July 2, 1940. L. A. SCHNEIDER 2,206,307

MACHINE FOR MAKING RAIL ANCHORS

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Fig. 1.

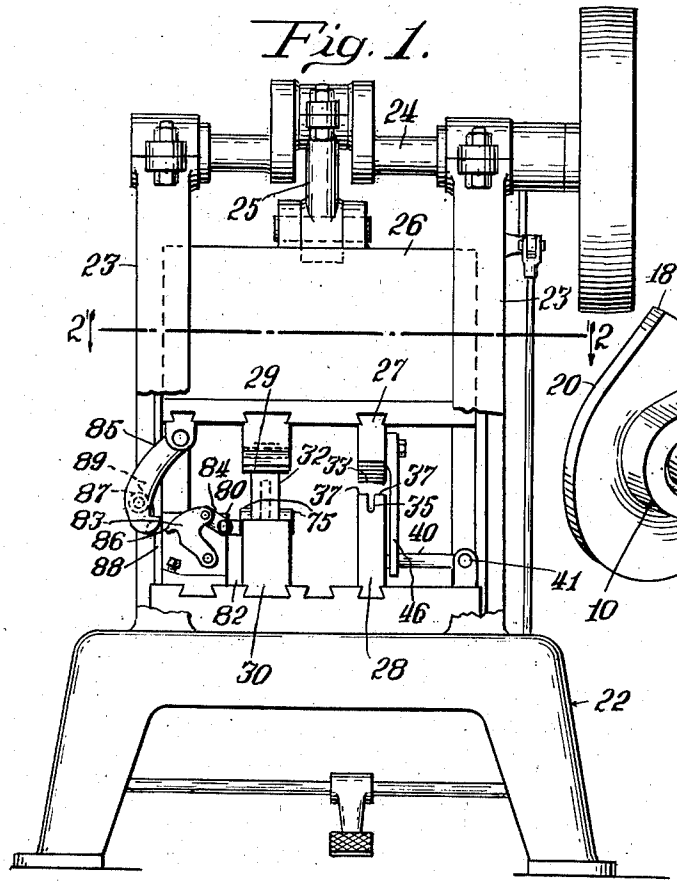


Fig. 3.

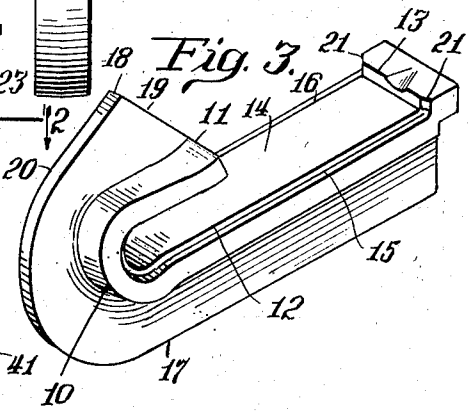
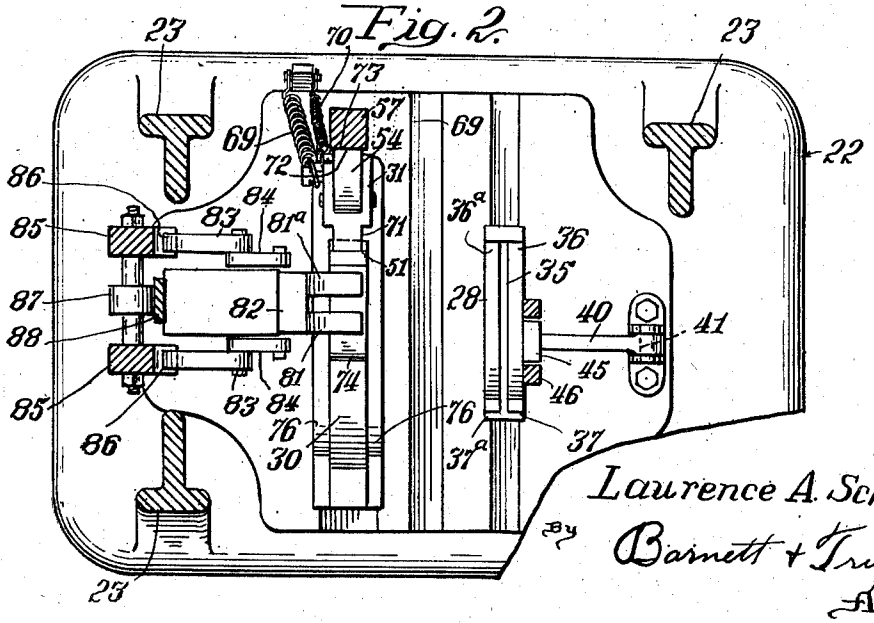


Fig. 2.



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Fig. 4.

