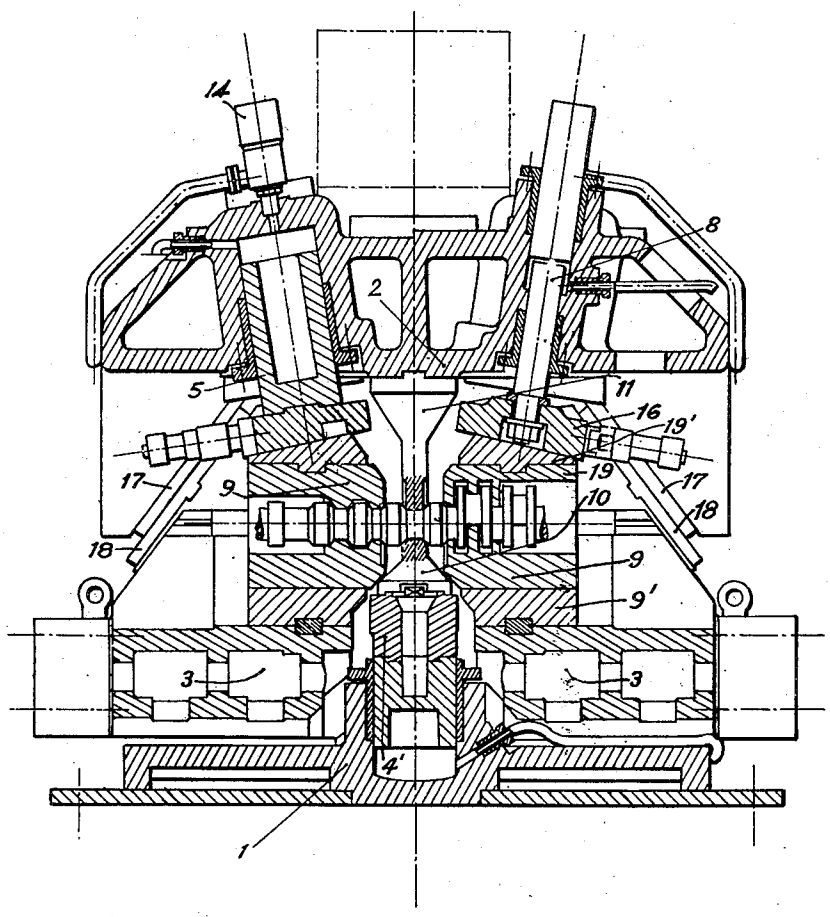
Dec. 19, 1950 F. MELEY 2,534,613

APPARATUS FOR FORGING PARTS SHOWING IMPORTANT VARIATIONS IN THEIR CROSS SECTION

Filed June 19, 1945 6 Sheets-Sheet 1

Fig. 1



Inventor:
Francois Meley

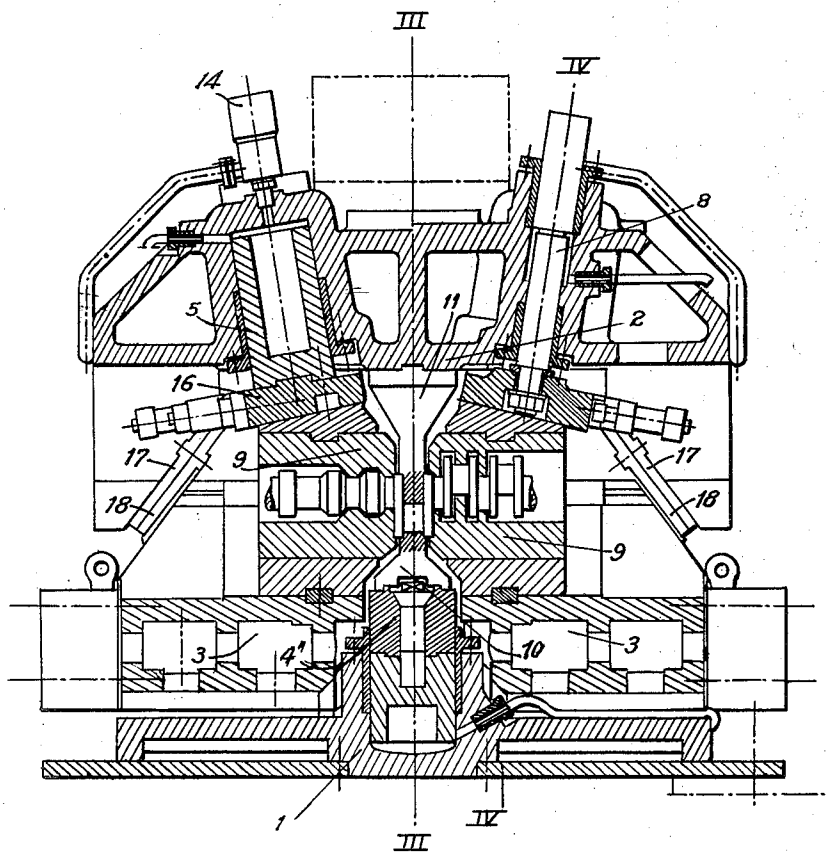
By E. F. Kinnaird
Attorney

Dec. 19, 1950 F. MELEY 2,534,613

APPARATUS FOR FORGING PARTS SHOWING IMPORTANT VARIATIONS IN THEIR CROSS SECTION

