Aug. 11, 1942. F. AMIOT 2,292,731

DEVICE FOR SHAPING PIECES

Original Filed May 6, 1939 2 Sheets-Sheet 1

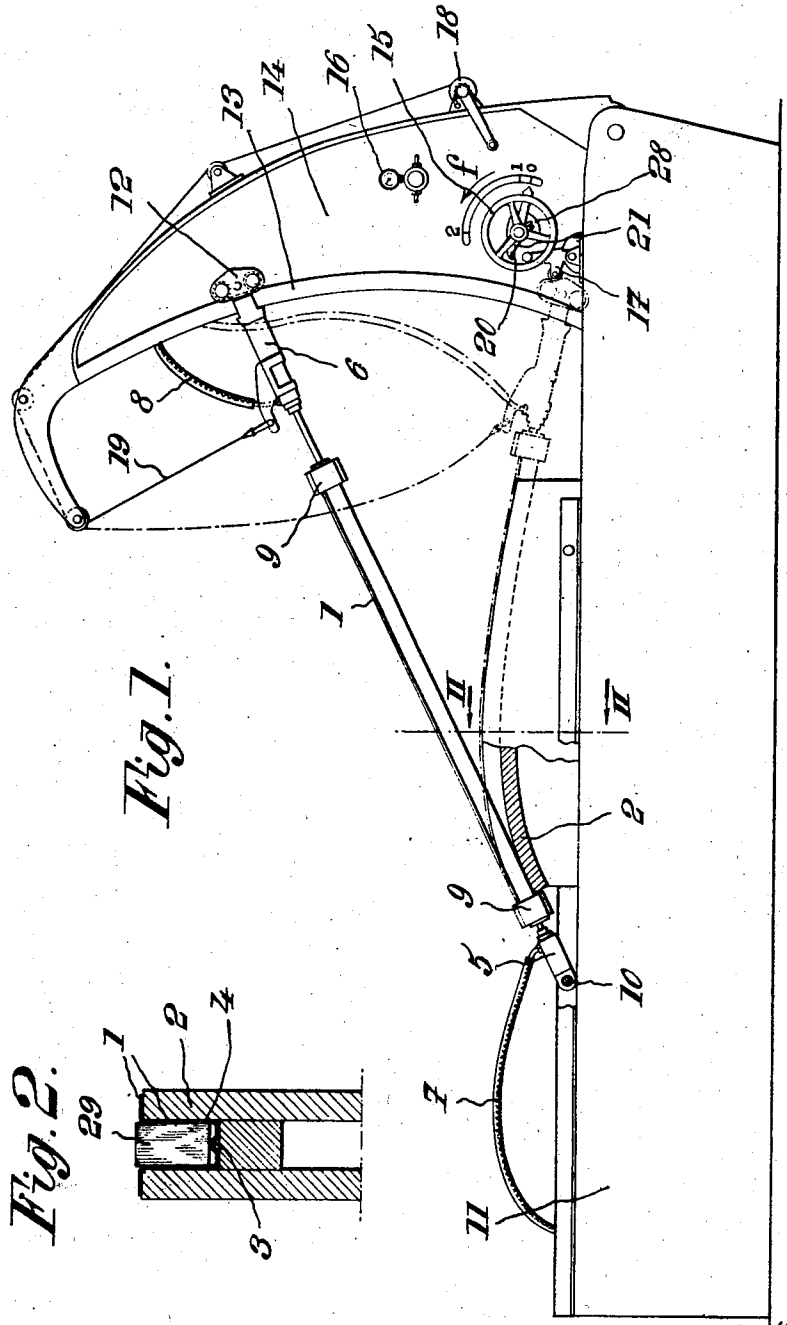


Fig. 1.

Fig. 2.