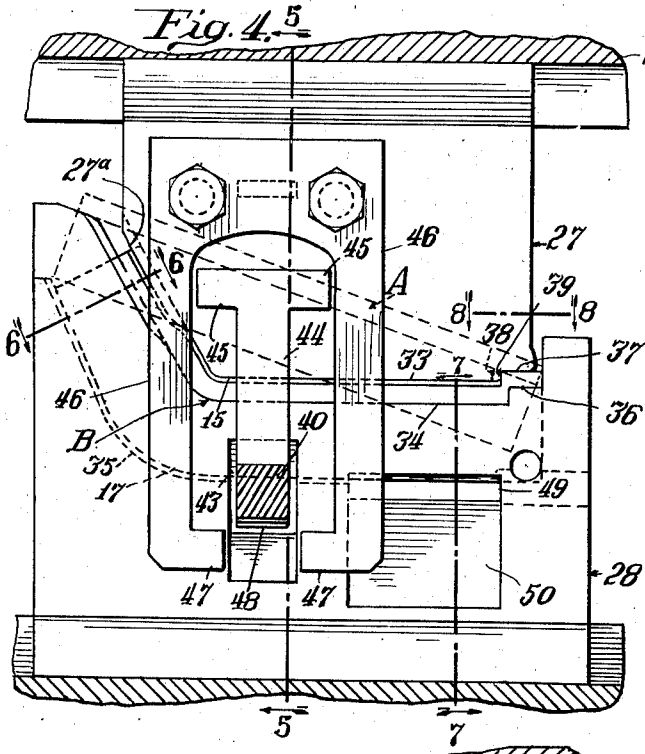


Fig. 6.

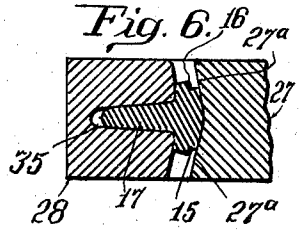


Fig. 7.

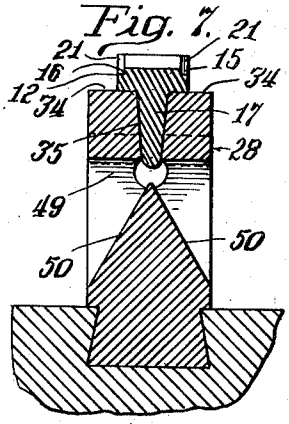


Fig. 5.

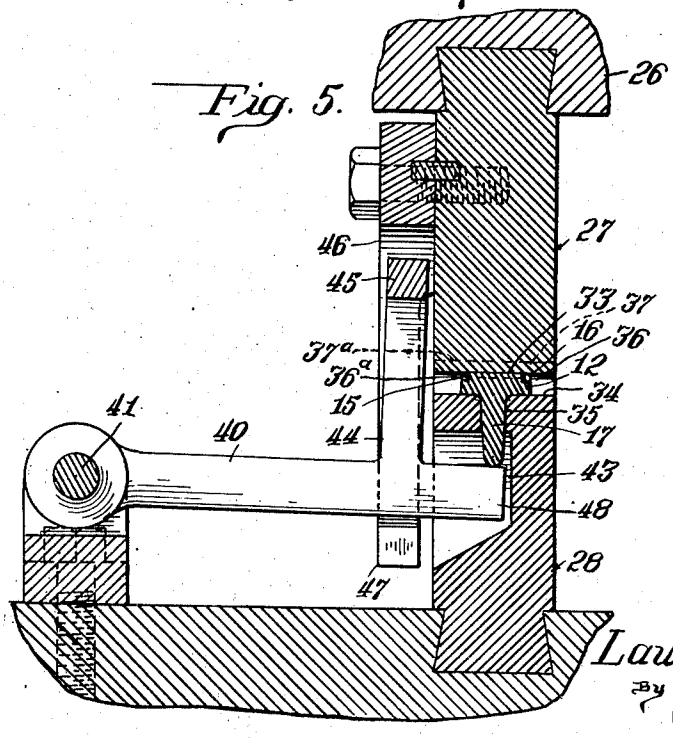
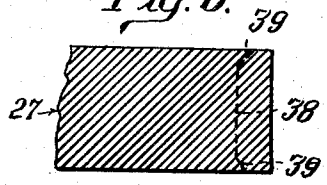


Fig. 8.



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MACHINE FOR MAKING RAIL ANCHORS