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Fig. 2



Inventor:
François Meley,

By E. F. Neuerburth
Attorney

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APPARATUS FOR FORGING PARTS SHOWING IMPORTANT VARIATIONS IN THEIR CROSS SECTION

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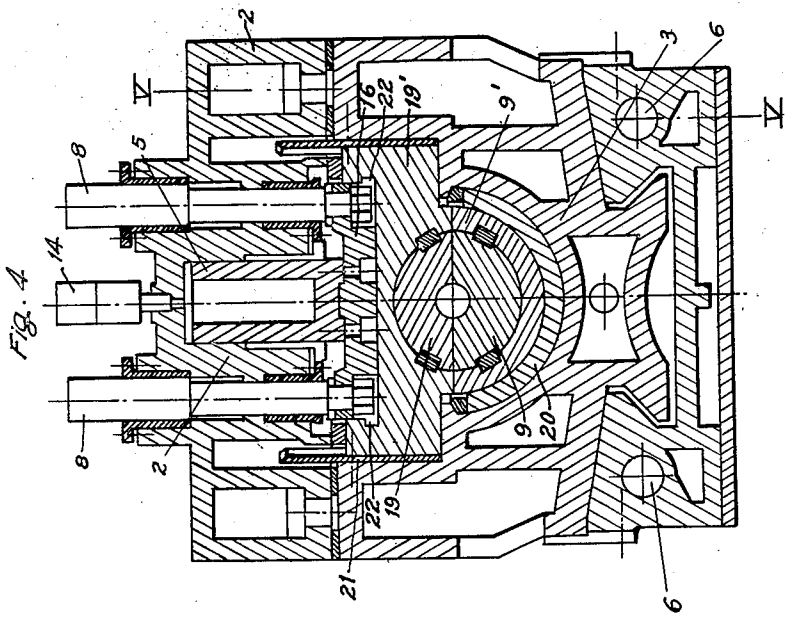


