Aug. 13, 1968 F. HILDEBRAND 3,396,956

MACHINE FOR BENDING AND HARDENING LEAF SPRINGS

Filed Feb. 4, 1966 3 Sheets-Sheet 1

Fig.3

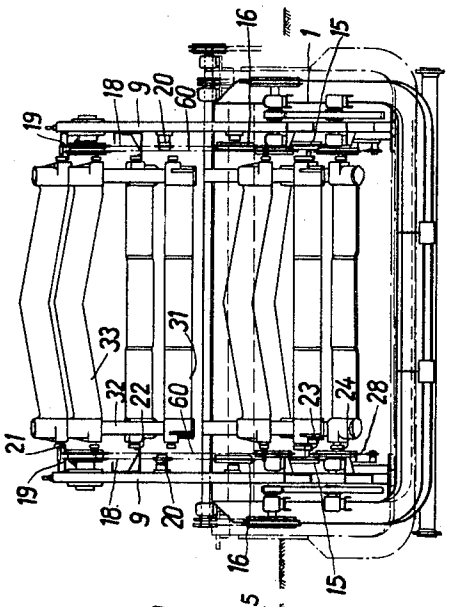


Fig.1

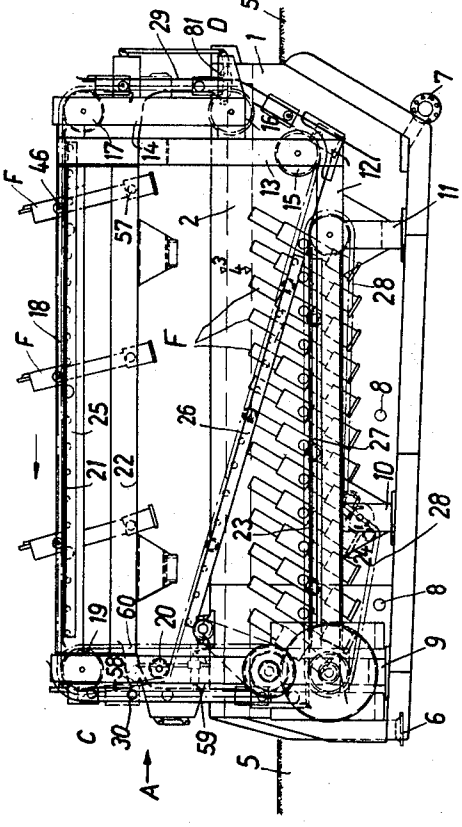
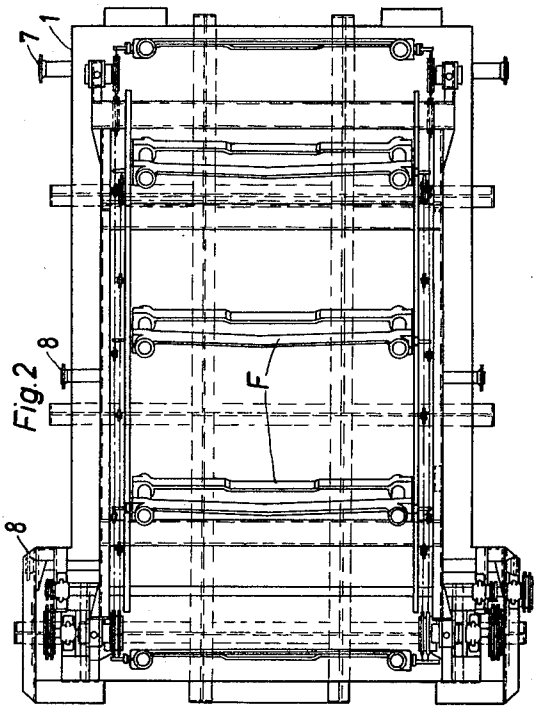


Fig.2



Inventor:
Fritz Hildebrand,

By Ernest D. Marmorek,
His Attorney.

