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SPRING FORMING AND QUENCHING MACHINE

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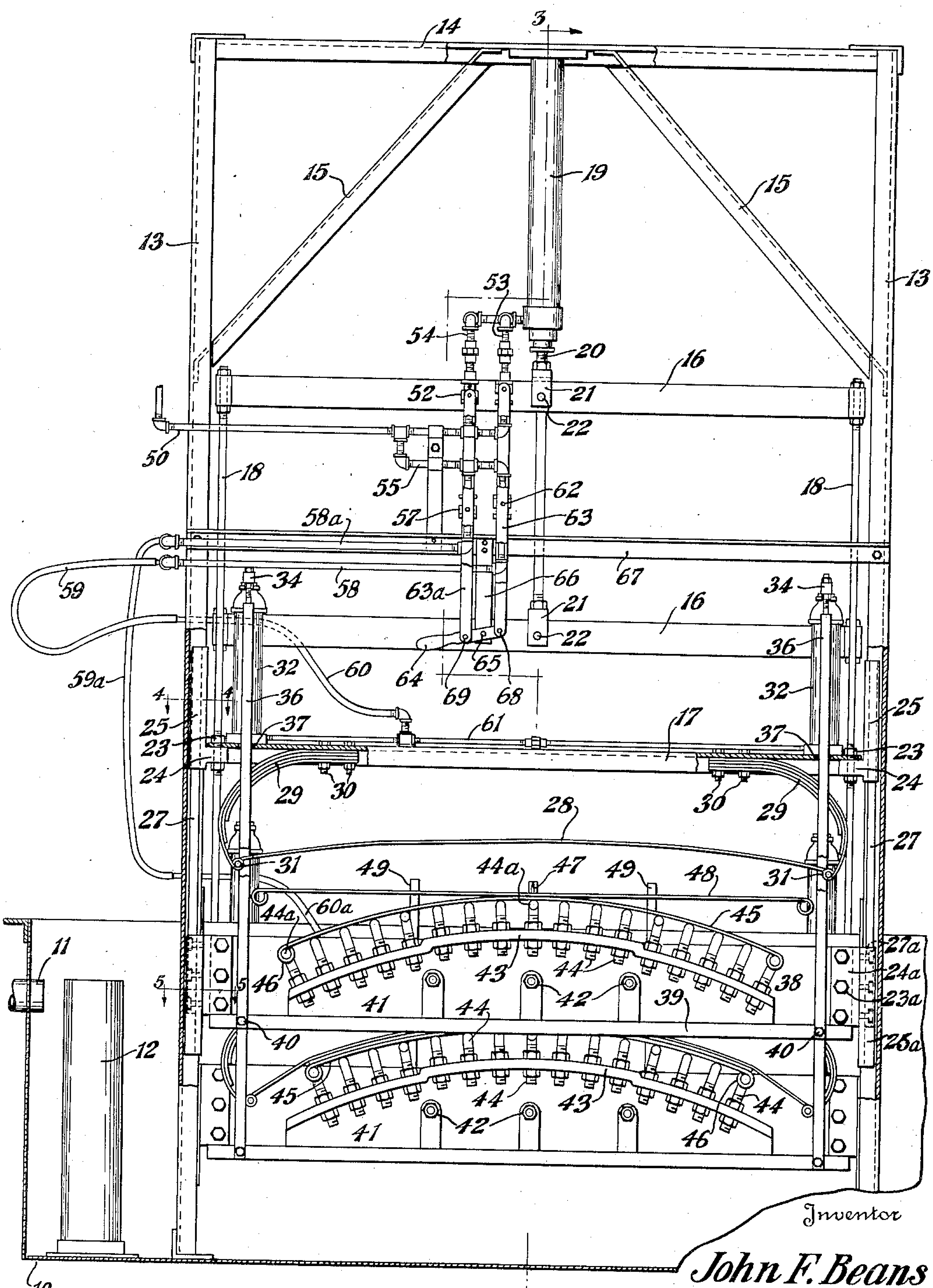