Fig. 4

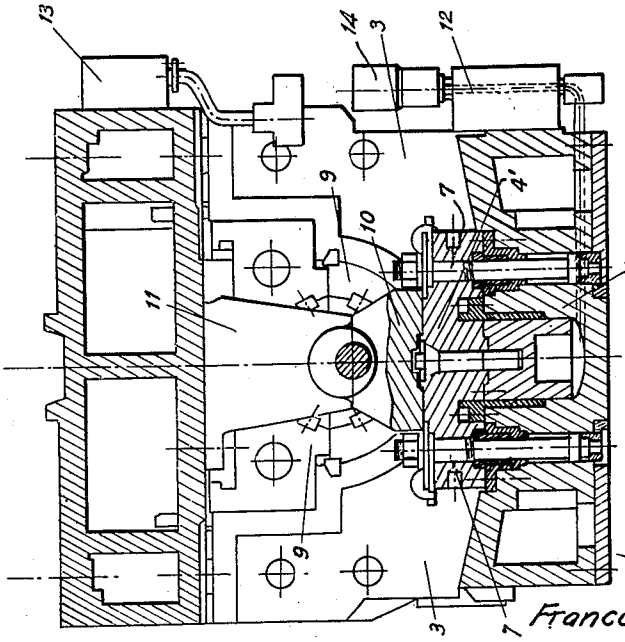


Fig. 3

Inventor:
Francois Meley,

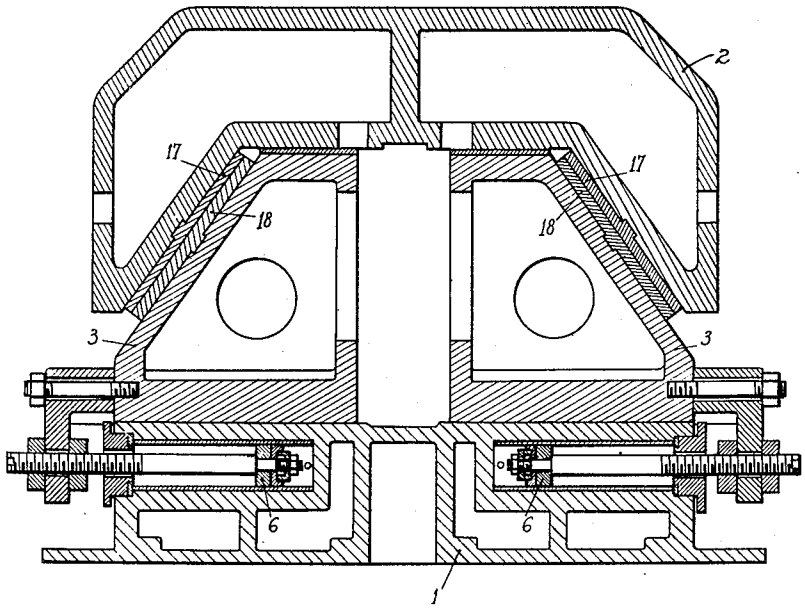
By E. F. Wunderlich
Attorney

Dec. 19, 1950 F. MELEY 2,534,613

APPARATUS FOR FORGING PARTS SHOWING IMPORTANT VARIATIONS IN THEIR CROSS SECTION

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Fig. 5



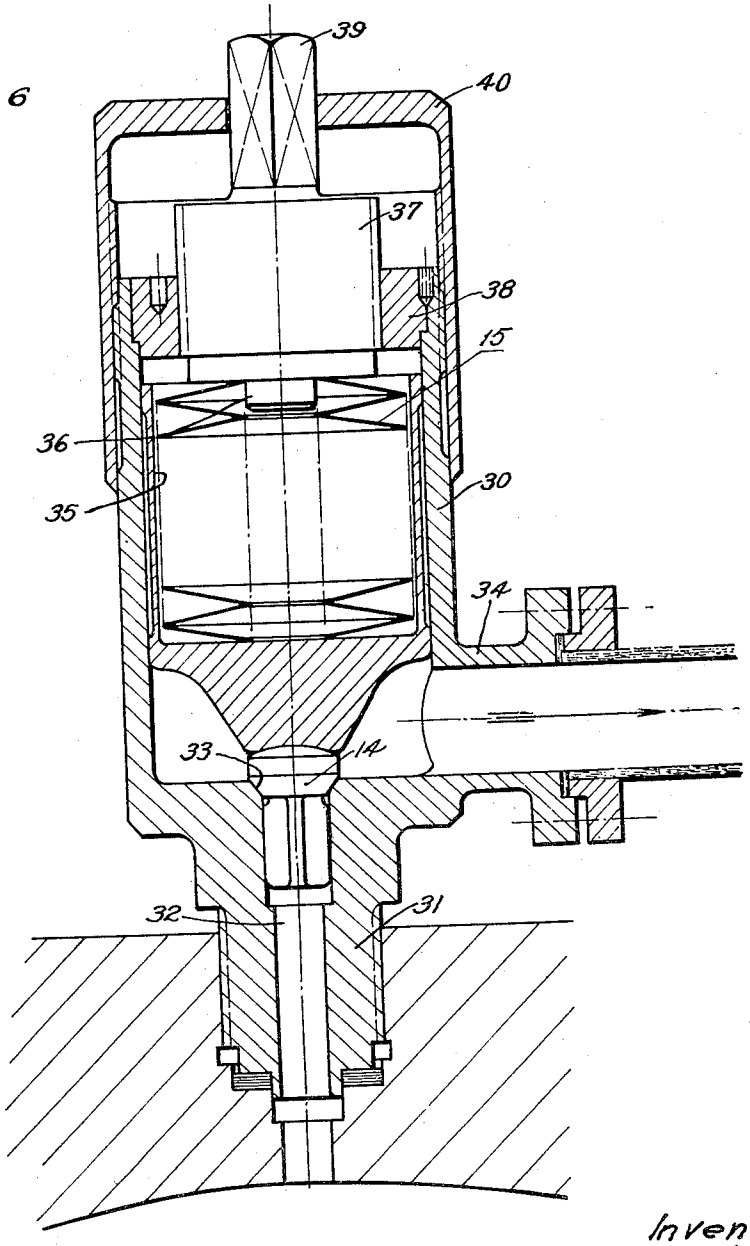
Inventor
F. Meley
By
Wenderoth, Lind & Ponack
Attorneys

Dec. 19, 1950 F. MELEY 2,534,613