Aug. 13, 1968 F. HILDEBRAND 3,396,956

MACHINE FOR BENDING AND HARDENING LEAF SPRINGS

Filed Feb. 4, 1966 3 Sheets-Sheet 2

Fig.6

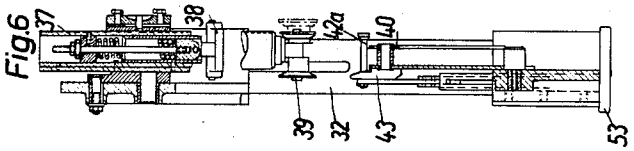


Fig.5

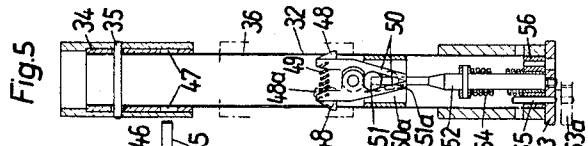
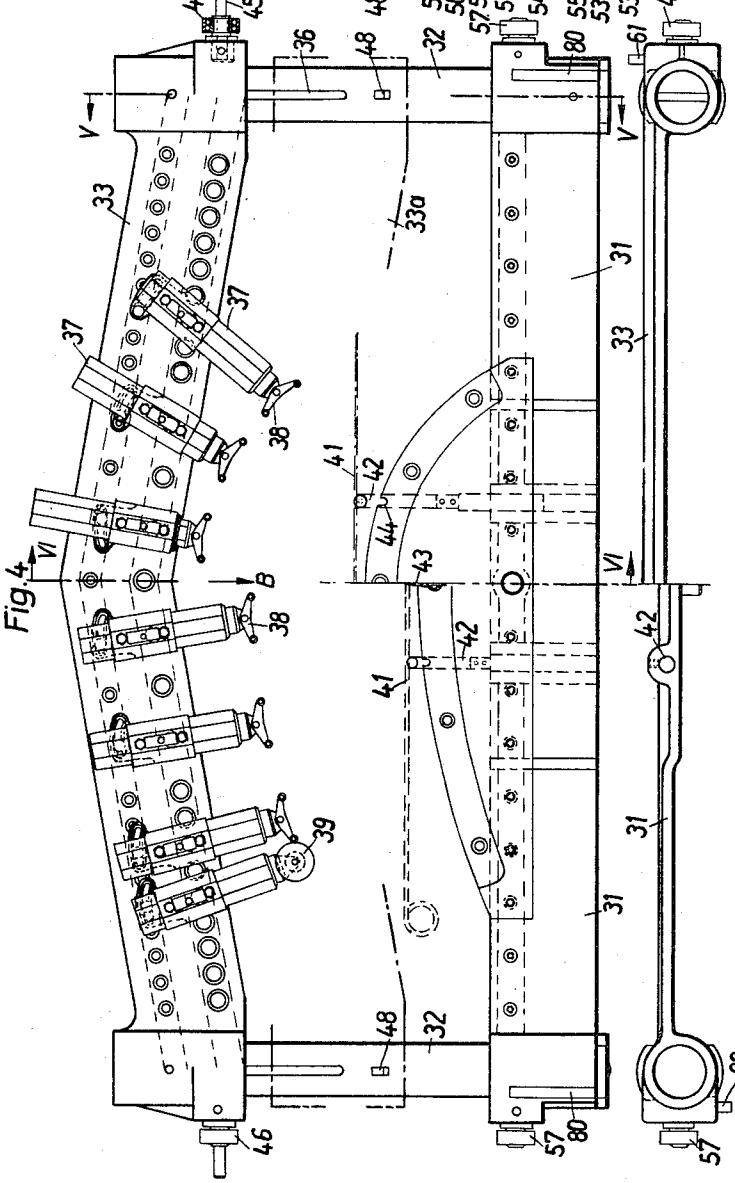


Fig.4



Inventor:
Fritz Hildebrand,

By Edmund D. Manneck,
His Attorney.

