

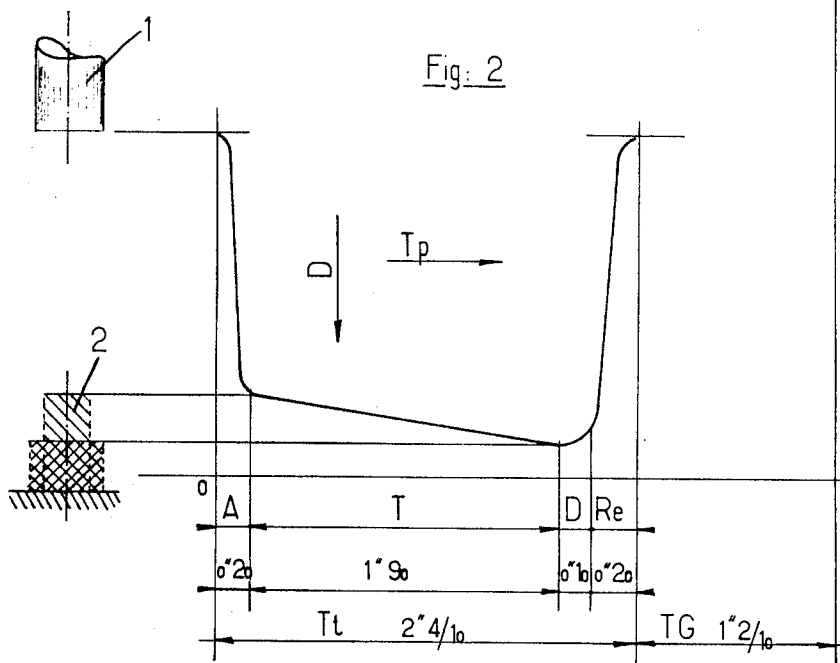
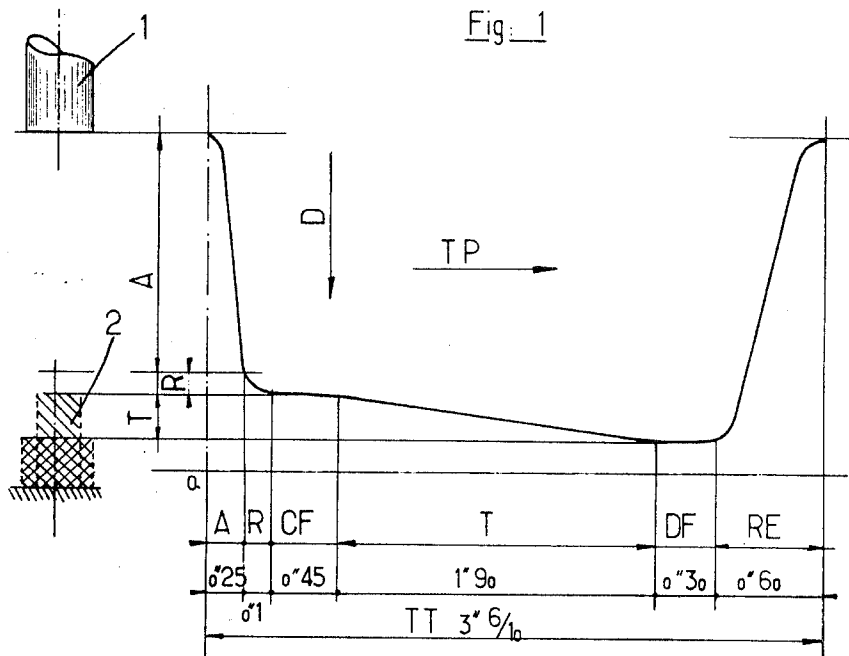
July 7, 1970