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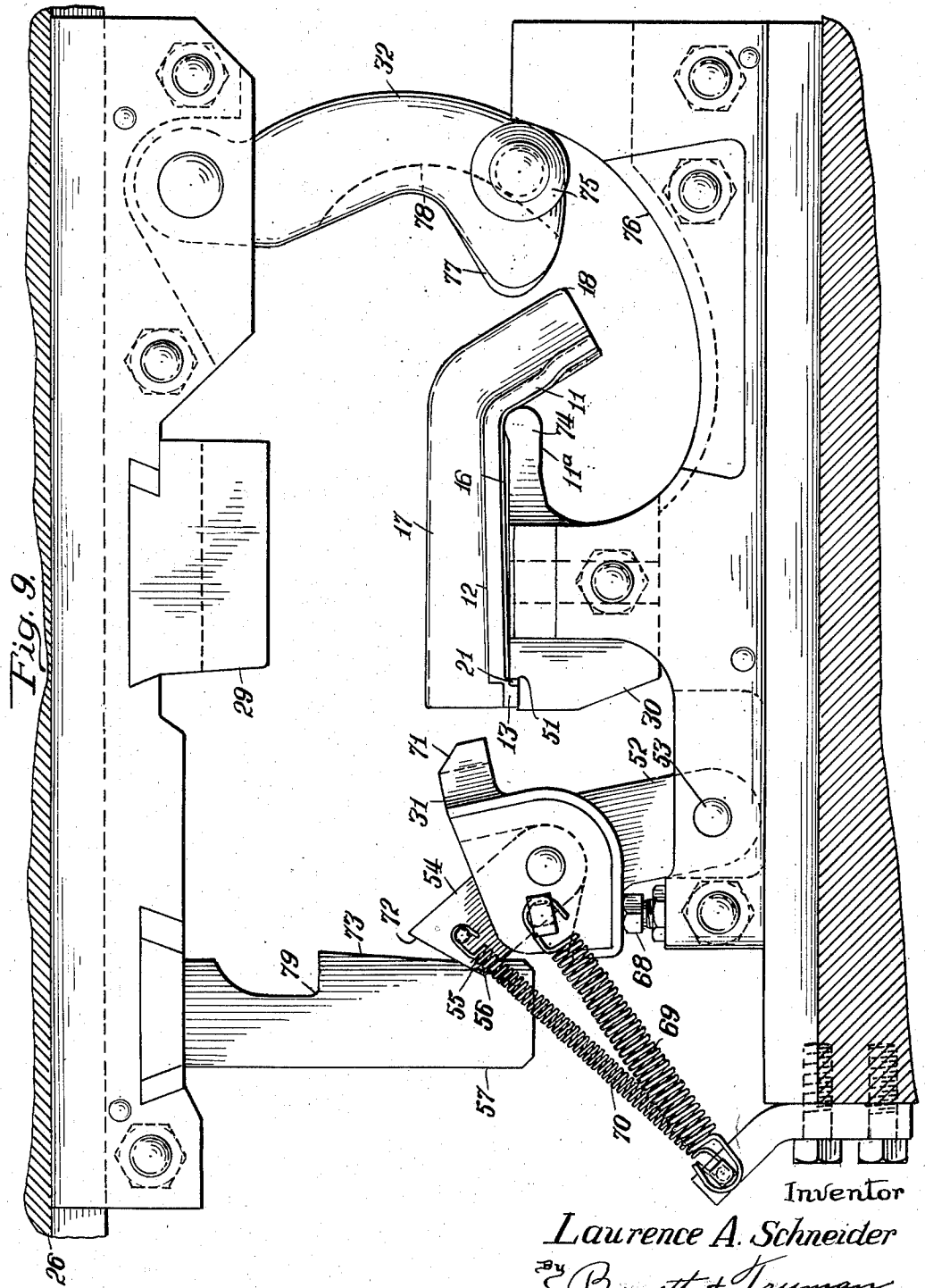


Fig. 9.

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MACHINE FOR MAKING RAIL ANCHORS

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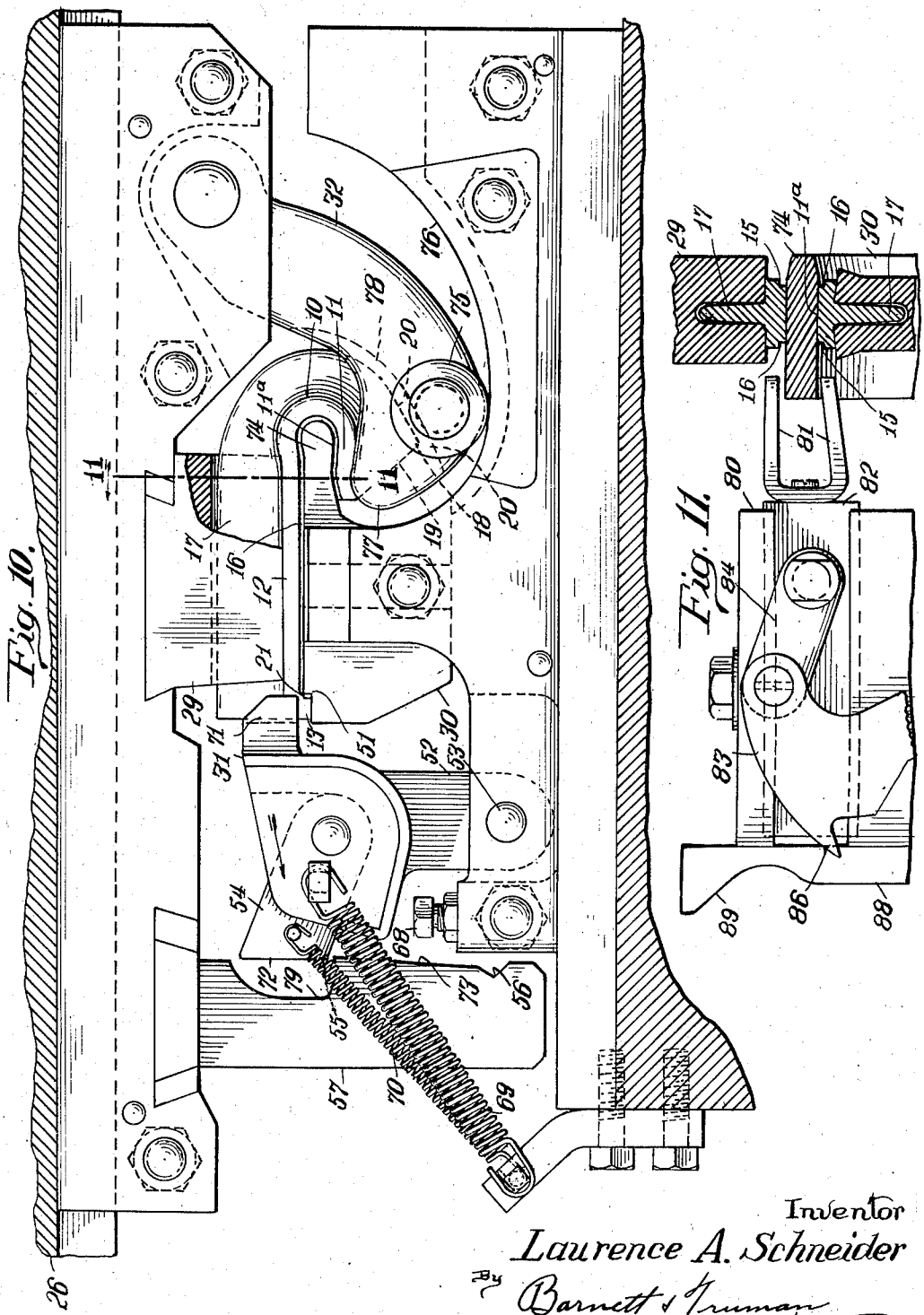


