine is as follows: The operator manipulates the reversing switch 102 to a position to energize motor 99 to cause the rack 78 and the outer carriage member 30 to be moved as far as possible, to the left in Figs. 1 and 2, so as to stretch out all of the links 47–56 inclusive in a straight line as best seen in Fig. 2. Thus, all of the links are positioned with their toggle action on dead center. It is to be noted, however, that the links 47—48 are restricted from getting into the dead center position arrived at by all of the other links by a stop 105 which engages the upper surface 106 of the link 48, the stop 105 being preferably fixed to the movable carriage member 31, so that the linkage 47—48 has its pivotal connection 57 slightly depressed below the normal straight line of full stretch out of all the remaining links as best seen in Fig. 2. The work piece or rod W is then placed in the machine with its one end 107*a* abutting against the stop and locating surface 74 of the end stop and positioning block 73 and with the abutment surface 75 of this block 73 over the top of the work piece rod W. The rod is supported on top of the withdrawal anvil rods 64 which at this time have been extended to the outer position 64*a* by manipulation of the control lever 65. The outer end of the work piece rod W is placed under the abutment surface 77 of the positioning block 76 so that at the start of the operation the straight rod is positioned in the machine as best seen in Fig. 2.

The operator then manipulates the reversing switch 102 in the opposite direction reversing the motor 99 and now causing the rack 78 to move to the right, Fig. 2, to begin the bending operation. Since the combination of the work rod W and the fact that all of the links, except the links 47—48, are on dead center the first thing that happens is that the links 47—48 fold up as the carriage member 30 moves to the right, Fig. 3. And this action continues until the surface 107 on the link 48 engages the trip piece 108 to cause the sequence lever 109 to rock in a counterwise direction, Fig. 3, bringing its pin 110 in its outer end down against the surface 111 of the next link 49. This slightly deflects the linkage 49—50 from its dead center position so that further movement of the rack under the power of the motor 99 now causes the next group of links 49—50 to begin to fold as shown in Fig. 3 to begin the first kink or bend in the rod W. The process continues until the kink formed by the links 49—50 is substantially completed whereupon the surface 112 of the link 50 engages the trip piece 113 of the sequence lever 114 to bring its pin 115 onto top surface 116 of the link 51, to again trip the second linkage group 51—52 from its dead center position to again start the next kink or bend in the work piece. This procedure continues with the further sequence levers 117 and 118 all respectively pivotally mounted on the carriage members 31, 32, 33 and 34 respectively by suitable pivots 119 until all of the kinks have been made in the work as best shown in Figs. 8, 9 and 10.

At the conclusion of the bending operation and as the machine parts arrive in the position shown in Figs. 4 and 10, the operator then merely swings the lever 65 to operate the rockshaft 66 to withdraw the anvil rod 64 back to position 64*b* whereupon the bent work piece automatically drops from the machine away from the anvil members 63 on to a suitable conveyor for immediate and automatic withdrawal of the work piece from the machine without skill or effort being required by the operator in getting the work from the machine after the bending operation. The cycle is then repeated as described by re-positioning lever 65 and the anvil rod 64 back to position 64*a* and re-loading the next work piece for the next operation. It is also to be understood that a whole series of rods may be bent simultaneously in this manner by placing them on the extension of the anvil 64 and 63 which, as can be seen in Fig. 5, is arranged to accommodate several rods at a time. By suitably lengthening the members 64 and 63 of course any reasonable number of rods could be bent and released automatically from the machine at one time, only a single rod being shown for illustrative purposes in this disclosure.

It is to be further noted that the limit switch 100 may be positioned along the upper flange 21 to cause the main drive motor 99 to stop at any point along the way so that if only a single bend for example, as shown in Fig. 8, were desired the limit switch could be properly set to be tripped by the dog 103 of the carriage member 30 thereby only a single kink would be made in the rod to be bent. Any other repositioning of the limit switch would, of course, give the additional bends or any degree of bending desired.

While the apparatus herein disclosed and described constitutes a preferred form of the invention, it is also to be understood that the apparatus is capable of mechanical alteration without departing from the spirit of the invention and that such mechanical arrangement and commercial adaptation as fall within the scope of the appendent claims are intended to be included herein.

Having thus fully set forth and described this invention what is claimed and desired to be obtained by United States Letters Patent is:

1. In a rod bending machine, a first series of horizontally spaced work contacting anvils located in a straight line below a rod to be bent, second series of horizontally spaced downwardly movable work contacting anvils located between said first series and above said rod to be bent, means for withdrawing said first series of anvils from under said rod to be bent to allow said rod to drop from working position in said machine, and means for simultaneously moving one anvil of said first series horizontally while moving one anvil of said second series downwardly, said pairs of one anvil of each series being sequentially actuated to complete the rod bending operation.