Fig. 1

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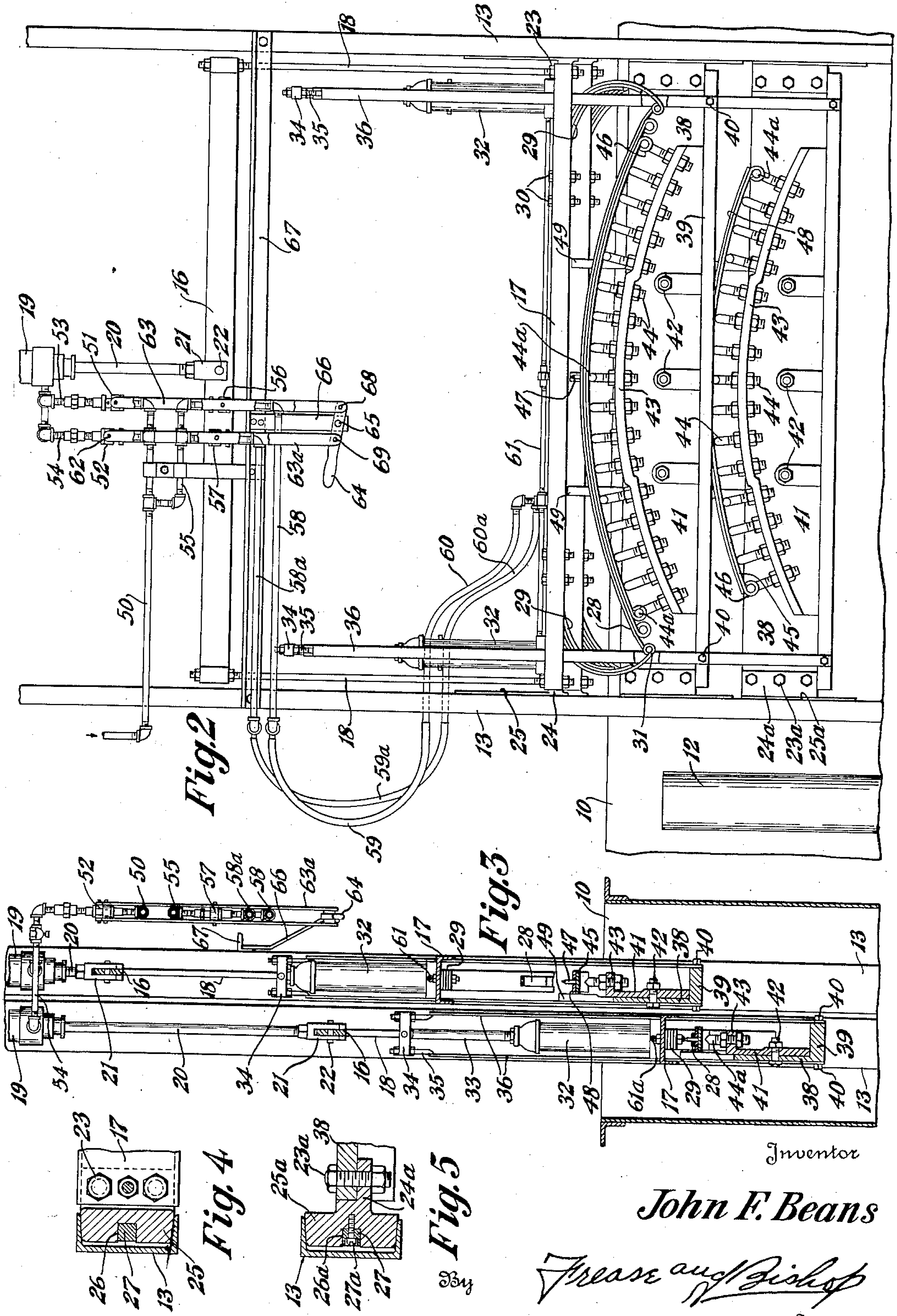

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SPRING FORMING AND QUENCHING MACHINE

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4 Claims. (Cl. 266—6)

The invention relates to improvements in machines for forming and quenching the leaves of springs such as are used upon automobiles and similar vehicles, and more particularly to a machine of this character operated by fluid controlled cylinders.

In manufacturing springs of the character referred to, each spring is formed of a plurality of leaves, each of which is formed from a flat bar of steel which is then bent to a predetermined curvature and hardened to retain the exact curvature.

The several leaves forming a complete spring must be bent exactly and uniformly and all of the leaves of the spring must be uniformly and evenly hardened in order that they retain the proper shape in the finished spring.

The objects of the present improvement are to provide a machine for exactly and uniformly hot forming the leaves of a spring and for immediately quenching the hot formed leaves while they remain clamped in the forming mechanism so as to quickly and uniformly harden the leaves in order that they will retain the desired form.