Fig. 10.

Fig. 11.

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2,206,307

UNITED STATES PATENT OFFICE

2,206,307

MACHINE FOR MAKING RAIL ANCHORS

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Application March 31, 1939, Serial No. 265,121

13 Claims. (Cl. 29—34)

This invention relates to certain new and useful improvements in a machine for forming railway rail anchors from bars by bending the bars into suitable form to provide portions for clampingly engaging the rail and for abutting against the rail supporting structure.

An object of the invention is to provide, in a machine of the above type, certain new and improved constructions suitable for use in connection with the manufacture of rail anchor devices from metal bars of such cross-sectional shape or under such conditions as make it desirable to avoid direct application of bending pressure to a predetermined portion of the bar and thereby permit such portion of the bar full freedom to stretch and bend in response to the tension in the metal during the bending operation.

A further and more specific object of the invention is to provide a machine of suitable construction for use in the manufacture of rail anchor devices from metal bars of T-shaped cross-section or of such other cross-sectional configuration as may make it desirable to bend the bar by application of bending pressure exclusively to the horizontal portions of the bar. In this connection the invention contemplates the provision of forming dies which are suitably recessed to receive the relatively thin central web portion of a T-shaped bar and which at the same time will insure against the collection of excessive amounts of scale in the recess of the die.

Another novel feature of the present invention includes means for loosening or partially ejecting the metal blank from a die member and means in the form of a wing arm of novel construction for applying bending pressure to the bar at opposite sides of the outwardly or vertically disposed ribs thereof.

Further objects and advantages of the invention will be readily apparent from the detailed description of the construction and operation of the several parts of the machine as shown in the drawings.

In the drawings:

Fig. 1 is a front view of a machine constructed in accordance with this invention.

Fig. 2 is a sectional plan view taken on line 2—2 of Fig. 1.

Fig. 3 is a view in perspective of a rail anchor device formed in the machine by bending a substantially T-shaped metal bar to the configuration shown and by offsetting one end of the bar to form a locking shoulder.

Fig. 4 is a side view of cooperating die members for performing certain bending and pressing operations on the T-shaped bar and illustrating also means operable automatically for loosening the bar in the die.

Figs. 5, 6 and 7 are sectional views taken on lines 5—5, 6—6 and 7—7 of Fig. 4.

Fig. 8 is a fragmentary sectional plan taken on line 8—8 of Fig. 4 to illustrate the shoulder construction of the upper die used in connection with the offsetting operation of the T-shaped bar to form the locking shoulder of the anchor.

Fig. 9 is a side view of the finishing die members together with the holding and bending members of the machine in their relative position when the upper die member is in its extreme upper position.

Fig. 10 is a side view of the various elements shown in Fig. 9, but illustrating them in the positions which they assume when the upper die member reaches its extreme lower position, and

Fig. 11 is a view on a somewhat larger scale of the knock-off mechanism shown in Fig. 1; the said Fig. 11 being taken on line 11—11 of Fig. 10.

The machine herein illustrated is designed specifically for the manufacture of a rail anchor device of the type and cross-sectional contour shown in Fig. 3 of the drawings. The said anchor device may be described generally as comprising a metal bar of T-shaped configuration in cross-section. One end of the bar is bent into hook form, as indicated by the reference numeral 10, to provide upper and lower jaw portions 11 and 12, which are adapted to be driven onto one flange of a rail base. The other end of the bar is offset, as indicated at 13, to provide a shoulder adapted to engage the vertical edge portion of the rail base at the other side of the rail to lock the anchor device in its applied position. The intermediate portion 14 of the bar is substantially straight and extends horizontally across beneath the rail base. The longitudinal edges adjacent the bar are offset downwardly, as indicated at 15 and 16, so that the horizontal flanges of the bar may be made relatively wide without increasing the width of the rail gripping surface of the bar. Either of the horizontal flanges is adapted to overlie a cross-tie and abut against the edge of an adjacent tie plate. The said rail anchor device is reinforced throughout its length by means of a centrally disposed rigidifying rib 17. The portion of the rib which overlies the upper jaw 11 converges into a peak 18 at a substantial distance outwardly from the inner edge of the jaw 11. The angularly disposed surfaces 19 and

20 extend downwardly in opposite directions from the said peak 18.

