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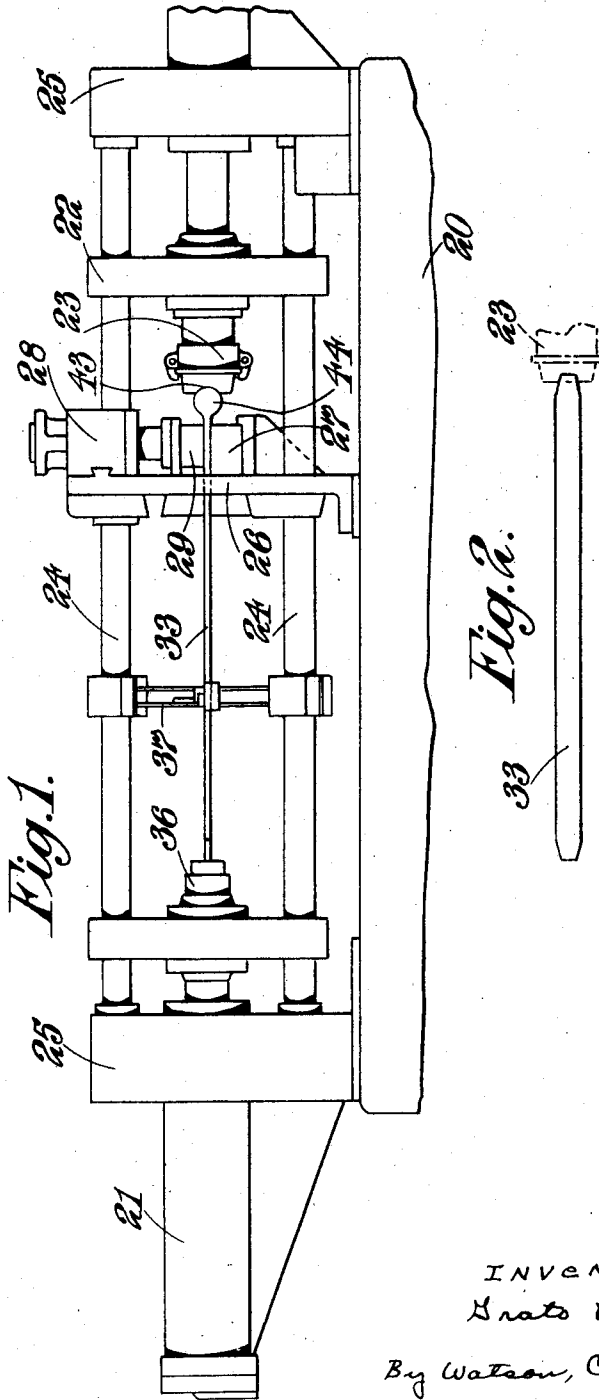
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2,430,529