INVENTOR
FELIX AMIOT

BY

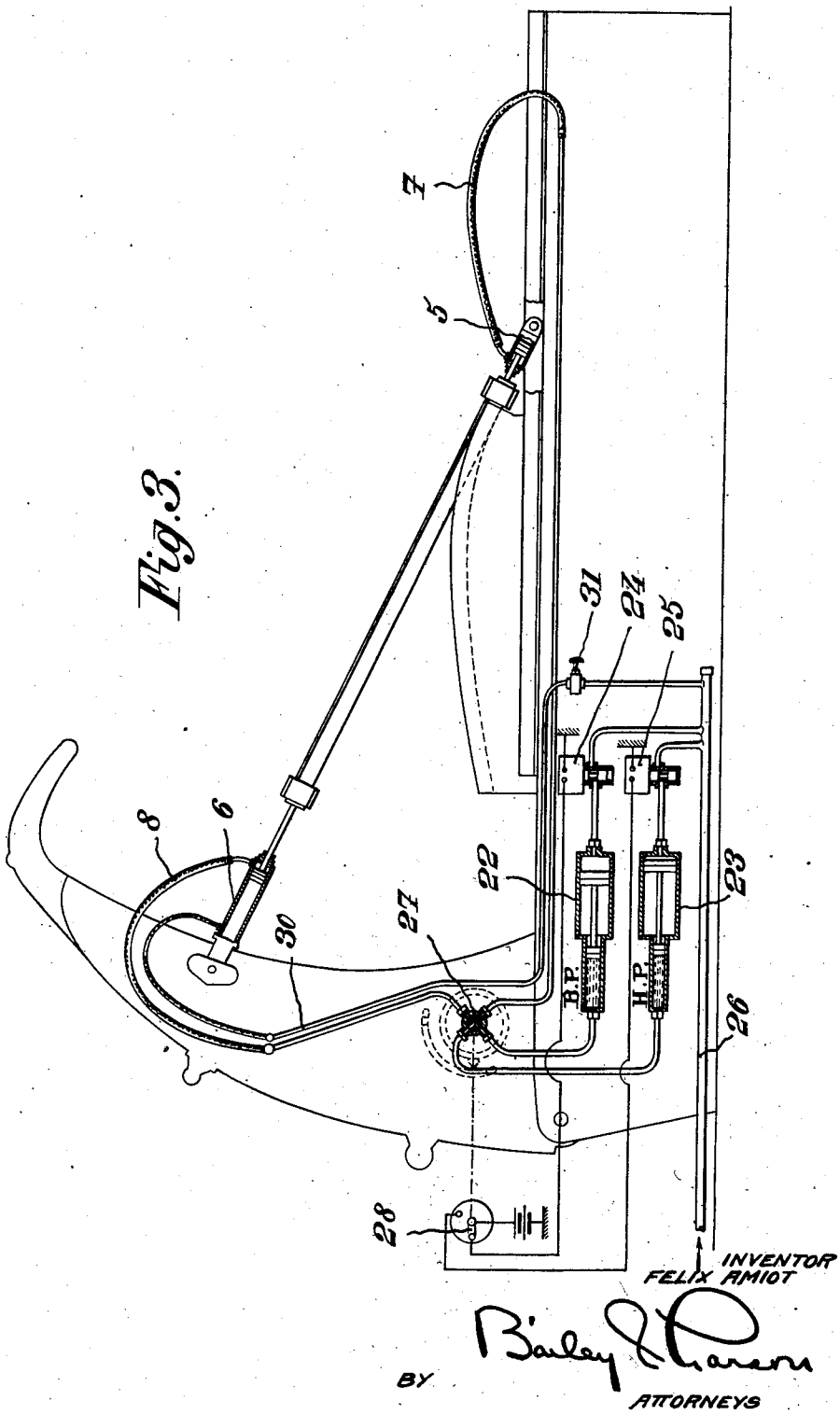
ATTORNEYS

Aug. 11, 1942. F. AMIOT 2,292,731

DEVICE FOR SHAPING PIECES

Original Filed May 6, 1939 2 Sheets-Sheet 2

Fig. 3.