APPARATUS FOR FORGING PARTS SHOWING IMPORTANT VARIATIONS IN THEIR CROSS SECTION

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Fig. 6



Inventor:
Francois Meley,

By E. A. Neuderoth
Attorney

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APPARATUS FOR FORGING PARTS SHOWING IMPORTANT VARIATIONS IN THEIR CROSS SECTION

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FIG. 7

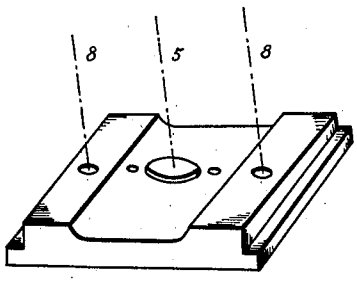


FIG. 8

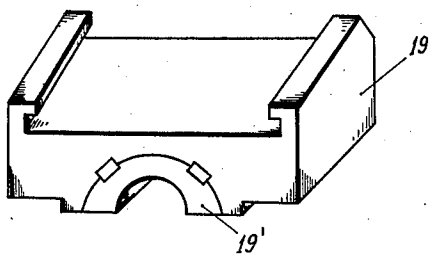
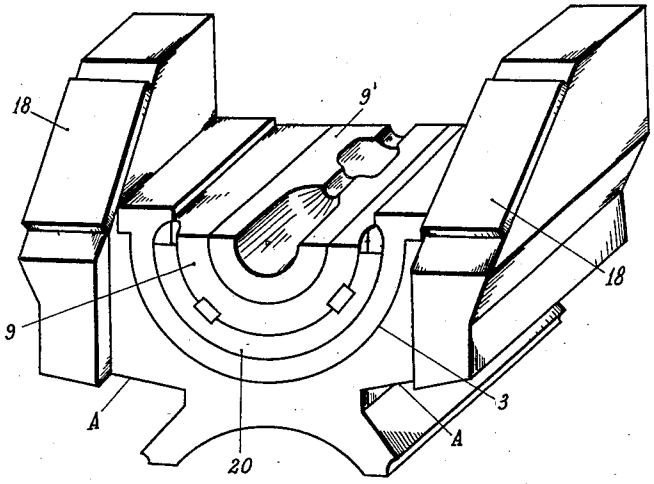