G. S. FORICHON
HYDRAULIC PRESS, MORE PARTICULARLY FOR
TREATING METALS BY SHAPING

3,518,869

Filed June 6, 1967

5 Sheets-Sheet 1



INVENTOR
Gaston Sébastien Forichon
by
Woff, Greenfield & Hickin

July 7, 1970

G. S. FORICHON
HYDRAULIC PRESS, MORE PARTICULARLY FOR
TREATING METALS BY SHAPING

3,518,869

Filed June 6, 1967

5 Sheets-Sheet 2

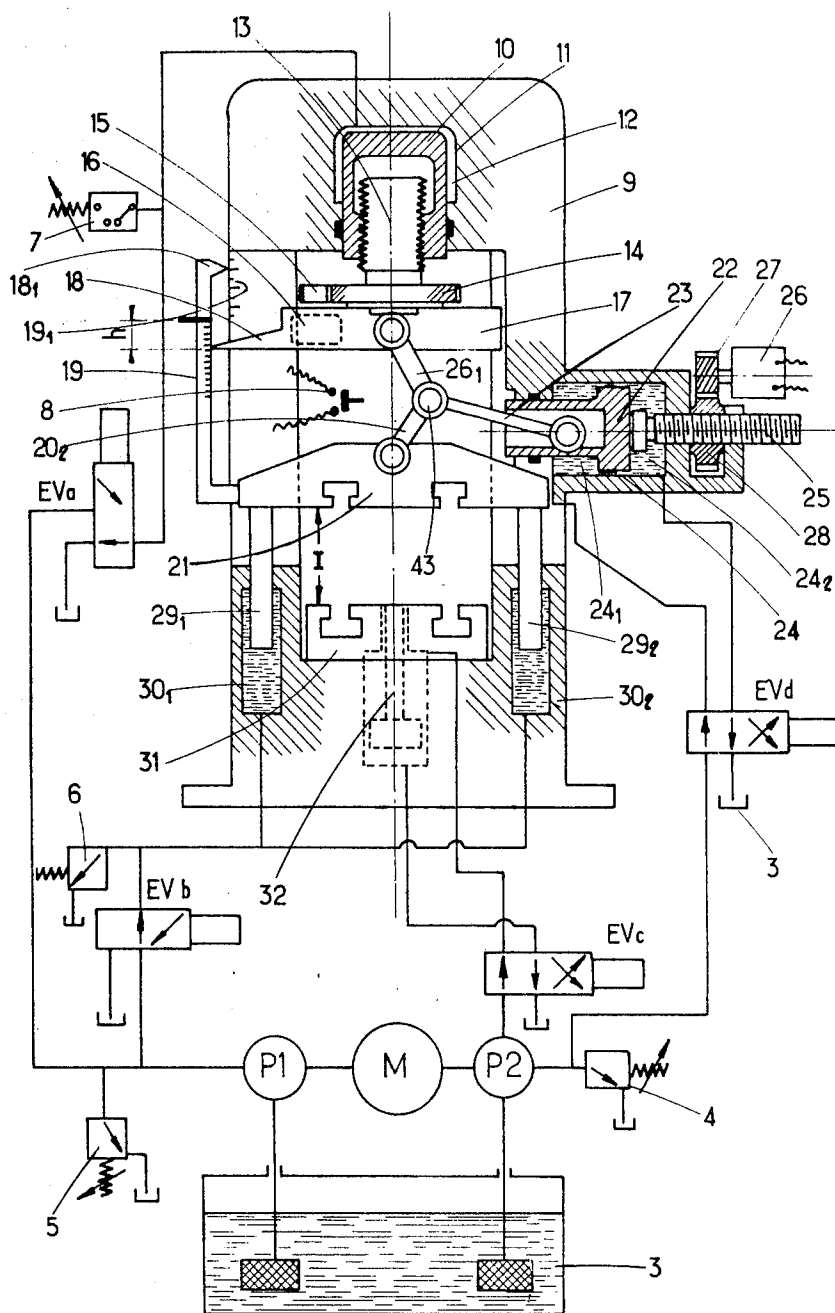


Fig. 3

INVENTOR
Gaston Sébastien Forichon