2. In a rod bending machine, a first series of horizontally spaced work contacting anvils located in a straight line below a rod to be bent, second series of horizontally spaced downwardly movable work contacting anvils located between said first series and above said rod to be bent, means for withdrawing said first series of anvils from under said rod to be bent to allow said rod to drop from working position in said machine, and end stop abutment engaging one end of said rod to be bent, positioning abutment means at each end of and engaging from above said rod to be bent, and means for simultaneously moving one anvil of said first series horizontally toward said end stop abutment while moving one anvil of said second series downwardly, said pair of one anvil of each series being sequentially actuated progressively in a direction toward said end stop abutment.

3. A rod bending machine comprising, a bed, longitudinally disposed guideways on said bed, a series of carriage members on said guideways comprising, a carriage member at one end of said series fixed at one end of said bed, power means connected to the last slidable carriage member at the other end of said series on said bed from

said fixed carriage member, means for reversibly energizing said power means to reciprocate said last slidable carriage member on said guideways on said bed, a link pivotally mounted at one of its ends on said fixed carriage member for swinging about a horizontal axis thereon, a link pivotally mounted at one of its ends on said last power actuated carriage member for swinging about a horizontal axis thereon, pairs of links pivotally mounted at one of their ends intermediate slidable carriage members located between said fixed carriage member and said power actuated last slidable carriage member for swinging about horizontal axes thereon, means for pivotally connecting the outer ends of said pairs of links to the outer ends of other pairs of links and to the outer ends of the links on said fixed and power actuated carriage members, retractable anvils located at the pivotal mounting of said pairs of links on said intermediate carriage members and positioned below the work piece to be bent, and further anvils located at the pivotal connection of the outer ends of said pairs links pivotally mounted on said intermediate carriage members and positioned above the work piece to be bent.

4. A rod bending machine comprising, a bed, longitudinally disposed guideways on said bed, a series of carriage members on said guideways comprising, a carriage member at one end of said series fixed at one end of said bed, power means connected to the last slidable carriage member at the other end of said series on said bed from said fixed carriage member, means for reversibly energizing said power means to reciprocate said last slidable carriage member on said guideways on said bed, a link pivotally mounted at one of its ends on said fixed carriage member for swinging about a horizontal axis thereon, a link pivotally mounted at one of its ends on said last power actuated carriage member for swinging about a horizontal axis thereon, pairs of links pivotally mounted at one of their ends intermediate slidable carriage members located between said fixed carriage member and said power actuated last slidable carriage member for swinging about horizontal axes thereon, means for pivotally connecting the outer ends of said pairs of links to the outer ends of other pairs of links and to the outer ends of the links on said fixed and power actuated carriage members, retractable anvils located at the pivotal mounting of said pairs of links on said intermediate carriage members and positioned below the work piece to be bent, and further anvils located at the pivotal connection of the outer ends of said pairs links pivotally mounted on said intermediate carriage members and positioned above the work piece to be bent, and stop means to limit upward swinging movement of said pivotally interconnected links between said last power actuated carriage member and the intermediate carriage member immediately adjacent to said last power actuated carriage member to prevent said pair of links from moving to dead center position.

5. A rod bending machine comprising, a bed, longitudinally disposed guideways on said bed, a series of carriage members on said guideways comprising, a carriage member at one end of said series fixed at one end of said bed, power means connected to the last slidable carriage member at the other end of said series on said bed from said fixed carriage member, means for reversibly energizing said power means to reciprocate said last slidable carriage member on said guideways on said bed, a link pivotally mounted at one of its ends on said fixed carriage member for swinging about a horizontal axis thereon, a link pivotally mounted at one of its ends on said last power actuated carriage member for swinging about a horizontal axis thereon, pairs of links pivotally mounted at one of their ends intermediate slidable carriage members located between said fixed carriage member and said power actuated last slidable carriage member for swinging about horizontal axes thereon, means for pivotally connecting the outer ends of said pairs of links to the outer ends of other pairs of links and to the outer ends of the links on said fixed and power actuated carriage members, retractable anvils located at the pivotal mounting of said pairs of links on said intermediate carriage members and positioned below the work piece to be bent, and further anvils located at the pivotal connection of the outer ends of said pairs links pivotally mounted on said intermediate carriage members and positioned above the work piece to be bent, stop means to limit upward swinging moviment of said pivotally interconnected links between said last power actuated carriage member and the intermediate carriage member to prevent said pair of links from moving to dead center position, said stop means comprising a stop lug fixed on said intermediate carriage member immediately adjacent to said last power actuated carriage, and an abutment surface on said stop lug engaging an upper surface on the link on said intermediate carriage member connected to the link on said last power actuated carriage.