In forming the rail anchor device from a T-shaped bar, the bending pressure is applied directly to the horizontal portion only of the bar at opposite sides of the rigidifying rib 17. In this way the said rib 17 is left free to stretch both vertically and lengthwise of the bar during the bending operation and thereby insures the proper positioning of the peak 18 of the rib relative to the inner end of the jaw 11. This freedom of the rib 17 to stretch during the bending operation insures that the height of the peak 18 will be equal to or greater than the original height of the rib. The locking shoulder 13 is preferably formed at 21 to extend outwardly at an angle relative to the edge portion of the rail base so as to restrict the effective length of the said shoulder 13.

The machine assembly for making the said anchor may be described briefly as comprising a base 22 provided with upstanding guide members 23. A crank shaft 24 is journaled in suitable bearings at the upper end of the guide member 23. This member is connected by means of a connecting rod 25 to a vertically reciprocating head member 26 to which certain of the die elements and other operating parts of the machine are secured.

The die members for imparting the desired configuration to the metal bar comprise upper and lower members 27 and 28 of a break-down die structure and a finishing die structure comprising an upper member 29, a lower die member 30, bar clamping mechanism 31, and a wing arm 32 for applying bending pressure to one end of the bar so as to bend it into hook form around a portion of the lower die member 30. The said member 27 is fixed to the reciprocating head 26 of the machine and is formed with a lower pressing face 33 of the desired contour to form the shoulder 13 at one end of the bar and to impart a desired upward bend to the other end of the bar. The upwardly inclined end face of the said die has angularly disposed faces 27a—27a (shown best in Fig. 6) to press the horizontal flanges to angular positions at a location near the end of the bar. This formation near the end of the bar compensates for the vertical stretching of the web 17 during the final bending of the bar into hook form and insures a substantially flat rail bearing surface 11a (Fig. 11) at the end of the upper jaw of the anchor device. The upper face 34 of the die member 28 corresponds substantially to the configuration of the pressing faces of the upper die and is formed with a central recess 35 for receiving the flange 17 of the bar.

When the upper section 27 of the break-down die structure is in its up position, a straight bar, heated to a suitable temperature, is placed in the dotted line position A in the lower die member 28. In this position of the bar, the flange 17 extends into the said recess 35 while the horizontal flanges of the bar rest on the shoulders 36—36a and the surfaces 37—37a of the die member. The downward movement of the upper die member 27 brings its lower face into contact with the horizontal top surface of the bar and presses the horizontal portion of the bar between the upper and lower die structures in the manner indicated by the reference character B in Fig. 4. The vertical shoulder 38 of the upper die member is preferably inclined at opposite ends, as indicated at 39—39 in Fig. 8, so as to form the angular faces 21—21 at the locking shoulder end 13 of the anchor.

When the upper die member is raised to its upper position, a workman grasps the partially formed anchor with tongs and transfers it to the lower die member 30. In order to expedite this work, the bar is loosened and partially ejected from the die member 28 by means of the following mechanism. An arm member 40 is pivoted at 41 to the base of the machine. The other end of the arm extends into a recess 43 formed in one side face of the lower die member 28. The said recess 43 extends beyond the lower portion of the recess 35, so that the end of the arm 40 may be positioned beneath the lower edge of the rib 17 of the bar when the latter is pressed into the recess 35. The free end of the arm 40 is provided with an upstanding T-shaped arm 44 having lateral arms 45—45 at its upper end. A yoke member 46 is suitably secured to the upper die member 27 so as to move therewith. The said yoke member embraces the T-shaped arm 44 and is formed with inturned lower ends 47—47 adapted to engage the lower surfaces of the lateral arms 45—45 when the die 27 reaches a predetermined position in its upward movement and thereby causes the end 48 of the arm 40 to strike the lower edge of the flange 17 of the metal bar in a manner to force it upwardly out of the recess 35 of the lower die member. The lost motion connection between the T-shaped arm 44 and the yoke member 46 is such that the arm 40 is caused to strike the rib 17 of the bar only when the upper die member 29 has moved upwardly to a suitable position which will permit the workman to grasp the partially bent bar with suitable tongs. The recess 35 in the lower die is kept substantially clear of scale which may be dislodged from the heated bar during the bending operation. The said scale is discharged from the said recess 35 into the recesses 43 and 49. The latter preferably extends entirely through the die member 28 and its lower portion is formed with inclined walls 50—50 adapted to direct the scale to a position beyond the side plane of the die member.

When the partially formed anchor is transferred from the die member 28 to the die member 30, the said bar is arranged in an inverted position on the die 30 with the locking shoulder 13 of the bar engaging the shoulder 51 of the die member. The member 31 is caused to move into position to clamp the shoulder 13 of the bar tightly against the vertical shoulder 51 of the die member 30. This clamping operation takes place during the initial downward movement of the upper die member 29 from the position shown in Fig. 9. Preferably the clamping mechanism and the means for operating the same is in the form of a jointed lever, the lower end 52 of which is pivoted at 53 to a fixed portion of the lower die. The upper portion of the arm 52 is recessed to receive the lower end of the upper section 54 of the said jointed lever. The said section 54 is preferably in the form of a pivoted dog and is so proportioned that a corner portion 55 thereof rests in a V-shaped notch formed in a post 57. The said post depends from the reciprocating head 26 of the machine.