FIG. 9



Inventor
F. Meley
By
Wenderoth, Lind & Ponack
Attorneys

Patented Dec. 19, 1950 2,534,613

UNITED STATES PATENT OFFICE

2,534,613

APPARATUS FOR FORGING PARTS SHOWING IMPORTANT VARIATIONS IN THEIR CROSS SECTION

François Meley, Saint-Martin en Coailleux, France, assignor to Compagnie des Forges et Acieries de la Marine et d'Homecourt, Paris, France, a joint-stock corporation of France

Application June 19, 1945, Serial No. 600,378
In France December 7, 1944

5 Claims. (Cl. 29—6)

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My invention has for an object an apparatus designed to forge directly without reticulation (beetling) crank shafts in which the fibers of the metal are oriented in such manner that:

1. The axial zone of the original ingot coincides with the neutral fibre of the finished forged part.

2. The portions of the part submitted to the maximum strain correspond to the soundest parts of the original ingot.

3. The fibres of the metal are parallel to the outer surfaces of the parts.

This apparatus is to be used under a normal forging press. I start from a blank which may either (*a*) include swellings adapted to produce the wider portions of the part, which swellings are separated by throttled elements adapted to form the burnished portions of the part, whether eccentric or not, said blank being in this case forged progressively from point to point in one or several operations according to the number of these swellings (generally, each operation produces the forging of a burnished portion and the two adjacent swellings or of a swelling and the two adjacent burnished portions), (*b*) or else be provided in the portions to be deformed during operation with any desired shape depending on the final shape to be obtained.

The so-called intermediate portions, whatever may be their position in the part, are those which do not require any deformation during operation; they have a size and shape which allow their being housed inside the swages the impresses of which are designed to this end.

The blank thus prepared is enclosed between the extreme swages which hold in their impresses the intermediate portions limiting the parts to be deformed with a pressure sufficiently great for allowing only the parts the shapes of which are to be transformed to be submitted to the desired deformations during the forging operation. Thus the axial zone of the original ingot remains always in coincidence with the neutral fibre. As they come nearer together, the swages ensure in a simultaneous manner the longitudinal forging of the parts which are to be transformed and their transversal forging in the desired azimuth, which latter forging is obtained by means of a set of central swages.

The pressure to be exerted on the intermediate portion cannot, by reason of its very magnitude be obtained by the usual means of an accumulator. This pressure which is very high per square centimeter must be obtained by a system of loaded valves which allow the liquid contained

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in the cylinder corresponding to the swages to flow out under a predetermined pressure; this pressure depends on the size of the intermediate portions, the compressed surfaces of which are enclosed inside the swages and must be capable of supporting a pressure per square centimeter which is higher than that required for the deformation of the metal of the blank whereby the intermediate parts are not submitted during the forging operation to any deformation other than that allowed by the swages between which they are enclosed.

In the apparatus according to the invention, slopes integral with the central set of swages act on other slopes integral respectively with the extreme swages so as to associate the operative stroke of the extreme swages with that of the central set of swages.

The hollow swages, each constituted by two parts are adapted to house the intermediate parts of the blank located to either side of those which are submitted to operation, this housing being even such, in the case where eccentricity is to be provided, as will produce this eccentricity in the desired azimuth. Hydraulic pistons act on the swages for holding between their two cooperating parts, before and during the forging, the intermediate portions of the blank arranged to either side of those which are being forged. Another hydraulic piston acts similarly under the central swage so as to prevent any sliding or deformation of the central intermediate portion. Thus during this double movement, only the elements which are to suffer a deformation are submitted to forging; the intermediate portions between the latter elements or adjacent to same may be displaced but are not forged and retain their original size and shape whereby:

1. The axial zone of the original ingot remains in coincidence with the neutral fibre of the finished forged part.

2. The metal fibres are parallel to the outer surfaces.

3. The central intermediate portion is shifted exactly through the desired angular and longitudinal amount.

The apparatus in accordance with my invention shows a number of novel features, which will appear from the reading of following description. In said description reference is had to accompanying drawing which shows:

Fig. 1 is a cross-sectional view through the longitudinal axis of the apparatus.