MANUFACTURE OF LEAF SPRINGS

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*Fig. 1.*

*Fig. 2.*

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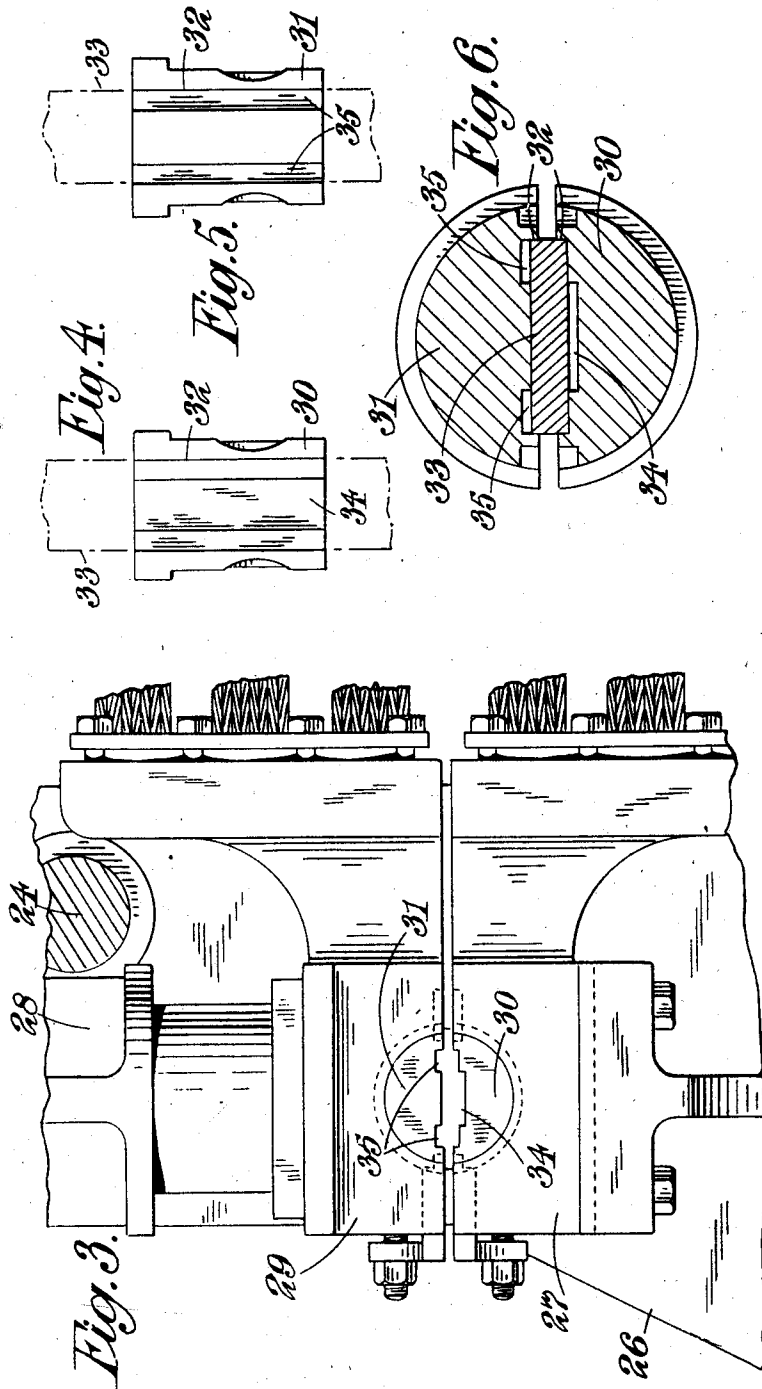
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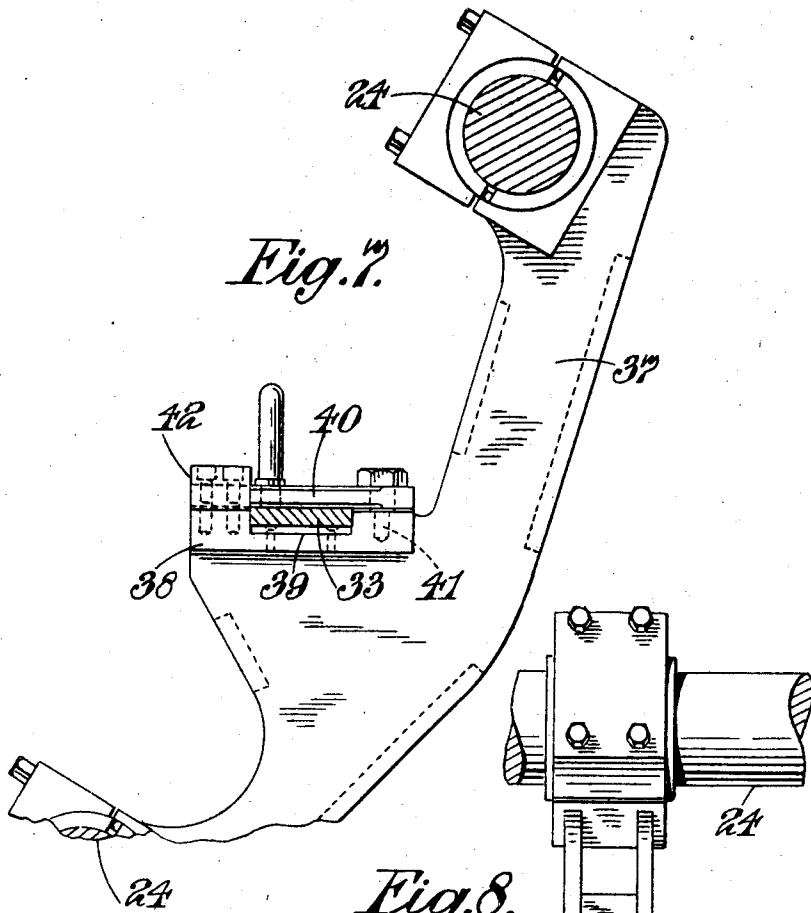
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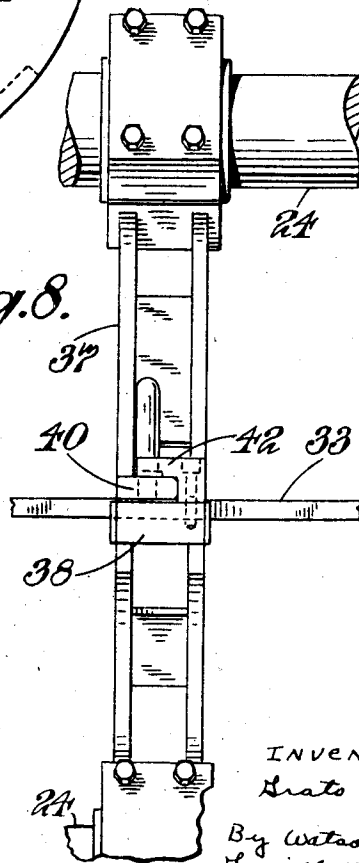
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*Fig. 8.*