Another object is to provide a spring forming and tempering machine, each unit of which is adapted to form and temper one leaf at a time, the forming mechanism comprising vertically movable upper and lower forming jaws and fluid operated cylinders adapted to simultaneously separate the jaws and raise them out of a quenching tank and to close the jaws and lower them into the quenching tank.

Another object of the improvement is to provide a machine of the character referred to in which a lifting cylinder is provided for raising and lowering a movable frame upon which the upper jaw is carried, forming cylinders being carried by said movable frame, the lower jaw being suspended from said forming cylinders so that they will vertically move the lower jaw relative to the upper jaw.

A still further object is to provide a machine of the character referred to having a plurality of pairs of forming jaws, fluid operated cylinders for opening and closing each pair of jaws and moving them into and out of a quenching tank, and means for coordinating the operation of said cylinders so that when one pair of jaws is closed and lowered into the tank, an adjacent pair of jaws will be simultaneously raised from the tank and opened.

The above, together with other objects which may be hereinafter pointed out or which will be evident from the accompanying drawings and following description, may be attained by constructing the improved spring forming and quenching machine in the manner illustrated in the drawings, in which

Figure 1 is a vertical sectional elevation of a spring forming machine embodying the invention and comprising two units, the forming jaws of one unit being shown in closed or clamped position within the quenching tank and the jaws of the other unit being shown in the raised and open position;

Fig. 2, a view similar to Fig. 1, showing the forming jaws of the front unit just at the instant the jaws have closed upon a spring leaf preparatory to being lowered into the quenching tank, and the jaws of the rear unit opening and starting to rise from the quenching tank;

Fig. 3, a transverse section taken as on the line **3—3**, Fig. 1;

Fig. 4, a transverse section through one of the upright channel guides and the corresponding sliding guide block of the upper jaw, taken on the line **4—4** Fig. 1; and

Fig. 5, a similar section of the upright channel guide and the sliding guide block of the lower forming jaw, taken on the line **5—5**, Fig. 1.

Similar numerals refer to similar parts throughout the drawings.

In the practical application of the invention, it has been found advantageous to arrange a plurality of the forming units in connection with a quenching tank, and in position to be successively operated by one workman, as each spring leaf should be left in the quenching bath a sufficient time to be properly cooled and tempered before being removed from the forming jaws. Although any desired number of forming units may thus be located together in a single machine, for the purpose of illustration, a machine comprising two forming units is illustrated and described.

The improved machine includes a quenching tank indicated generally at **10**, adapted to rest upon the floor and provided at either or both ends with means for admitting oil or other suitable quenching liquid to the tank, such as the inlet pipe **11** which may be connected to any suitable supply of oil or the like, and means for providing for a maximum liquid level in the tank, such as the overflow pipe **12** which extends upward through the bottom of the tank, the upper open end thereof being at the maximum liquid level desired while the lower open end of the overflow pipe may communicate with any suitable means for receiving the overflow of liquid from the tank.

Each unit of the machine comprises a spaced pair of upright channel members 13, the lower ends of which are supported upon the bottom of the tank 10 and the upper ends preferably connected as by the crossbar 14. Angular braces 15 may be provided between the upper portions of the channel uprights 13 and the crossbar 14.

A vertically slidable frame is provided in each unit of the machine, said frame including the upper horizontal bar 16 and the horizontal channel member 17 spaced below the same and suspended therefrom as by the tie rods 18. This sliding frame is adapted to be vertically moved by means of the lifting cylinder 19, the upper end of which is connected to the underside of the crossbar 14, as shown in Fig. 1.

The piston rod 20 of the lifting cylinder may be provided at its lower end with a fork 21 which receives the upper bar 16 of the sliding frame and is connected thereto as by the pin 22. Each end of the channel member 17 is connected, as by the bolts 23, to a horizontal flange 24 formed at the lower end of a guide block 25 slidably mounted in the corresponding channel guide 13. Each of these guide blocks is provided with a squared groove 26 to slidably receive the sliding guide bar 27 which will be later described.

The upper forming jaw is carried by the channel member 17 and is preferably a flexible member such as the strap 28 of iron or the like. This flexible upper jaw is suspended below the horizontal channel member 17 as by the curved leaf springs 29 connected at their upper ends to the channel member 17 as by bolts 30 and provided at their lower ends with eyes 31 to which the ends of the strap 28 may be attached.