Fig. 2 is a similar view with certain of the elements shown in a different position.

Fig. 3 is a cross-sectional view taken perpendicular to the view shown in Fig. 1.

Fig. 4 is a cross-sectional view parallel to the view shown in Fig. 3 and passing through the swages.

Fig. 5 is a cross-sectional view taken on section line V—V of Fig. 4 and

Fig. 6 is a cross-sectional view through the axis of a loaded valve.

Fig. 7 is a perspective view of a connecting element.

Fig. 8 is a perspective view of a half swage, and

Fig. 9 is a perspective view of the cradle carrying the lower half swage.

As shown in the drawings, the apparatus according to the invention comprises a base 1 having slides upon which cradles 3 may slide. The base has mounted thereon a lower locking piston 4 which serves as a support for the lower central half swage 10 through the intermediary of a transverse element 4' to which are attached two return pistons 7 for the central lower half swage 10. The base 1 has located therein the cylinders of the four lateral pistons 6 for the return of the sliding cradles 3 (see Fig. 5).

A cross-bar 2 is secured to the upper part of the press. This cross-bar is provided with two pistons 5 for locking the upper half swages which are each formed of two portions 19, 19', upon the blank and four return pistons 8 for the half swages. Each of the pistons 5 is associated with two pistons 8 located at both sides. The three pistons are attached to a common element 16 (see Figs. 1, 2, and 4) and the longitudinal edges of this common element 16 slide in a slide 22 which forms the cooperating edge of the half swage 19 concerned. The above arrangement permits the half swages to be displaced transversely with relation to the upper pistons for the locking and the returning during the forging. The cross-bar 2 also has four inclined slopes 17 and the upper central half swage 11 is fixed to the center of such cross-bar.

Each of the sliding cradles are provided with two inclined slopes 18, 18 upon which the inclined slopes 17 of the cross-bar 2 are supported.

These two cradles receive the lower half swages which are each in two pieces 9, 9'. A circular key 20 and two rectilinear keys 21, during the longitudinal forging of the four half swages 9, 9' and 19, 19' fix the latter to their respective cradles. The half swages 9 and 19 receive those portions of the blank which are located at the sides of the portion which is to form the elbow.

As shown in Fig. 1, one portion of the blank has already been forged while the other has not.

For economical reasons each half swage is formed from two portions. The external portion is invariable while the internal portion varies according to the type of element to be forged.

Two distributors 12, 13 serve respectively for all the hydraulic control means on the base of the press and for all the hydraulic control means on the upper cross-bar 2.

Three exhaust valves 14 loaded by an adjustable spring 15 constituted for instance as shown in Fig. 6 by a pile of Belleville washers are respectively in communication with the three hydraulic cylinders. They allow an adjustment of the pressure per unit of surface, beyond which the liquid contained in the hydraulic cylinder is exhausted whereby the forging operation is allowed as given out hereinabove.

The apparatus according to my invention operates as follows: The prepared blank is placed on the apparatus in a manner such that the central intermediate portion separating two elements to be forged lie in front of and between the two central half swages 10 and 11. The elements to be forged in front of or to the rear of those undergoing the forging operation are held by the half-swages, between which they are fastened through the admission into the cylinder 5 of liquid under a pressure of the magnitude generally obtained in an accumulator.

The blank being thus fastened and the two half-swages brought into contact with the central intermediate portion of the blank the communication between the cylinders 5 and the accumulator is closed and the forging press is set in operation. During operation, the volume of the cylinder 5 decreases and the liquid escapes only under the pressure required for opening the loaded valves i. e. under a pressure sufficiently high for there to be no displacement of the intermediate portions fastened between the swages during operation.