Aug. 13, 1968 F. HILDEBRAND 3,396,956

MACHINE FOR BENDING AND HARDENING LEAF SPRINGS

Filed Feb. 4, 1966 3 Sheets-Sheet 3

Fig. 7

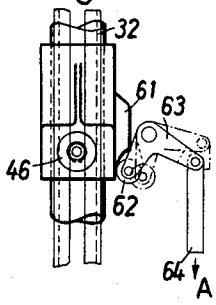


Fig. 8

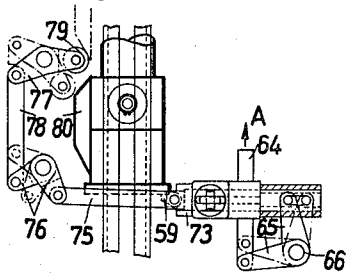


Fig. 9

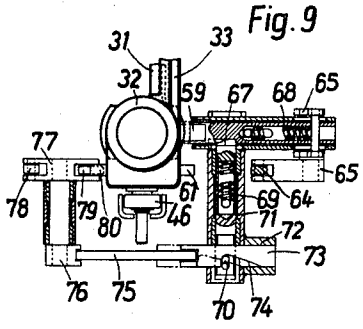
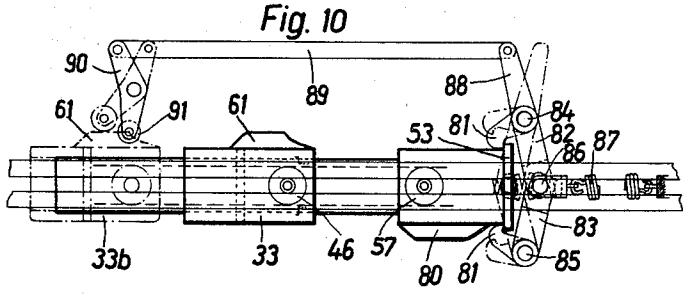


Fig. 10



Inventor:
Fritz Hildebrand,

By Pierce A. Marcus,
His Attorney.

United States Patent Office 3,396,956 Patented Aug. 13, 1968

3,396,956

MACHINE FOR BENDING AND HARDENING LEAF SPRINGS

Fritz Hildebrand, Werdohl, Westphalia, Germany, assignor to Stahlwerke Bruninghaus G.m.b.H., Westhofen, Westphalia, Germany, a corporation of Germany

Filed Feb. 4, 1966, Ser. No. 525,204
Claims priority, application Germany, Feb. 5, 1965, St 23,322
7 Claims. (Cl. 266—6)

ABSTRACT OF THE DISCLOSURE

A machine for bending and hardening leaf springs has a series of independently operable frames, a bath, a conveyor to move the frames through the bath, and means for operating the frames to close and to open them.

The invention relates to the art of bending and hardening of leaf springs, and relates more particularly to that art using leaf spring holding frames and a quenching bath.

It is known to bend and to harden leaf springs by machine. The most advanced of the machines of the prior art is formed as an octagonal star and carries 8 templates and 8 form uppers which may be moved together and apart. In that machine now in use, the hot red leaf spring was supplied to the forward vertical section, and the leaf spring bent by closure of the parts of the form, and subsequently the form was shifted for one step and the leaf spring quenched in an oil bath. The leaf spring remained in the oil bath for two shifting steps, and during the third step it was released from the form which had opened by then, and removed from it.

In this machine of the prior art, the leaf spring remained in the oil for about a relatively short time, with attendant difficulties regarding the permanence of the bending and hardening of the leaf spring. The springs very often left the bath after the temperature had been lowered only to 200° C., or even above that temperature. Every person familiar with this art knows, however, that it is desirable to keep the leaf spring in the hardening bath down to a temperature of about 50° C.

A further disadvantage of the machines of the prior art was that they were not readily changeable from one size of leaf spring to other sizes. In order to accomplish such changes it was necessary to remove the fixed forming parts from the octagonal star, which normally means time losses of from 25 to 30%.

It is accordingly among the principal objects of the invention to provide a machine of the type referred to which avoids the drawbacks of the prior art and which permits the changing from one leaf spring size to another practically without any time loss, and to hold the leaf spring while it is cooled down to about 50° C.

It is another object of the invention to provide such a machine in which a plurality of independently operated frames is provided, one for each leaf spring, and which are conveyed through a quenching bath.

It is a further object of the invention to provide such frames which are movable independently of each other, whereby the duration of the various treatment steps may be chosen independently of the time required for inserting the leaf springs into the frames and for removing them from the frames.

It is still another object of the invention to provide conveyor means for the aforesaid independent frames which include two driven conveyor chains, two driven bath chains, and actuating means which comprise two

actuating chains that move in timed relation with respect to the conveyor chains. This offers the advantage to control the speed of movement in the various sections of the path through which they are conveyed, and thus to move the frames with the leaf springs through the quenching bath at a speed considerably slower than that with which the empty frames are returned and/or the frames are loaded with springs or are latched after the springs have been placed thereinto.