6. A rod bending machine comprising, a bed, longitudinally disposed guideways on said bed, a series of carriage members on said guideways comprising, a carriage member at one end of said series fixed at one end of said bed, power means connected to the last slidable carriage member at the other end of said series on said bed from said fixed carriage member, means for reversibly energizing said power means to reciprocate said last slidable carriage member on said guideways on said bed, a link pivotally mounted at one of its ends on said fixed carriage member for swinging about a horizontal axis thereon, a link pivotally mounted at one of its ends on said last power actuated carriage member for swinging about a horizontal axis thereon, pairs of links pivotally mounted at one of their ends intermediate slidable carriage members located between said fixed carriage member and said power actuated last slidable carriage member for swinging about horizontal axes thereon, means for pivotally connecting the outer ends of said pairs of links to the outer ends of other pairs of links and to the outer ends of the links on said fixed and power actuated carriage members, retractable anvils located at the pivotal mounting of said pairs of links on said intermediate carriage members and positioned below the work piece to be bent, and further anvils located at the pivotal connection of the outer ends of said pairs links pivotally mounted on said intermediate carriage members and positioned above the work piece to be bent, and stop means to limit upward swinging movement of said pivotally interconnected links between said last power actuated carriage member and the intermediate carriage member immediately adjacent to said last power actuated carriage member to prevent said pair of links from moving to dead center position, and means for sequentially tripping pairs of links between said intermediate carriage members from dead center position during the bending operation on said work piece.

7. A rod bending machine comprising, a bed, longitudinally disposed guideways on said bed, a series of carriage members on said guideways comprising, a carriage member at one end of said series fixed at one end of said bed, power means connected to the last slidable carriage member at the other end of said series on said bed from said fixed carriage member, means for reversibly energizing said power means to reciprocate said last slidable carriage member on said guideways on said bed, a link pivotally mounted at one of its ends on said fixed carriage member for swinging about a horizontal axis thereon, a link pivotally mounted at one of its ends on said last power actuated carriage member for swinging about a horizontal axis thereon, pairs of links pivotally mounted at one of their ends intermediate slidable carriage members located between said fixed carriage member and said power actuated last slidable carriage member for swinging about horizontal axes thereon, means for pivotally connecting the outer ends of said pairs of links to the outer ends of other pairs of links and to the outer ends of the links on said fixed and power actuated carriage members, retractable anvils located at the pivotal mounting of said pairs of links on said intermediate carriage members and positioned below the work piece to be bent, and further anvils located at the pivotal connection of the outer ends of said pairs links pivotally mounted on said intermediate carriage members and positioned about the work piece to be bent, and stop means to limit upward swinging movement of said pivotally interconnected links between said last power actuated carriage member and the intermediate carriage member immediately adjacent to said last power actuated carriage member to prevent said pair of links from moving to dead center position, and means for sequentially tripping pairs of links between said intermediate carriage members from dead center position during the bending operation on said work piece, said sequential tripping means comprising a sequence lever pivotally mounted on each of said intermediate carriage

members, a trip piece fixed on said sequence lever adapted to be engaged by the link of said pair of links pivotally mounted on said intermediate carriage members located toward said last power actuated carriage member to operate said sequence lever, and a trip pin on said lever arranged to engage and move off dead center the other link of said last mentioned pair of links and the link pivotally connected to the outer end thereof.

8. A rod bending machine comprising, a bed, longitudinally disposed guideways on said bed, a series of carriage members on said guideways comprising, a carriage member at one end of said series fixed at one end of said bed, power means connected to the last slidable carriage member at the other end of said series on said bed from said fixed carriage member, means for reversibly energizing said power means to reciprocate said last slidable carriage member on said guideways on said bed, a link pivotally mounted at one of its ends on said fixed carriage member for swinging about a horizontal axis thereon, a link pivotally mounted at one of its ends on said last power actuated carriage member for swinging about a horizontal axis thereon, pairs of links pivotally mounted at one of their ends intermediate slidable carriage members located between said fixed carriage member and said power actuated last slidable carriage member for swinging about horizontal axes thereon, means for pivotally connecting the outer ends of said

pairs of links to the outer ends of other pairs of links and to the outer ends of the links on said fixed and power actuated carriage members, retractable anvils located at the pivotal mounting of said pairs of links on said intermediate carriage members and positioned below the work piece to be bent, further anvils located at the pivotal connection of the outer ends of said pairs links pivotally mounted on said intermediate carriage members and positioned above the work piece to be bent, said further anvils comprising an anvil block pivotally mounted on the pivotal interconnection of the outer ends of the links on said intermediate carriage members, and an anvil piece fixed on said anvil block above said last mentioned pivotal interconnection and located above the work piece to be bent.

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