The forming cylinders 32 are mounted upon the upper surface of the horizontal channel member 17, one of these cylinders being preferably located near each end thereof. The piston rod 33 of each of the forming cylinders extends upward therefrom and has a crosshead 34 fixed to its upper end. Bolts 35 are located through opposite ends of this crosshead and the lower ends of these bolts are welded or otherwise connected to the upper ends of the depending strap links 36 which hang downward upon opposite sides of the cylinder 32 and may be located through apertures 37 formed near the edge portions of the channel 17.

These strap links support the lower jaw which may include the form cradle 38 having the horizontal base portion 39 at its lower edge to which the lower ends of the strap links are connected as by the screws 40. This cradle is adapted to be slidably mounted upon the channel guides 13 and for this purpose, guide blocks 25*a* may be slidably mounted in the channel guides 13 and connected to the ends of the cradle 38 as by the bolts 23*a* which are located through the end portions of the cradle and through the flanges 24*a* of the guide blocks 25*a*.

The sliding guide bars 27 are carried by the guide blocks 25*a*, the lower end portions of said guide bars being preferably received in the grooves 26*a* of the guide blocks 25*a* and connected thereto as by the screws 27*a* which may be counter-sunk in the bar 27 as shown in Fig. 5. As above stated, these sliding guide bars are slidably received in the grooves 26 of the guide blocks 25 upon the horizontal channel member 17. With this construction, the horizontal channel member 17 and the cradle 38 are always maintained in parallel relation to each other as they are slidably moved in the channel guides 13.

The form plate 41 may be attached to the cradle as by the bolts 42 and is provided at its upper edge with the substantially arcuate flange 43 through which are located the threaded studs 44 which may be adjusted to the curvature of the pattern 45 which is an accurately formed steel bar or strap curved exactly to the curvature desired to be produced in the spring leaf to be formed.

The end studs and one or more intermediate studs may have T-heads, as indicated at 44*a*, to hold the spring pattern rigidly against turning or tilting and in order to attach the pattern, the ends thereof may be bent around the T-heads of the end bolts, as indicated at 46. A pin 47 may be provided at the center of the pattern to be received in the usual central aperture in the spring leaf blank indicated at 48 in order to properly position the blank longitudinally upon the pattern. For the purpose of positioning the blank transversely upon the pattern, stop lugs 49 may be mounted at the upper edge of the cradle or form plate to contact with the rear edge of the blank when the same is placed upon the pattern.

For the purpose of operating the cylinders, fluid from any suitable source of fluid supply is admitted through the pipe 50. This pipe communicates with the valves 51 and 52 which are connected as by the pipes 53 and 54 respectively, with the lower ends of the lifting cylinders 19 of the front and rear units respectively, as viewed in Figs. 1 and 2. A branch pipe 55 communicates with the fluid inlet pipe 50 and leads to the valves 56 and 57 which communicate with the forming cylinders 32 of the front and rear units respectively, as viewed in Figs. 1 and 2.

For this purpose a pipe 58 leads from the valve 56 in a substantially horizontal position to a point at one side of the machine where it is connected to one end of a flexible hose 59, the other end of which is connected to a pipe 60 communicating with an intermediate portion of a pipe 61 mounted upon the top of the horizontal channel member 17 of the front unit and communicating with the lower ends of both of the forming cylinders 32 of said unit.

A similar arrangement is provided for the rear unit, a pipe 58*a* leading from the valve 57 to a point at one side of the machine where it is connected, as by the flexible hose 59*a* with a pipe 60*a* which communicates with an intermediate portion of the pipe 61*a* which leads to the lower ends of the forming cylinders 32 of the rear unit.

Where air is to be used in the cylinders, each of the valves 51, 52, 56, and 57 may be provided with an exhaust aperture 62 adapted to permit the air to exhaust into the atmosphere when the valve is in the closed position, that is, when communication between the air supply pipe 50 and the respective cylinder is cut off by the operation of the valve. This exhaust opening, however, is closed by the movement of the valve to open position to admit air from the pipe 50 to the respective cylinder. As any well known form of valve of this type may be used, it is not thought necessary to illustrate the valves in detail.