If a quenching time of 60 seconds be considered, the aforesaid octagonal star machine of the prior art, with which the spring was quenched during about 2½ shifting steps, yielded a succession time interval of about 20 seconds, providing for an hourly treatment of about 180 leaf springs without counting any time loss for changing to different spring sizes.

In constrast thereto, if in the instant invention there are used only 10 frames, and again a quenching time of 60 seconds is considered, there occurs a succession time interval of 6 seconds, yielding an hourly treatment production of 600 leaf springs. Where, however, as shown in the example of FIG. 1, there are used 18 frames, there will result a succession time interval of 3.33 seconds, so that about 1,080 leaf springs may be treated, hardened and cooled per hour in accordance with the instant invention.

The temperature of the oil bath will be so chosen as to make possible a minimal cooling time; the bath should be maintained at a temperature of about from 50° C. to 60° C. Owing to the slow production figures of machines of the prior art, it was usually necessary to reheat the bath to maintain it at the desired bath temperature; this need, however, does not occur with the instant invention in view of its high production figures, and in fact the bath may even need to be cooled.

The invention accordingly comprises the features of construction, combination of elements and arrangement of parts which will be exemplified in a construction hereinafter set forth and the scope of the application of which will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed descripition, taken in connection with the accompanying drawings in which:

FIG. 1 is a schematic side elevational view of a system in accordance with the instant invention, showing a chamber structure and frames being transported therein; one side wall having been removed for the sake of clarity and simplicity of presentation;

FIG. 2 is a plan view thereof;

FIG. 3 is an end elevational view thereof seen in the direction A of FIG. 1, but with the front wall removed for simplicity of presentation;

FIG. 4 is a large scale front elevational view of a frame in accordance with the invention;

FIG. 5 is a sectional view taken on the line V—V of FIG. 4;

FIG. 6 is a sectional view taken along the line VI—VI of FIG. 4;

FIG. 7 is a fragmentary elevational view of a detail;

FIG. 8 is a fragmentary sectional view of another detail;

FIG. 9 is a fragmentary elevational view, partly in section, of a further detail; and

FIG. 10 is a fragmentary elevational view of a device for unlatching the closed frame, all parts having been turned for 90°, so that the normally upright frame is shown horizontally.

As shown in FIGS. 1–3, there is provided a chamber

structure that comprises a container **1** that holds an oil quenching bath **2**. The level of the bath **2** can be raised or lowered depending on the hourly production, namely the number of frames passing through the bath per hour, and may thus vary between a maximum level **3** and a minimum level **4** (FIG. 1).

In accordance with a preferred embodiment, the container **1** may be sunk below the level of the ground **5**. The container is provided with customary inflow pipes **6** and outflow pipes **7**. Heating and cooling pipes **8** may be additionally provided, in accordance with well known practice. Two columns **9** are provided that carry the driving gears and the tracks for the conveyors. Near the rear portion of the container there is provided a frame-like structure **12** that has feet **10** and **11**, and which carries vertical supports **13** and **14** that carry deflecting rolls **15**, **16** and **17** for the two conveyor chains **18**. Each of the conveyor chains **18** is an endless chain and, for example, may be suspended on a driving gear **19**, and on a deflecting roll **20**, in addition to the aforesaid deflecting rolls **15**, **16** and **17**; although any other suitable drive and suspension for the conveyor chains **18** may conveniently be chosen instead.

Upper tracks **21** and lower tracks **22** for the empty frames F are provided in the upper portion of the chamber structure, and are supported by the columns **9** and the supports **13** and **14** of the frame **12**. Furthermore, upper tracks **23** and lower tracks **24** are provided for the loaded and closed and latched frames F; each frame F is loaded with a leaf spring and is closed for bending it, and holding it in the bent position, as explained below, and is latched in the closed position. Furthermore, there are provided on the chamber structure roll conveyors **25**, **26** and **27**, for the conveyor chains **18** and for two endless driven bath chains **28**. The movement of the frames F is furthermore supported by tracks **29** and **30** that include end projections for guiding the supporting rolls, namely two upper rolls **46** and two lower rolls **57**, respectively, of the frames F. As best shown in FIGS. 1 and 3, the lower rolls of each frame F engage the lower tracks **22** and **24**, respectively, and the upper rolls **46** engage the upper tracks **21** and **23**, respectively.