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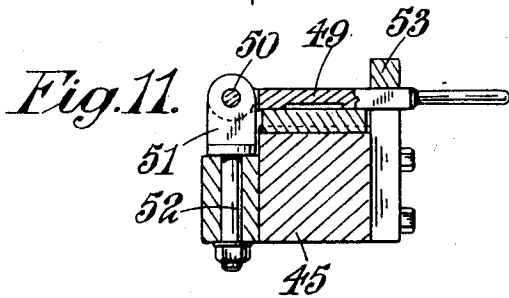
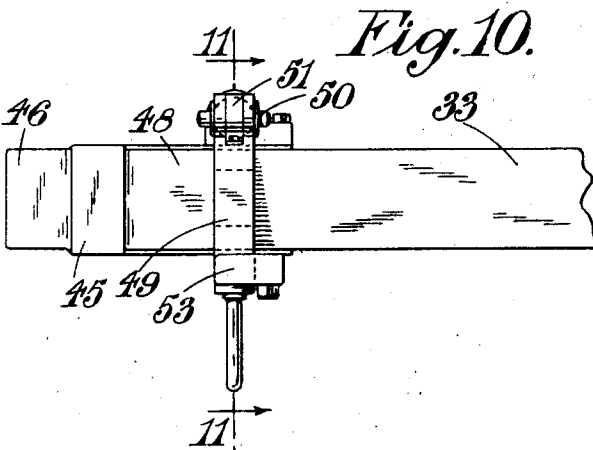
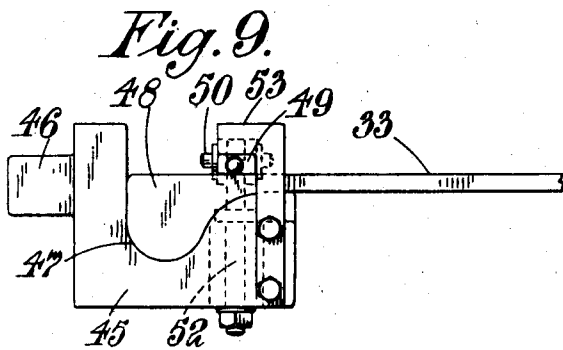
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MANUFACTURE OF LEAF SPRINGS

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4 Sheets-Sheet 4



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# UNITED STATES PATENT OFFICE

2,430,529

## MANUFACTURE OF LEAF SPRINGS

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3 Claims. (Cl. 219—3)

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This invention comprises improvements in or relating to the manufacture of leaf springs.

Leaf springs are frequently made with a main or upper leaf which has forged eyes at the end to receive a shackle pin and the present invention relates to the forging of the ends of such leaves. Hitherto forging of the eyes has been performed by hand. Ordinarily the eye ends of the spring are flush with one face of the spring surface and the thickening of the metal which accommodates the eye-hole for the passage of the shackle pin is all located to one side of the leaf, usually the upper side. This can be effected either by upsetting the end and forging by the methods usually adopted by a blacksmith or by curling over the end of the leaf to form the eye. If the end is upset it needs to be drilled through to receive the shackle pin.