INVENTOR
FELIX AMIOT

BY Bailey & Parsons

ATTORNEYS

Patented Aug. 11, 1942 2,292,731

UNITED STATES PATENT OFFICE

2,292,731

DEVICE FOR SHAPING PIECES

Felix Amiot, Neuilly-sur-Seine, France

Original application May 6, 1939, Serial No. 272,281. Divided and this application December 16, 1939, Serial No. 309,656. In Luxemburg April 15, 1939

9 Claims. (Cl. 153—32)

The present invention which is a division of my copending application Serial No. 272,281, filed May 6, 1939, relates to devices for shaping pieces, especially metal pieces by causing them to conform to shaping members or suitable curved pieces.

The chief object of the present invention is to provide a device of the type above referred to which is capable of meeting the requirements of practice, especially concerning the finish of the articles obtained and the rapidity of work.

The essential object of the present invention consists in subjecting the pieces to be treated, in the course of their shaping, to a given tension or stretching, preferably close to their elastic limit.

Preferred embodiments of the present invention will be hereinafter described, with reference to the accompanying drawings, given merely by way of example,

Fig. 1 is an elevational view of a machine for bending sectional irons, this machine being made according to the invention;

Fig. 2 is a sectional view on an enlarged scale on the line II—II of Fig. 1;

Fig. 3 is a partial diagrammatic back view corresponding to Figs. 1 and 2.

In the following description with reference to the drawings, the invention is applied to the bending and shaping of sheet iron pieces intended, for instance, for use in aeronautical construction.

It is already known, for shaping such pieces, to take elements or irons of suitable section, either rectilinear or already curved, and apply them to shaping elements.

One of the difficulties that are met with is to ensure a perfect contact of the metal at all points with the shaping element. As a matter of fact, some portions of the piece to be treated tend to form undulations or folds.

In order to obviate these drawbacks, and also to obtain further advantages which will appear hereinafter, I construct the machine in such manner, according to the present invention, that the pieces are subjected, in the course of their shaping, to a suitable tension or stretching, which may approach the elastic limit of the metal of which said pieces are made.

This tension may be applied in a single operation during the whole time of the shaping operation, while the piece is being brought into contact with the surfaces of the bent element, or this tension may be applied only during a portion of this operation, especially at the end thereof, after the piece to be treated has already been brought into contact with the bent element and there remains only to perfect the bending of said piece.

Or, according to a preferred embodiment of the invention, the tension or stretching is applied in several successive steps, and this, if need be, in correspondence with different values of the tension; I construct, for instance, my machine in such manner that it applies, firstly, a relatively low tension f during the period of time for which the piece is brought into contact with the shaping element, and then, after this contact has been established, subjects the piece to a higher tension F (which is for instance, in the case above considered, close to the elastic limit, while the first value f averages F/10 or more).

Of course, the tension or stretching may be applied in a different manner.

In the preferred embodiment of my invention, I make use, in order to cause the piece to be treated to conform to the shape of the curved element, of the tension applied to said piece, this tension serving, in combination with suitable guiding means, automatically to produce the desired displacements or deformations.

Supposing, for instance, that it is desired to bend a sectional iron 1 to the shape of a curvilinear element 2, for example with a view to obtaining a rib element for an airplane wing, said sectional iron having, in particular, in the known manner, a U-shaped section with a groove 3 along which it can be sawed into two parts, and shaping member 2 having inner shaping surfaces 4 which correspond to those of said sectional iron, I proceed as follows.

Concerning first the means for exerting the desired tension or stretching on the sectional iron, I preferably make use of pneumatic or hydraulic means. In particular, if a certain pneumatic pressure is available, it is advantageous, especially if two operations are to take place at tensions f and F, to have this pressure acting through hydropneumatic relays, in such manner as to have, at will, either of two hydraulic pressures p and P, it being understood that it is possible to control the pneumatic pressure through pressure relieving means.