Each frame F comprises a lower base beam **31**, two upright columns **32**, made of precision tubing, and a yoke **33**. The yoke carries at each end a sleeve **34**, and each sleeve **34** surrounds a column **32** and is connected thereto by a lost motion device, namely by a splint **35** (FIG. 5) that moves in elongated opposite holes **36** of the column **32**. The yoke carries tension members **37** that may be adjustably tilted and otherwise adjusted by suitable conventional means.

In accordance with a preferred embodiment, each tension member **37** carries a spring loaded presure member **38** or a roll **39** (FIGS. 4, 6). The tension members will need to be adjusted in accordance with the desired bending radius of the leaf spring to be bent and treated; they are designed to cooperate with the bending template **40** which is connected to the base beam **31**.

A leaf spring **41**, as shown in broken lines in FIG. 4, is first deposited onto resiliently held leaf spring supports **42** and made to abut against a central abutment member **43**. During closure of the frame F, pins **42***a* (FIG. 6) of the supports **42** will enter into corresponding recesses **44** (FIG. 4) of the template **40**.

On each of its lateral ends the yoke **33** carries an axle **45** that journals the aforesaid roll **46**. Each sleeve **34** carries two diametrically opposite recesses **47** which match opposite openings **48** that are formed in each column **32**.

In the open position, when the frame is either empty or is being loaded or the spring being removed therefrom, the yoke **33** is at the upper position of maximal spacing from the base beam **31**, as shown in solid lines in FIGS. 4 and 5. The said upper position is determined by the splint **35** in the top position in the elongated holes **36**. The yoke **33** may be moved downwardly in the direction of the arrow B from said upper position into a lower closed frame position **33***a* of minimum spacing from the base beam, indicated in broken lines in FIGS. 4 and 5.

In that lower position, the recesses **47** are aligned with the openings **48**, and two latching elements **48***a* in the lower position **33***a* of the yoke **33** protrude through the openings **48** into the recesses **47**. The latching elements **48***a* are urged apart into a normal extended position by a spring **49**, and are pivoted inside each column **32**, and each latching element has an extension **50** which are in close proximity when the latching elements are normally spread apart. A wedge element, such as a roll **51** is disposed between the extensions **50** and is movable between an inactive position (shown in solid lines in FIG. 5) adjacent said pivots during the normal position when said latching elements **48***a* are normally spread apart and, respectively, an active position (shown in broken lines in FIG. 5 at **51***a*) wherein the roll **51** spreads apart the extensions **50** and thereby retracts the latching elements **48** into the column **32** (as shown in broken lines in FIG. 5).

The roll **51** is mounted on a central rod **52** which is secured to a projecting element **53** that normally engages the underside of the base beam **31**. In the active position **51***a* of the roll **51**, however, the projecting element **53** is spaced below the underside of the base beam **31** (as shown at **53***a* in broken lines in FIG. 5). A spring **54** is provided to urge normally the roll **51** into the inactive position and, correspondingly, the projecting element **53** into the position of close proximity to the base beam **31** (as shown in solid lines in FIG. 5).

Guide pins **55** may be provided that guide the projecting element **53** in a guide piece **56** that is mounted in the base beam **31** and that guides also the rod **52**. The previously mentioned lower rolls **57** are mounted on the base beam **31** of each frame F.

As best shown in FIG. 1, the empty frames F are transported in open positions (see the upper part of FIG. 1) by the conveyor chains **18**, in positions of slight inclination, and the upper rolls **46** rolling on the upper tracks **21**, and the lower rolls **57** on the lower tracks **22**. The region where the leaf springs are mounted in the frames F is designated C. In the region C, the lower tracks **22** turn downwardly so that, as each frame F enters the region C, its lower section is moved downwardly, thereby tilting the frame F towards the vertical; near the point where the conveyor chains **18** are taken up by the driving gears **19**, the frame F will have reached the vertical position (shown in broken lines in the region C in FIG. 1). This movement is enhanced by the track **30**, as well as by guide tracks **58**.