When the various parts of the machine are in the positions indicated in Fig. 9, the clamping lever 52 is held seated against an adjustable stop member 68 by means of a coil spring 69 and a lighter spring 70 holds the upper section 54 of the lever seated in the V-shaped notch 56.

It will be seen, therefore, that downward movement of the post 57 will exert tilting pressure on the end of the pivoted dog 54 and thereby tilt the arm 52 to clamp the end of a metal bar positioned on the die 30. Preferably, the said lever portion 52 is provided at its upper end with a bifurcated lug 71 which clamps the horizontal arms of the bar at opposite sides of the rib 17.

After the said lever member 52 is moved into clamping engagement with the bar the pivoted dog 54 assumes a position whereby the end face 72 of the dog aligns with the inclined face 73 of the vertical post 57 and thereby holds the metal bar firmly clamped to the lower die section 30 during the further downward movement of said post member, and during the bending of the other end of the bar around the portion 74 of the finishing die. This last mentioned bending of the bar is accomplished by means of the wing arm 32 which is pivotally attached to the reciprocating head 26. The lower end of the wing arm is provided with rollers 75—75 at opposite sides of the arm adapted to move downwardly and inwardly on a curved trackway 76 of the die member 30. During the said downward and inward movement of the lower end of the arm the end or toe portion 77 thereof engages the lateral flanges of the bar near the end and bends the said end around the portion 74 of the die 30, as indicated in Fig. 10. The inner face of the said wing arm 32 is preferably recessed, as indicated at 78, to receive the outwardly projecting flange 17 of the bar and thereby insures application of bending pressure to the horizontal flanges only of the bar. By applying the bending pressure in this manner while the said rib 17 is free to stretch both vertically and lengthwise of the bar, the corner 18 of the said rib will assume the position indicated in Figs. 3 and 10 to provide a peak shaped fin above the upper jaw 11 of the anchor.

When the said wing arm 32 reaches its extreme down position the upper die member 29 exerts pressure on the horizontal body portion of the bar to press it firmly against the upper face of the die member 30. The said die member 29 is recessed so as to embrace the rigidifying rib 17 of the bar and apply the said pressure to the horizontal flanges only of the bar at opposite sides of the said rib.

When the said die member 29 reaches its lowest position, the corresponding downward movement of the post 57 positions the recess 79 in the post to receive the end of the dog 54. At this instant the combined action of the springs 69 and 70 move the lever 52 out of its bar-clamping position. Immediately thereafter the reciprocating head 26 and members carried thereby are caused to move upwardly toward the up position. During this upward movement the lever 52 is held against the stop 68 by means of the heavier spring 69 but the lighter spring 70 will permit the dog 54 to swing about its pivot and again ride along the surface 73 of the post 57 until the corner 55 of the dog is again caused to snap into the V-shaped notch 56.

When the said reciprocating head 26 approaches its extreme up position, a kick-off mechanism 80 is actuated to force the finished anchor off the finishing die 30. The kick-off mechanism comprises preferably a U-shaped member 81 which embraces the portion 74 of the finishing die and a member 81a which engages the body of the anchor near the shoulder 13. The said members 81—81a are secured to a cross-head 82. A pair of pivotal arms 83 connect to opposite sides of the cross-head by means of suitable connecting links 84. A pair of hook levers is pivotally supported on the reciprocating head 26, these levers being formed at their lower ends with hooks adapted to engage projections 86 formed on the levers 83. Preferably when the reciprocating head reaches a position near the end of its upward travel the hook levers 85 move outwardly to disengage from the said projections 86 of the levers 83, whereupon the levers 83 and the associated mechanism are permitted to drop by gravity to their normal inoperative position. The means for disengaging the levers 85 from the levers 83 preferably comprises a roller 87 which is mounted on a shaft carried by the said levers 85 and moves along a vertical trackway 88 and onto an outwardly and upwardly inclined portion 89 thereof. During the next downward movement of the reciprocating head, the hook levers 85 will have camming action on the curved upper ends of the levers 83 whereby the said levers 85 will swing outwardly to clear the outer end of the projections 86 of the levers 83.

The operation of the machine may be briefly summarized as follows: The first downward stroke of the head 26 presses the hot anchor bar between the die members 27 and 28 so as to form the locking shoulder 13 of the anchor and partially bend the other end of the bar. On the next upper stroke of the head 26 the yoke 46 engages the T-shaped portion of a lever 40, near the upward extremity of the stroke, to partially eject the bent bar from the recess 35 of the lower die 28. The partially bent bar is then removed from the die 28 and placed in an inverted position on the upper face of the die 30. During the first position of the next downward movement of the member 26 the clamping arm 52 is moved into position to clamp the bar tightly upon the finishing die member 30. Immediately thereafter the wing 32 moves into engagement with the downwardly bent end of the bar and bends it around the portion 74 of the lower die. During this movement the upper die member 29 is brought into pressing engagement with the lateral arms of the bar so as to press the intermediate portion of the bar firmly against the top surface of the die 30. At this period of operation the various elements are substantially in the position indicated in Fig. 10, whereupon the coiled springs 69 and 70 operate to move the bar clamping lever 52 out of engagement with the bar. As soon as the vertically moving parts have been sufficiently elevated to clear the flange 17 of the bar, the hook levers 85 engage the pivoted arms 83 and thereby impart horizontal movement to the cross-head 82 and kick-off members 81—81a to knock the finished anchor off the die member 30.