The hydraulic or other pressure that is obtained is then caused to act:

a. Either only at one of the ends of the sectional iron, the other end of said piece being secured in any suitable manner; or

b. At least during the second step of the process, at both ends in such manner as to obtain, by balancing the frictional stresses on the curved

element, a suitable balancing of the tensions over the whole length of the piece.

In the embodiment of Fig. 1, I have shown two motors, for instance of the hydraulic type, 5 and 6, which receive fluid under pressure through flexible conduits 7 and 8 and are connected to the sectional iron through jaws 9 of any suitable type holding the ends of said sectional iron 1.

Concerning now the means for bringing the sectional iron into intimate contact with the corresponding shaping piece, through the application of the pressure, they are, for instance, advantageously made as follows:

One of the motors, 5 for instance, is pivotally secured at 10 to the frame 11 of the machine;

The other motor is carried by a carriage 12 capable of moving along a guiding path element 13 arranged in such manner that the application of the pressure tends to cause said carriage to move forward along said path in the desired direction. In order to obtain this result, the tangent to the guiding path should make, with the direction of the effort exerted by the pressure, an angle different from 90°, which angle will be calculated in a suitable manner as a function of said pressure (this obliquity corresponding, for instance, to a gradient, of, say, 10%).

The guiding rail 13 is, for instance, carried, by a support 14 which may also carry means for controlling the pressure such as 15, a pressure gauge 16, and so on.

Advantageously, I further provide means for coordinating the displacements or deformations of the piece to be bent with the control of the pressure, in such manner that the passage from pressure p to pressure P can take place only when the piece comes into its bent position on shaping element 2.

For this purpose, for instance, carriage 12 can come, at the end of its movement, into engagement with a locking member 17. Said member coacts with the end 20 of a finger 21 carried by the operating wheel 15 of the machine. Normally, locking member 20, in cooperation with 17, prevents wheel 15 from being turned in the direction of arrow f. When the carriage passes (position shown in dotted lines in Fig. 1) locking member 17 is moved away, and the operating wheel 15 can be turned. I might provide any other equivalent means and, in particular, member 17 might be adapted automatically to produce the shifting from pressure p to pressure P.

In Fig. 3, I have shown, by way of example, several means for the control of the pressure applied by the apparatus.

The hydropneumatic relays shown at 22 (low pressure) and 23 (high pressure) are electrically controlled, through electro-valves 24, 25. In one position, these electro-valves, admit into the corresponding cylinder the air from the compressed air main conduit 26 and, in the other position, they connect said cylinder with the exhaust, it being well understood that, instead of this electric control, I might provide any other type of control, for instance a pneumatic control.

The operating wheel, such as 15 (Fig. 1) is adapted simultaneously to control:

a. On the one hand, a three way cock 27 (Fig. 3) which acts, in a first position, to connect cylinder 6 to the low pressure relay, and, in a second position, to connect both of the cylinders 5 and 6 to the high pressure relay; and,

b. On the other hand, a switch 28 (Figs. 1 and 3) adapted to bring into play first electro-valve 24 and then electro-valve 25.

I thus obtain a system which works in the following manner:

At the beginning of a shaping operation, the sectional iron occupies a position such as shown in solid lines by Fig. 1. The relays are then in communication with the atmosphere, which corresponds to the zero position (Fig. 1) of wheel 15.

This wheel 15 is then operated in direction f until it comes into position 1, illustrated by Fig. 1, for which the low pressure is introduced into motor 6, for instance through the action of valve 24 and cock 27. The component of this pressure in the direction of the rolling track 13 immediately produces the displacement of carriage 12.

Sectional iron 1 is caused to conform to the shape of piece 2. The reaction at the other end, at 5, is supported, in the embodiment illustrated, by the drawings, by the frame of the machine, due to the fact that the jaw 9 on the left hand side is applied against the shaping member 2, or the frame 11.