From the region C each frame F will travel downwardly for a distance in a vertical portion of its path. As the frame F descends in the region C, its projecting member **53** will engage an abutment element **59** that projects into the path of the projecting element **53**, thereby temporarily arresting the downward movement of the frame F. At this point the leaf spring will be mounted in the frame F, as shown in FIG. 4; endless driven tension chains **60** (FIGS. 1, 3) are provided that engage the axles **45** and thereby press the yoke **33** downwardly until the frame F is closed, and thus the latching elements **48***a* engage the recesses **47** of the sleeves **34** of the yoke **33**. In that instant, a cam **61** (FIG. 7) that is mounted on the yoke **33** engages the rolls **62** of a pivoted bell crank lever **63** and thereby raises a rod **64**. The rod **64**, on the other hand, as best shown in FIG. 8, by its being pulled upwardly moves a bell crank lever **65** that is connected by a bolt **66** to the abutment element **59** and thereby retracts the abutment element **59** from the path of the projecting element **53**. This enables the closed frame F to continue on its downward path, driven by the tension chains **60**, until it is taken over by the bath chains **28**.

In order to prevent the abutment element **59** from snapping back after the cam **61** has passed the roll **62**,

a safety device is provided that is shown in FIG. 9. The safety device comprises a spring pressed latch **67** which engages a lateral recess of the abutment element **59**. The abutment element **59** is also spring pressed. The latch **67** is guided in a housing **71**, and carries a pin **70**. The housing **71** of the latch **67** includes a sleeve **72** that guides a cam **73** that moves parallel to the movement of the abutment element **59**, but at right angles to the movement of the latch **67**. When the cam **73** is moved to the left (FIG. 9), it will move the pin and therewith the latch **67** downwardly (FIG. 9), thereby releasing the abutment element **59** to be moved to the left under the pressure of its spring **68**. The cam **73** is driven by a rod **75** which is moved, by way of two-armed levers **76** and **77**, from a rod **78** (FIG. 8). The lever **77** carries a roll **79** which forms a cam follower for a release cam **80** that is arranged on the base beam **31** and is arranged approximately oppositely with respect to the cam **61** of the yoke **33**.

The abutment elements **59** thus will return to their position of projection into the path of the projecting elements **53** after the base beam **31** and therewith the release cams **80** have passed the roll **79**. Thus, the abutment elements **59** are in position to stop the next empty frame F to be loaded with the leaf spring.

After the frames F have passed through the bath (see the lower part of FIG. 1), they will reach the unloading region D, where the frames are opened, in accordance with an arrangement shown in FIG. 10. (FIG. 10, as previously mentioned, has been turned around for 90°; actually, the columns should be upright, rather than horizontal as shown.)

Claws **81** are provided that project into the path of the projecting elements **53**. The claws **81** are mounted on levers **82** and **83** that are tiltable on bolts **84** and **85**. The free ends of the levers **82** and **83** have elongated holes that surround a pin **86**. The pin **86** is mounted resiliently by means of a spring **87**. As the conveyor chains move the frame F, the projecting elements **53** will be retracted (into the position **53***a*, see FIG. 5), whereby the latching elements **48***a* will be retracted into the column **32**, thereby releasing the yoke **33**.

The lever **82** has a further arm **88** that is pivoted to a rod **89** that engages one arm of a two-armed lever **91** that carries on its other arm a roll **91**. When the yoke **33** has reached the upper position (shown at **33***b* in broken lines in FIG. 10), its cam **61** will have moved the roll **91**, the lever **90**, the arm **88** and the levers **82** and **83** to open the claws **81**, so that the frame F can thereafter be transported in open position; the treated leaf spring may be removed out of the frame in the usual conventional manner, while the frame continues to be transported by the conveyor chains, to be re-used.

Although the conveyor chains **18** and the bath chains **28** are circulating continuously, the frames F may nonetheless be moved throughout the various regions of the chamber structure at different speeds, for instance slower through the bath, as compared to the upper portion of the chamber structure, providing a complete control for the hardening treatment. As best shown in the lower part of FIG. 1, the tracks **23** and **24** are so spaced apart from each other, as compared to the spacing between the rolls **46** and **57** on the closed frames F, that the frames will be in an inclined position. This inclined position promotes the rinsing of the leaf springs, while the inclined position of the frames after the bath and during the return movement promotes the dripping of the oil from the frames.

The frames F close positively. The tension members **37**, though resiliently mounted, are provided with their springs only to compensate for inaccuracies and differences in thickness of material. They are much stronger than the force needed to bend the hot leaf springs.

I wish it to be understood that I do not desire to be limited to the exact details of construction shown and described, for obvious modifications will occur to a person skilled in the art.