It will be observed that the operation of the machine has been described with reference to the manufacture of a single anchor device. It will be understood, however, that the machine performs both the break-down and the finishing operations during each downward movement of the head 26.

I claim:

1. A machine for forming rail anchors from metal bars comprising, in combination, a fixed die member and a reciprocating die member for imparting an initial bend to a heated bar of angular cross-section including a horizontal por-

tion and a rigidifying flange extending outwardly therefrom, the said fixed die member being formed with a groove extending lengthwise thereof to receive the said rigidifying flange of the bar and having an opening at the bottom of the groove for the discharge of scale dislodged from the bar during the bending operation and means for loosening the bar in the fixed die member and partially ejecting it therefrom comprising an arm extending into an opening in the fixed die member at a location beneath the rigidifying flange of said bar, and operating means movable with the reciprocating die member and having a lost motion connection with said arm, whereby the said arm is caused to strike the bar and force it upwardly when the reciprocating die nears the end of its outward movement relative to the fixed die member.

2. A machine for forming rail anchors from metal bars comprising, in combination, a fixed die member and a reciprocating die member for imparting an initial bend to a heated bar of angular cross-section including a horizontal portion and a rigidifying flange extending outwardly therefrom, the said fixed die member being formed with a groove extending lengthwise thereof to receive the said rigidifying flange of the bar, means for loosening the bar in the fixed die member and partially ejecting it therefrom comprising an arm extending into an opening in the fixed die member at a location beneath the rigidifying flange of the bar, and operating means movable with the reciprocating die member and having a lost motion connection with said arm, whereby the said arm is caused to strike the bar and force it upwardly when the reciprocating die member nears the end of its upward movement.

3. A machine for forming rail anchors from metal bars comprising, in combination, a fixed die member and a cooperating reciprocating die member for imparting an initial bend to a heated bar of angular cross-section including a horizontal portion and a rigidifying flange extending outwardly therefrom, the said fixed die member being formed with a groove extending lengthwise thereof to receive the said rigidifying flange of the bar, means for loosening the bar in the said die member and partially ejecting it therefrom comprising an arm pivoted at one end to a fixed part of the machine and with the other end extending into an opening in the fixed die member at a location beneath the rigidifying flange of said bar, and operating means movable with the reciprocating die member and having a lost motion connection with said arm, whereby the said free end of the pivoted arm is caused to strike the bar and force it upwardly when the reciprocating die nears the end of its outward movement.

4. A machine for forming rail anchors from metal bars comprising, in combination, a fixed die member and a cooperating reciprocating die member for imparting an initial bend to a heated bar of angular cross-section including a horizontal portion and a rigidifying flange extending outwardly therefrom, the said fixed die member being formed with a groove extending lengthwise thereof to receive the said rigidifying flange of the bar, means for loosening the bar in the fixed die member and partially ejecting it therefrom comprising an arm pivoted at one end to a fixed portion of the machine and extending at its other end into an opening in the fixed die beneath the said bar, an upwardly extending T-shaped member on the pivoted arm, and a yoke member movable with said reciprocating die member and adapted to engage the upper end of the said T-shaped member and thereby move the pivoted arm into impact engagement with the lower portion of the bar when the reciprocating die member nears the limit of its outward movement.

5. A machine for forming rail anchors from metal bars of angular cross-section including a horizontal portion and a rigidifying flange extending outwardly therefrom, comprising, in combination, a stationary die member for receiving a bar in inverted position so that the rigidifying flange thereof extends upwardly from the supporting face of the said die member, a pivoted member movable into engagement with the bar at opposite sides of the said rigidifying flange to hold the bar on the said die member, a reciprocating member having means engaging the pivoted member to move it into its bar clamping position, a pivoted arm on the reciprocating member formed to embrace the rigidifying flange and to engage the horizontal portion only of the bar to bend the bar around a portion of the die member, and means carried by the reciprocating member for applying pressure to an intermediate portion of the bar.

6. A machine for forming rail anchors from metal bars of angular cross-section including a horizontal portion and a rigidifying flange extending outwardly therefrom, comprising, in combination, a stationary die member for receiving a bar in inverted position so that the rigidifying flange thereof extends upwardly from the supporting face of the said die member, a pivoted member movable into engagement with the bar at opposite sides of the rigidifying flange to hold the bar on the said die member, a reciprocating member having means engaging the pivoted member to move it into its bar clamping position, a pivoted arm on the reciprocating member formed to embrace the rigidifying flange and to engage the horizontal portion only of the bar to bend the bar around a portion of the die member, and a die member carried by the reciprocating member for applying pressure to an intermediate portion of the bar, and the last mentioned die member being formed with a groove for receiving the rigidifying flange of the bar, whereby the pressure is applied to the horizontal portion only of the bar at opposite sides of the rigidifying flange.