When the carriage 12 comes near to the end of its movement, it acts upon locking member 17. Consequently, finger 21 is unlocked, so that the operator can actuate wheel 15 so as to bring it into position 2, which causes the high pressure to be admitted to both of the motors 5 and 6.

Finally, when it is found that the deformations of the piece have become permanent, the hand wheel 15 is brought back to the zero position, which stops the action of the pressure.

It is then possible to remove the finished piece.

Means, such as a winch 18 and a cable 19, may be provided for bringing back carriage 12 to its initial position. Furthermore, a compressed air conduit 30 (Fig. 3), provided with a cock 31, may also be provided for bringing back the pistons of the motors to their initial positions, by discharging the liquid toward relays 22, 23.

On the other hand, it should be noted that, in order to avoid the risk of the lips of the sectional iron being moved toward each other, during the stretching operation, I may place between them small spacing members 29 (Fig. 2).

Also, it should be noted that a single carriage 12 and a single motor system 5, 6 might be used for bending a plurality of sectional irons over one or more shaping elements.

These shaping elements 2 might further be made deformable at will in such manner as to permit shapings of all kinds. Likewise, supporting member 14 might be made adjustable.

In any case, it will be readily understood that the invention has many advantages, and, in particular, the following:

The pieces are obtained without defects, and especially without folds, which are avoided by the stretching of the metal.

It is possible to apply the bending operation to all kinds of pieces (for instance, in aeronautical construction, to sectional irons for making elements of the fuselage, of the wings, and so on).

The operation is quickly effected, since the shaping takes place under the sole action of the tension.

Of course, before and after the shaping, the pieces may be subjected to all suitable thermic operations.

In a general manner, while I have, in the above description, disclosed what I seem to be practical and efficient embodiments of the present invention, it should be well understood that

I do not wish to be limited thereto as there might be changes made in the arrangement, disposition and form of the parts without departing from the principle of the present invention as comprehended within the scope of the appended claims.

What I claim is:

1. An apparatus for shaping an elongated metal piece which comprises, in combination, a shaping member against which said piece is to be applied, means for holding one end of said piece adjacent one end of said shaping member, a track located substantially in the general plane of said shaping member, a carriage, adapted to be secured to the other end of said piece, movable along said track, and means for stretching said piece between said carriage and said holding means, said track having such a shape as to produce, upon the operation of said stretching means, a component force in a direction to cause displacement of said carriage along said track in the direction corresponding to the application of said piece against said shaping member.

2. An apparatus for shaping an elongated metal piece which comprises, in combination, a frame, a shaping member supported by said frame and adapted to receive along its edge the piece to be shaped, a track supported by said frame and located substantially in the general plane of said shaping member, a carriage movable along said track, a stretching device, operative by fluid under pressure, carried by said carriage and adapted to hold one end of said piece to be shaped, another stretching device adapted to hold the other end of said piece and pivoted to said frame near the end of said shaping member, said track having such a shape as to produce, upon the operation of at least one of said stretching means, a component force in a direction to cause displacement of said carriage along said track in the direction corresponding to the application of said piece against said shaping member, and means for controlling said stretching devices.

3. An apparatus for shaping an elongated metal piece which comprises, in combination, a frame, a shaping member supported by said frame and adapted to receive along its edge the piece to be shaped, a track supported by said frame and located substantially in the general plane of said shaping member, a carriage movable along said track, a stretching device, operative by fluid under pressure, carried by said carriage and adapted to hold one end of said piece to be shaped, another stretching device, operative by fluid under pressure, pivoted to said frame near the end of said shaping member and adapted to hold the other end of said piece to be shaped, said track having such a shape as to produce, when said stretching devices are in action, a component force in a direction to cause displacement of said carriage along said track in the direction corresponding to the application of said piece against said shaping member, means for feeding fluid under moderate pressure to said stretching devices, means for feeding fluid under high pressure to said stretching devices, and means operative by said carriage for keeping said second mentioned fluid feeding means in inoperative position as long as said carriage has not come, along said track, into a position corresponding to the piece to be shaped being fully applied against the shaping member.