Having thus described the invention, what I claim as new and desire to be secured by Letters Patent is as follows:

1. In a machine, for use in bending and hardening leaf springs, a plurality of frames each operable independently of the other frames to be closed and respectively opened for releasably clamping and holding a leaf spring, a chamber structure comprising reservoir means establishing a container for a quenching bath, closure actuating means operable for the closing and latching of each frame, release actuating means operable for the unlatching and the opening of each frame subsequently, and conveyor means operable for guiding and transporting said frames in a predetermined path throughout said bath, said conveyor means comprising two endless driven conveyor chains spaced apart from each other and two endless driven bath chains spaced from each other, said actuating means comprising two endless driven actuating chains moving in timed relation with respect to the conveyor chains.

2. In a machine, as claimed in claim **1**, each frame comprising latching means movable between latching and release positions, respectively, releasing means for said latching means in driving connection with said latching means and movable between a retracted position when said latching means is in the latching position and, respectively, an extended position wherein it moves said latching means to said release position, said actuating means engaging said releasing means of each frame for moving it between the retracted and extended positions, for closing and latching and, respectively, unlatching and opening the frame.

3. In a machine, as claimed in claim **2**, each frame comprising a base beam and two columns, and a yoke engaging said columns and guided thereon for movement to and from a closed frame position of minimum spacing of the yoke from the base beam in which position said yoke is adapted to clamp and to hold a leaf spring in the frame, said columns being hollow and each having at least one opening, said yoke comprising two sleeves, each engaging a column and having at least one recess matching said opening and in alignment therewith in the closed position of said frame, said latching means comprising at least one latching element disposed inside each column adjacent said opening, a spring urging said latching element into the latching position wherein the element protrudes through said opening to engage said recess of the yoke when the yoke is in the said closed frame position.

4. In a machine, as claimed in claim **2**, each frame comprising a base beam and two columns, and a yoke engaging said columns and guided thereon for movement to and from a position of minimum spacing from the base beam in which position it is adapted to clamp and to hold a leaf spring in the frame, said columns being hollow and each having two opposite openings, said yokes comprising two sleeves, each engaging a column and having two recesses matching said openings and aligned therewith in the closed position of said frame, said latching means comprising two latching elements each pivoted adjacent one of said openings and having an extension, a spring between said latching elements urging them apart and into a latching position in which they extend through said aperture and into the recess aligned therewith in the closed position, said releasing means comprising a wedge element positioned between the extensions of said two latching elements and being movable between an inactive position adjacent said pivots when said latching elements are in the latching position and, respectively, an active position spaced apart from said pivots wherein said wedge element spreads apart said extensions thereby retracting the latching elements into said column, and a projecting element connected to said wedge element and movable therewith between retracted and extended positions, respectively.

5. In a machine, as claimed in claim **4**, said engaging means comprising at least one abutment element disposed in the path of said projecting element of said base beam in said chamber at a position of said path at which the

closure of each frame is to commence, and cam and cam follower means between each yoke and said abutment element operable to remove said abutment element out of the path of the base beam after the yoke has been moved to the closure position on said frame.

6. In a machine, as claimed in claim **5**, and restoring means comprising cam and cam follower means including resilient means intermediate said base beam and said abutment element and operable for returning said abutment element into the position in the path of said projecting element.

7. In a machine, as claimed in claim **4**, said engaging means comprising spring pressed claws disposed in the path of said projecting element and being operable to engage said projecting element thereby to release said latching means, and claw opening means including cam and cam follower means operable for opening said claws against the spring power after the yoke has been completely opened.

References Cited

UNITED STATES PATENTS

1,303,657	5/1919	Gueutal et al.	266—6
1,459,208	6/1923	Hendrickson	266—6
1,487,530	3/1924	Bowers et al.	266—6
1,535,454	4/1925	Grell	266—6
1,742,730	1/1930	Rockhoff	266—6
1,816,377	7/1931	Hobracht	266—6
2,386,781	10/1945	Daly	95—94
2,575,827	11/1951	Miklic	266—6
3,094,576	6/1963	Gogan	266—6
856,996	6/1907	Custer et al.	118—423 X
2,570,746	10/1951	Bablik	118—423 X
3,270,710	9/1966	Johnson et al.	118—423 X

J. SPENCER OVERHOLSER, *Primary Examiner.*

R. S. ANNEAR, *Assistant Examiner.*