This forging is executed simultaneously in the longitudinal direction and in the transversal direction by making the press under which the apparatus is located act through the associated play of the slopes of the cross-bar against the slopes of the cradles which are brought into contact.

As the actions produced by the right-hand and the left-hand cradles are identical, the metal is thrust back longitudinally and transversely and there is obtained after operation an elbow such as that shown in Fig. 2.

Wedges arranged between the cross-bar and the cradles allow after adjustment a limitation of the stroke and ensure for each eccentricity the same value.

The return into their starting position of the different parts which have been set in movement is provided for hydraulically by the different return movements.

As illustrated, the apparatus according to the invention allows, by way of example and by no means in a limitative sense, the execution of bent shafts having a plurality of elbows arranged one with reference to the other in any suitable angular position. After forging a bend or crank it is sufficient to begin operation over again with the blank and to proceed with the forging of the following elbows.

According to the shape of the forged part, there are mounted on the sliding cradle adapted to carry and to fasten said part, half-swages wherewith it is possible to enclose said part the energetic fastening of which is obtained through the action of the pistons in the cylinder 5.

The swage 11 is fixed upon the upper movable platform of a forging press upon which is mounted the apparatus which is the object of the application.

It is lowered therefore with this platform. As for the swage 10 this is supported by a piston 4 which slides in a hydraulic cylinder housed in the base 1 of the apparatus, which base rests upon the lower fixed platform of the press. The cylinder of the piston 4 communicates with the exterior under the control of an escape valve 14 (Figs. 3 and 6).

When the upper platform of the press descends the swage 11 exercises a transverse pressure upon the portion of the blank which is caught between it and the swage 10, the swage 11 forces before it the said portion of the blank and the swage

16, which yields due to the pressure created in the cylinder of the piston 4 bringing about the raising of the valve 14 consequently the progressive escape of the liquid contained in said cylinder under the pressure for which the valve 14 is calibrated.

Each of the valves 14, see Fig. 6, is contained in a cylindrical case 30 whose bottom has a central neck 31 to which the case is fixed upon the cylinder of the piston 5, or joined to a conduit coming from the cylinder of the piston 4. The neck 31 is pierced with an axial conduit 32 which at its outlet at the bottom of the case 30 forms a seat 33 for the valve 14. The case 30 has a lateral neck 34 for the exit of the liquid which the valve 14 allows to pass.

In this case 30 a recessed piston 35 may slide whose bottom rests upon the valve 14. This recessed piston encloses a spring 15 which, as shown, is formed by a pile of Belleville discs. In the central hole of the disc farthest from the valve 14 engages the central stud 36 of a threaded plug 37 which screws into a ring 38 closing the case 30. Upon its other face the plug 37 has a central extension 39, of square cross-section, which permits turning it with the aid of a key in order to regulate the power of the spring 15 and consequently the pressure at which the valve 14 may rise. A cover 40 screwed upon the case 30 covers the plug 37 from which only the projection extends through an appropriate opening.

The swages 10 and 11 are moved from the position shown in Fig. 1 to the position of Fig. 2 by lowering the upper cross-bar 2 of the apparatus under the action of the press in which the apparatus is located, its base 1 resting upon a fixed portion of such press. This operates as the usual hydraulic forging press.

The hydraulic control system of the various pistons of the apparatus comprises simply valves which permit placing the corresponding cylinders either in communication with a fluid inlet under pressure or an exhaust which is evident to any worker in this art.

The lower clamps are mounted in the base for sliding movement as follows. The lower clamps are not mounted directly in the base. They are each carried by a cradle 3 which rests upon a slide in the base. Fig. 9 shows one of the cradles 3 carrying a lower clamp. This cradle rests upon the slide of the base by the surfaces A—A.

The lower clamps are returned under fluid pressure as follows.

Fig. 5 shows the arrangement of the hydraulic pistons designed to return the cradles 3 carrying the lower clamps. It illustrates also the connecting means between the pistons and the cradles 3.

Fig. 4 shows the arrangement of the locking piston 5 and the recall pistons 8 of the upper clamp. See also Figs. 7 and 8.