According to the present invention a process of forging a leaf spring with lugs at the ends of the leaf for shackle pins comprises the steps of gripping the leaf between the jaws of a vice-electrode so that one end of the leaf projects from the jaws, causing this end to abut against an anvil-electrode and thereby heating the portion between the electrodes electrically, upsetting the heated end by endwise pressure exerted between the spring and the anvil-electrode so as to form an upset lug and similarly forming an upset lug on the other end of the spring.

One of the difficulties which arises in carrying out the process as just described is that it is difficult to convey electric current into the flat bar, which is to constitute the workpiece, by means of vice jaws, in such manner that the current is evenly distributed throughout the section of the bar. Although the bar is described as a flat section its surface is commonly not strictly flat and during the upsetting operation the workpiece has to be forced through the vice jaws so as to slide therethrough. This causes wear of the surfaces of the vice jaws which themselves, after a short time, lose their flatness and cease to bear evenly upon the workpiece with the result that they may bear more firmly along the centre line than at the edges or vice versa. According to a further feature of the present invention therefore the vice jaws are formed so that one of them is hollowed out where it would otherwise bear along the centre of the workpiece and has a bearing surface only upon the side margins of the face while the other is shaped to bear upon a central zone only. Preferably the hollowed out vice jaw is the lower one and the one which bears on the central zone only is the upper one. In this way the one vice jaw conveys current evenly into the two side margins of the workpiece and the other vice jaw into the central zone and consequently the whole width of the bar receives a substantial flow of heating current.

This arrangement is of great importance be-

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cause if the workpiece is unevenly heated across its width it will not upset evenly when end pressure is applied and folds are produced in the metal.

Another difficulty which arises is that in upsetting the second lug, end-pressure on the workpiece has to be exerted by pressing on the lug first formed, which is ordinarily non-symmetrical in relation to the cross-section of the workpiece and thus the ram exerting pressure tends to bend the workpiece, or at all events the lug on the end of the workpiece, out of true.

A further feature of the invention lies in providing the end of the ram which engages the workpiece with a hollowed out portion shaped to fit the whole outline of the lug closely, so as to obviate the aforesaid bending. In order to permit of ready insertion and removal of the lugs in the hollowed out portion on the end of the ram one side of the same is made hinged or otherwise movable.

An apparatus in which the process according to this invention can be carried into effect and the process as carried out therein will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a side elevation of the apparatus,

Figure 2 shows a workpiece on which the process is to be carried out,

Figure 3 is an end elevation of a vice incorporated in the apparatus and is to a larger scale,

Figures 4 and 5 are views of two inserts in the jaws of the vice,

Figure 6 is a section showing the jaws of the vice gripping the workpiece,

Figure 7 is an end elevation of a support for the workpiece,

Figure 8 is a side elevation of the support shown in Figure 7,

Figure 9 is a side elevation of a device for engaging one end of the workpiece,

Figure 10 is a plan of the device shown in Figure 9, and

Figure 11 is a section on the line II—II of Figure 10.

The machine comprises a bed plate 20 on one end of which is an hydraulic ram 21 and on the other end an insulated mounting 22 for an anvil 23. The mounting 22 is carried by rods 24 extending between pillars 25 on the bed plate. A frame 26 is mounted on the bed plate and supported by the rods 24 and has a lower vice jaw 27 secured on it. An hydraulic ram 28 is also carried by the frame 26 and supports an upper vice jaw 29 so that, when hydraulic power is supplied to the cylinder 28, the upper jaw 29 is closed against the lower jaw. The anvil 23 and the vice jaws 27 and 29 are made of a high-conductivity copper alloy and are connected respectively to the two terminals of the secondary of an electric step-down transformer not shown.

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Each vice jaw is formed with a semi-cylindrical recess to receive inserts 30 and 31 which are retained therein by suitable means. Each jaw is formed with a longitudinal groove 32 of a width corresponding to the width of the workpiece 33 which is to be forged and of a depth equal to less than half the thickness of the workpiece. The workpiece will thus be received between the inserts in the grooves 32 and guided thereby. The lower insert 30 is further grooved at 34 along a central zone beneath the workpiece so that it only engages the workpiece on the underside along two broad side margins and not in the centre. The upper insert 31 is formed with two deeper grooves 35 so that it will not engage the said margins of the workpiece but will only engage it over a central zone.