7. In a machine for forming rail anchors from metal bars, including a fixed die member on which the bar is supported, a vertically reciprocating member, and means carried on the reciprocating member for applying pressure on the bar; means for clamping the bar on the fixed die member comprising a jointed arm structure including upper and lower sections, the latter of which is pivoted at its lower end to rock into and out of its bar clamping position and is normally biased in a direction away from the bar, and means for moving said arm structure into its bar clamping position comprising a rigid member depending from the reciprocating member and formed with a notch for receiving the upper end of the upper section of said jointed arm structure and adapted to support the upper arm section at an angle to the lower section, whereby downward movement of the reciprocating member rocks the jointed arm structure into clamping engagement with the said bar.

8. In a machine for forming rail anchors from metal bars, including a fixed die member on which the bar is supported, a vertically reciprocating member, and means carried on the reciprocating member for applying pressure on the bar; means for clamping the bar on the fixed die member comprising a jointed arm structure including upper and lower sections, the latter of which is pivoted at its lower end to rock into and out of its bar clamping position and is normally biased in a direction away from the bar, and means for moving said arm structure into its bar clamping position comprising a rigid member depending from the reciprocating member and formed with a notch for receiving the upper end of the upper section of said jointed arm structure, the said upper arm section being normally biased toward the rigid member and the said notch being positioned to support the upper arm section at an angle to the lower section, whereby downward movement of the reciprocating member rocks the jointed arm structure into clamping engagement with the said bar.

9. In a machine for forming rail anchors from metal bars, including a fixed die member on which the bar is supported, a vertically reciprocating member, and means carried on the reciprocating member for applying pressure to the bar; means for clamping the bar on the fixed die member comprising a pivoted arm structure including upper and lower sections, the latter of which is pivoted at its lower end to rock into and out of its bar clamping position and is normally biased in a direction away from the bar, and means for moving said arm structure into its bar clamping position comprising a rigid member depending from the reciprocating member and formed with a notch for receiving the upper end of the upper section of said jointed arm structure, the said upper arm section being normally biased toward the rigid member and the said notch being positioned to support the upper arm section at an angle to the lower section, whereby the initial downward movement of the reciprocating member rocks the jointed arm structure into clamping engagement with the bar, the length and angular position of the said upper section being such that the change in its angular position during the said initial downward movement of the rigid member moves the end face of the arm into sliding engagement with a vertical side face of the rigid member during the continued downward movement thereof.

10. In a machine for forming rail anchors from metal bars, including a fixed die member on which the bar is supported, a vertically reciprocating member, and means carried on the reciprocating member for applying pressure to the bar; means for clamping the bar on the fixed die member comprising a jointed arm structure including upper and lower sections, the latter of which is pivoted at its lower end to rock into and out of its bar clamping position and is normally biased in a direction away from the bar, and means for rocking the jointed arm to its bar clamping position and to permit the automatic release thereof comprising a rigid member depending from the reciprocating member and formed with upper and lower notches therein for receiving the outer end of the upper arm section when the reciprocating member reaches its lower and upper positions, respectively, the said lower notch being positioned to support the said upper arm section at a suitable angle whereby downward movement of the reciprocating member rocks the jointed arm into its bar clamping position and moves the upper section of the arm into sliding engagement with a vertical face of said rigid arm and whereby the said upper arm section is biased into the upper notch to permit outward movement of the lower section when the reciprocating member reaches its lower position.

11. A machine for forming rail anchors from metal bars having a horizontal portion and a rib projecting outwardly therefrom, comprising, in combination, a die member for receiving said bar, means for clamping the bar to said die member, and means for applying bending pressure to one end of the bar comprising an arm pivotally supported at its upper end, a trackway for guiding the movement of the lower end of the arm during the bending of the arm, the said arm being recessed to receive the said rib of the bar so that the bending pressure is applied by the said pivotal arm directly to the horizontal portions of the bar at opposite sides of the rib.

12. A machine for forming rail anchors from metal bars having a horizontal portion and a rib projecting outwardly therefor, the combination of break-down dies for imparting a preliminary bend to the intermediate portion of the bar and for pressing the horizontal portion of the bar at one end thereof to a position inclined relative to the plane of said rib, and means for bending the said end portion of the bar into hook form comprising a fixed die member for supporting the bar and a wing arm positioned to apply bending pressure to the said horizontal portion of the bar which inclines relative to the side plane of the rib, whereby the said horizontal portion of the bar adjacent said rib is pressed firmly against the fixed die.

13. In a machine for forming rail anchors from T-shaped bars, the combination of break-down dies for imparting a preliminary bend to an intermediate portion of the bar and for pressing the horizontal arms of the T-bar toward the outer edge of the central rib to provide the horizontal face of the bar with an angular configuration near one end of the bar, and means for bending the said end portion of the bar into hook form comprising a fixed die member for supporting the bar and a wing arm having spaced apart bar engaging portions positioned to apply pressure to the said outwardly pressed angular portion of the said horizontal arms of the bar, whereby the said pressure together with the outward stretching of the rib adjacent the end of the bar forms a substantially flat surface at the end of the hook.

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