Each upper clamp 19' is fixed in a block 19 whose upper face forms towards the rear an inclined slideway (Fig. 8). In this slideway is guided a slide (Fig. 7) to which is attached the locking piston 5 at the central and the recall pistons 8—8 at both sides.

The upper clamps are connected to the upper cross bar 2 of the apparatus by the pistons 5 and 8—8. At both sides of the pistons 8—8 the cross bar 2 forms two slopes 17 which are in contact with the reverse slopes 18 upon the cradle 3 upon which is mounted the lower clamp, see Fig. 9.

When the cross bar 2 is lowered under the action of the press the right hand pair of clamps

and the left hand pair of clamps upon Fig. 1 approach one another due to the action of the slopes 17 of the cross bar upon the slopes 18 of the cradles 3.

When the operation is finished the raising of the movable platform of the press is brought about by the usual means, then fluid under pressure is admitted in back of the recall pistons 6—6 of the cradles. These are again spaced from one another by raising the cross bar 2 through the action of the slopes 17 and 18 acting in the opposite direction from the preceding.

The lower swage 10 is kept from lifting the blank off the lower clamps before the upper swage becomes active as follows.

This is a question of operating the valves distributing the water under pressure in the cylinders of the locking pistons 5 of the upper clamps and not those of the piston 7 which return the element 10 upwardly. It is evident that one first locks the workpiece in the clamps by admitting fluid under pressure in back of the pistons 5. This same fluid is only admitted in back of the pistons 7 when the lowering of the upper cross bar 2 has placed the swage 11 in contact in its turn with the blank. Furthermore the pistons 7 have a small cross-section and can only exercise a simple locking force.

The press which operates the apparatus does not constitute a part of the invention. It is simply a means for controlling the lowering of the cross bar 2.

The apparatus according to the invention may also be used for obtaining blanks comprising swellings or plates. It is sufficient to start with a cylindrical blank which is held by half-swages and is forged longitudinally by means of the sliding cradles which act alone, the central half-swages being removed.

Obviously the present invention should not be considered as limited to the form of execution shown, but it can, on the contrary, be executed in accordance with different modifications the object of which may relate in particular to the means used for holding the blank during the forging. It may cover in particular an independent apparatus acting without the intervention of a forging press. Similarly, the object of the invention may be used for obtaining not only bent crankshafts but also similar mechanical parts having different shapes.

What I claim is:

1. An apparatus for forging crank shafts and similar elements starting from a blank having enlargements for the positioning of the webs of the crank to be forged comprising a base having a longitudinal slide, two cradles sliding upon said slide having slopes on both sides, lower clamps located between said slopes designed to support the blank on both sides of two consecutive enlargements of the latter, a cross bar having slopes opposite to those of said cradles supported upon the slopes of said cradles, upper clamps corresponding respectively to said lower clamps, hydraulic cylinders carried by said cross bar, locking pistons in said cylinders connected to said upper clamps by an element sliding with relation to said clamps, calibrated valves controlling the exhaust from said cylinders, an upper central swage fixed to said cross bar to act upon said blank between two consecutive enlargements, a lower swage located opposite to said upper swage, a piston carrying said lower swage, a hydraulic cylinder for said piston in said base and a cali-

brated valve controlling the exhaust from this latter cylinder.

2. An apparatus as set forth in claim 1 comprising hydraulic cylinders carried by said upper cross bar with return pistons for the upper clamps connected to said sliding element connecting the upper clamps to their locking pistons.

3. An apparatus as set forth in claim 1 comprising in said base longitudinal hydraulic cylinders with return pistons which are connected each respectively to one of said cradles.

4. An apparatus as set forth in claim 1 comprising in said base hydraulic cylinders with return pistons connected to said lower swage in order to raise it.

5. An apparatus as set forth in claim 1 comprising lower clamps and upper clamps which have hollows for receiving the cranks already forged in any orientation desired with relation to the working plane of the apparatus.

FRANÇOIS MELEY.

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