The workpiece 33 is mounted in the apparatus with one end abutting the piston 36 of the ram and the other end clamped between the vice jaws 27 and 29. It is supported between the ram and the vice by a support shown in Figures 7 and 8 comprising a frame 37 which is mounted on the bars 24 and is formed with a bent portion 38 which is grooved at 39 to receive and guide the workpiece 33. The workpiece is retained in the groove 39 by a part 40 which is pivoted at 41 and engaged under a hook 42. The part 40 can be swung about its pivot clear of the workpiece to allow of its removal.

In producing leaves for laminated springs on this machine, a flat steel bar to constitute the workpiece is taken which contains enough metal to produce an upset head of the desired size at each end and to leave the resulting forging of the required length. The workpiece is placed in the vice and the support and hydraulic pressure is applied simultaneously to the hydraulic rams 21 and 28. The workpiece is thus clamped in the vice and forced to slide through the vice towards the anvil so as to bear firmly against the latter. In this position current flows through the end of the workpiece between the vice and the anvil and this end is rapidly raised to forging temperature. As soon as this stage is reached the ram 21 forces the workpiece further towards the anvil so that its end is upset into a hollowed out part 43 of the anvil so as to form the required head 44. As shown in Figure 2 the ends of the workpiece are tapered off in a horizontal plane so as to reduce the width of the workpiece at each end. The effect is two fold: in the first place the reduced width at the end of the workpiece ensures that that end bears on the anvil with less unevenness than would be likely were the full width of the end of the workpiece to be engaging the anvil at this stage. Therefore the heat is not led towards one only of the two side margins of the bar as would otherwise be likely. In the second place, when the upsetting operation proceeds, the natural tendency of the workpiece to spread sideways as well as to swell up into the recess 43 of the anvil is counteracted and at the end of the upsetting operation the forged head will be approximately of the right dimensions laterally.

After upsetting the head at one end of the workpiece, the head is formed into a lug of the desired finished shape in a die-press. The bar is then reversed in the machine and a head upset at the other end or this operation may be conducted in a second machine of similar construction. During the second upsetting operation, the device shown in Figures 9, 10 and 11 is fitted to the end of the ram piston 36 and serves to hold

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the lug already formed on the workpiece. The device comprises an extension 45 having a part 46 by which it can be fitted on to the end of the ram piston 36 and hollowed out at 47 to fit the lug 48 on the end of the workpiece. The lug 48 is held down into the recess by a part 49 which is pivoted at 50 on a swivel 51 and the swivel has a spindle 52 that is rotatable in the extension 45. The part 49 is engaged under a hook 53 which retains it against the top of the workpiece so as to hold the lug 48 in the recess 47. To remove the workpiece, the part 49 is swung in a horizontal plane about the spindle 52 till it is clear of the hook 53 and is then swung up about its pivot 52 so that the workpiece can be lifted off the extension 45.

The second upsetting operation is performed in the manner already described but it will be understood that the lug 48 previously formed is supported in the extension 45 of the ram 21 so that it cannot be deformed by the end pressure during the second upsetting operation. The head formed in the second upsetting operation is also formed to the desired finished shape in a die-press.

After the two upsetting operations, the spring is bent to the desired curve, should a curved spring be required, and the lugs are drilled out for the shackle pins. Finally the spring is tempered.

I claim:

1. Apparatus for electrical upsetting of flat bars comprising in combination a frame, an anvil, pressing means opposed to the anvil to exert end-wise pressure on a flat bar to be upset, means to bring the pressing means and the anvil nearer together to effect upsetting, a pair of vice-jaw electrodes, located between the pressing means and the anvil, adapted to bear on the flat faces of the bar to be upset, one of said vice-jaws having a central bearing portion narrower than the width of the bar and the other having two lateral bearing portions spaced so that they are wider apart than the said central bearing portion, and means to supply current to the bar through both said vice-jaws of the anvil.

2. Apparatus according to claim 1, the said vice-jaw having a central bearing portion being the upper jaw of said pair.

3. Apparatus according to claim 1, said pressing means having a work-engaging portion shaped to fit the outline of a lug previously formed on the work-piece, and releasable means for retaining said lug in engagement with said work-engaging portion.

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