In order that the valves controlling the lifting cylinder and forming cylinders of a unit may be operated simultaneously, so that the forming jaws will be opened as they are raised from the quenching tank and closed as they are lowered into the tank, means is provided for simultaneously operating the upper and lower valve of each unit reversely. For this purpose the valves **51** and **56** of the front unit are connected by a link **63** and the valves **52** and **57** of the rear unit are similarly connected by a link **63***a*. Thus, it will be seen that as either link is pushed upward, the upper valve will be moved to the open position, admitting fluid to the lifting cylinder and the lower valve will be moved to the closed or exhaust position, exhausting fluid from the forming cylinders.

It is desirable to co-ordinate the operation of the valves of the different units and for this purpose means may be provided for simultaneously moving the links **63** and **63***a* in opposite directions. For this purpose a lever **64** may be provided, fulcrumed intermediate its ends as at **65** upon any suitable stationary portion of the machine, such as the bracket **66** mounted upon the crossbar **67** fixed to the channel guides **13**. This lever is pivotally connected on opposite sides of the fulcrum to the lower ends of the links **63** and **63***a*, as indicated at **68** and **69**, respectively. With this construction, as the forming jaws of one unit are closed and lowered into the quenching tank, the forming jaws of the adjacent unit are raised from the quenching tank and opened.

In the operation of the machine to form and quench the spring leaves, assuming the parts to be in the position shown in Fig. 1, the jaws of the front unit, as viewed in that figure, are in raised and open position and the jaws of the rear unit are in closed and lowered position, holding a newly formed spring leaf therebetween while the same is quenched in the tank.

The operator, having first removed the formed spring leaf from the open jaws of the front unit, takes a hot spring leaf blank from the furnace and places it upon the lower jaw in the position shown at **48** in Fig. 1. The lever **64** is then moved from the position shown in Fig. 1 to that shown in Fig. 2, reversing the positions of the valves controlling the lifting and forming cylinders of both units. The jaws of the front unit are closed by the operation of the corresponding forming cylinders **32**, raising the lower jaw toward the descending upper jaw, the flexible strap **28**, which is also provided with a central aperture to receive the pin **47**, clamping the hot spring leaf blank tightly upon the spring leaf pattern of the lower jaw, as shown in Fig. 2. The corresponding lifting cylinder will continue to lower the closed jaws into the quenching tank, holding the hot formed spring leaf to the exact curvature required while the same is quenched in the tank.

Simultaneous with this closing and lowering of the jaws of the front unit, the forming cylinders of the rear unit will be operated to permit the lower jaw thereof to descend away from the upper jaw, while at the same time the corresponding lifting cylinder will cause the upper jaw to rise, as shown in Fig. 2, and this operation will be continued until both jaws are in the fully raised and open position, at which time the formed and quenched spring leaf may be removed and a new hot blank placed in position as above described.

I claim:

1. A spring forming and quenching machine including a quenching tank, a frame including upright guides extending into said tank, an upper forming jaw slidable upon said guides, a fluid cylinder upon said frame operatively connected to said upper jaw, a fluid cylinder upon said upper jaw, a lower forming jaw slidable upon said guides and operatively connected to the last named fluid cylinder, and means for simultaneously operating said fluid cylinders in reverse directions.

2. A spring forming and quenching machine including a quenching tank, a frame including upright guides extending into said tank, an upper forming jaw slidable upon said guides, a fluid cylinder upon said frame operatively connected to said upper jaw, a fluid cylinder upon said upper jaw, a lower forming jaw slidable upon said guides and operatively connected to the last named fluid cylinder, a valve for controlling each fluid cylinder, and means for simultaneously operating said valves reversely.

3. A spring forming and quenching machine including a quenching tank, a frame including upright channel guides extending into said tank, an upper forming jaw having guide blocks slidable in said channel guides and provided with guide grooves, means for slidably moving the upper jaw, a lower forming jaw having guide blocks slidable in said channel guides, means for slidably moving the lower jaw relative to the upper jaw, and guide rods carried by the guide blocks of the lower jaw and received in said guide grooves.

4. A spring forming and quenching machine including a quenching tank, a frame including upright channel guides extending into said tank, an upper forming jaw having guide blocks slidable in said channel guides, means for slidably moving the upper jaw, a lower forming jaw having guide blocks slidable in the channel guides, means for slidably moving the lower jaw relative to the upper jaw, and guide rods carried by the guide blocks of one jaw and received in grooves in the guide blocks of the other jaw.

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