4. An apparatus for shaping an elongated metal piece which comprises, in combination, a frame, a shaping member supported by said frame and adapted to receive along its edge the piece to be shaped, a track supported by said frame and located substantially in the general plane of said shaping member, a carriage movable along said track, a stretching device, operative by fluid under pressure, carried by said carriage and adapted to hold one end of said piece to be shaped, another stretching device, operative by fluid under pressure, pivoted to said frame near the end of said shaping member and adapted to hold the other end of said piece to be shaped, said track having such a shape as to produce, when said stretching devices are in action, a component force in a direction to cause displacement of said carriage along said track in the direction corresponding to the application of said piece against said shaping member, a source of fluid under low pressure, a source of fluid under high pressure, means for connecting either of said sources with at least one of said stretching devices, a control member having two positions corresponding one to the bringing of said means into connecting relation with said source of low pressure and the other to the bringing of said means into connecting relation with said source of high pressure, locking means normally preventing said control member from coming into said second mentioned position, and means operative by said carriage for bringing said locking means out of action when said carriage has come into the position corresponding to the piece to be shaped being fully applied against the shaping member.

5. An apparatus for shaping an elongated metal piece which comprises, in combination, a shaping member against which said piece is to be applied, means for holding the two ends of said piece and for applying said piece against said shaping member, a stretching device operative by fluid under pressure, and arranged between said holding means and at least one end of said piece, means for feeding fluid under predetermined moderate pressure of a constant value to said stretching device, means for feeding fluid under high pressure to said stretching device, and control means for rendering operative the one or the other of the last mentioned means.

6. An apparatus according to claim 5, further comprising means adapted to render inoperative said second mentioned fluid feeding means as long as the piece to be shaped has not been fully applied against the shaping member.

7. An apparatus for shaping an elongated metal piece which comprises, in combination, a frame, a shaping member supported by said frame and adapted to receive along its edge the piece to be shaped, a track supported by said frame and located substantially in the general plane of said shaping member, a carriage movable along said track, means for connecting said carriage with one end of said piece to be shaped, another means for connecting pivotally the other end of said piece to the said frame near the end of said shaping member, at least one stretching device interposed in one of said connecting means, said track having such a shape as to produce, when said stretching device is in action, a component force in a direction to cause displacement of said carriage along said track in the direction corresponding to the application of said piece against said shaping member, means for feeding fluid under moderate pressure to said stretching device, means for feeding fluid under high pressure to said stretching device, and

means operative by said carriage for keeping said second mentioned fluid feeding means in inoperative position as long as said carriage has not come, along said track, into a position corresponding to the piece to be shaped being fully applied against the shaping member.

8. An apparatus for shaping an elongated metal piece which comprises, in combination, a shaping member against which said piece is to be applied, means for holding one end of said piece adjacent one end of said shaping member, a track located substantially in the general plane of said shaping member, a carriage adapted to be secured to the other end of said piece movable along said track, the tangent to said track at any point forming an acute angle with the tangent to the shaping member passing through such point, and means for exerting a longitudinal force on said piece between the carriage and said first named means to cause said carriage to move along said track in the direction corresponding to the application of said piece against said shaping member.

9. An apparatus for shaping an elongated metal piece which comprises, in combination, a shaping member against which said piece is to be applied, first and second means for holding the two ends of said piece, said second means being movable between first and second relative positions for applying said piece against said shaping member, means for exerting a tension on said piece and for causing said second holding means to move between said first and second positions, a control member for varying the tension exerting means, said control member including a restraining means for limiting the controlling movement of said control member, said restraining means being movable between operative and inoperative positions, and means driven by movement of said second holding means to said second position to move said restraining means to said inoperative position.

FÉLIX AMIOT.