by Wolf, Greenfield & Hicken

July 7, 1970

G. S. FORICHON
HYDRAULIC PRESS, MORE PARTICULARLY FOR
TREATING METALS BY SHAPING

3,518,869

Filed June 6, 1967

5 Sheets-Sheet 3

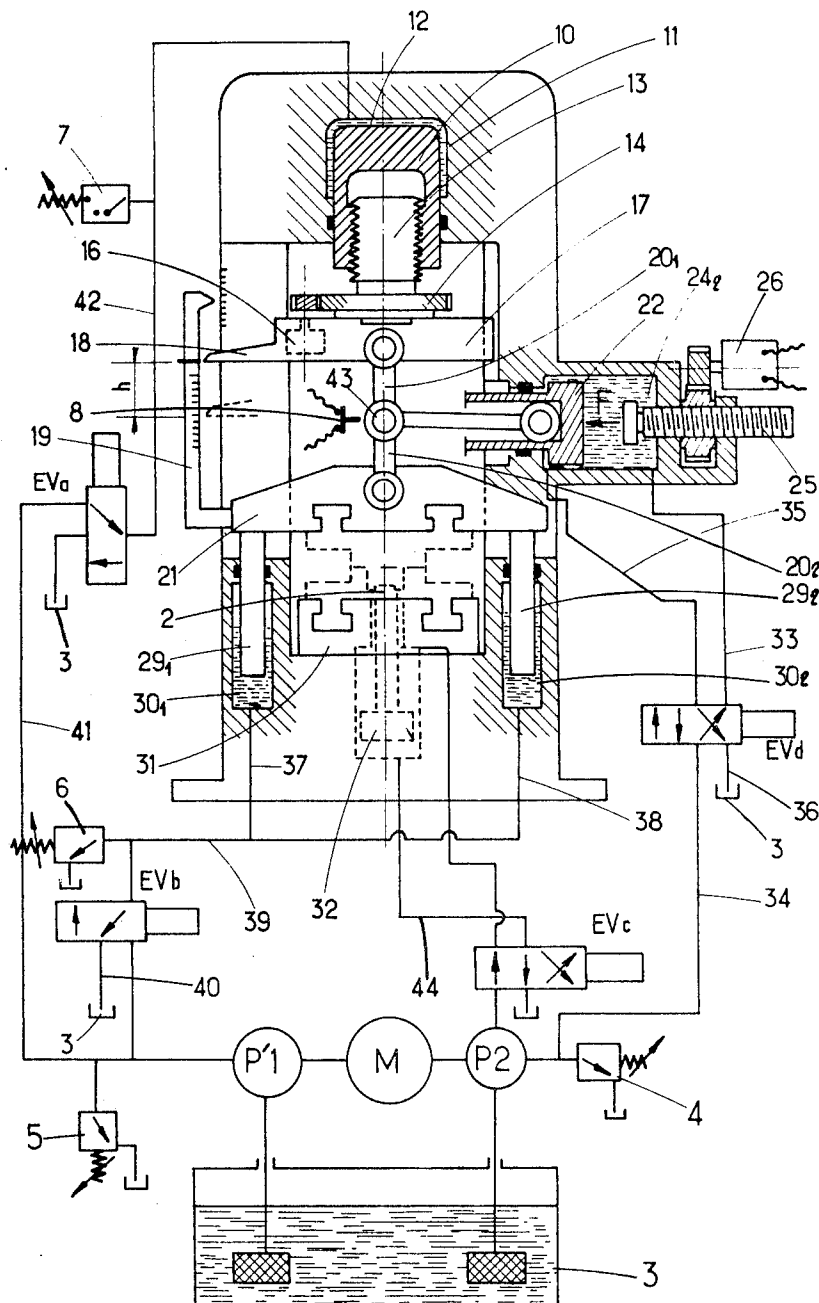


Fig. 4

INVENTOR
Gaston Sébastien Forichon
by *Wolf, Greenfield & Hickman*

July 7, 1970

G. S. FORICHON
HYDRAULIC PRESS, MORE PARTICULARLY FOR
TREATING METALS BY SHAPING

3,518,869

Filed June 6, 1967

5 Sheets-Sheet 4

Fig. 5

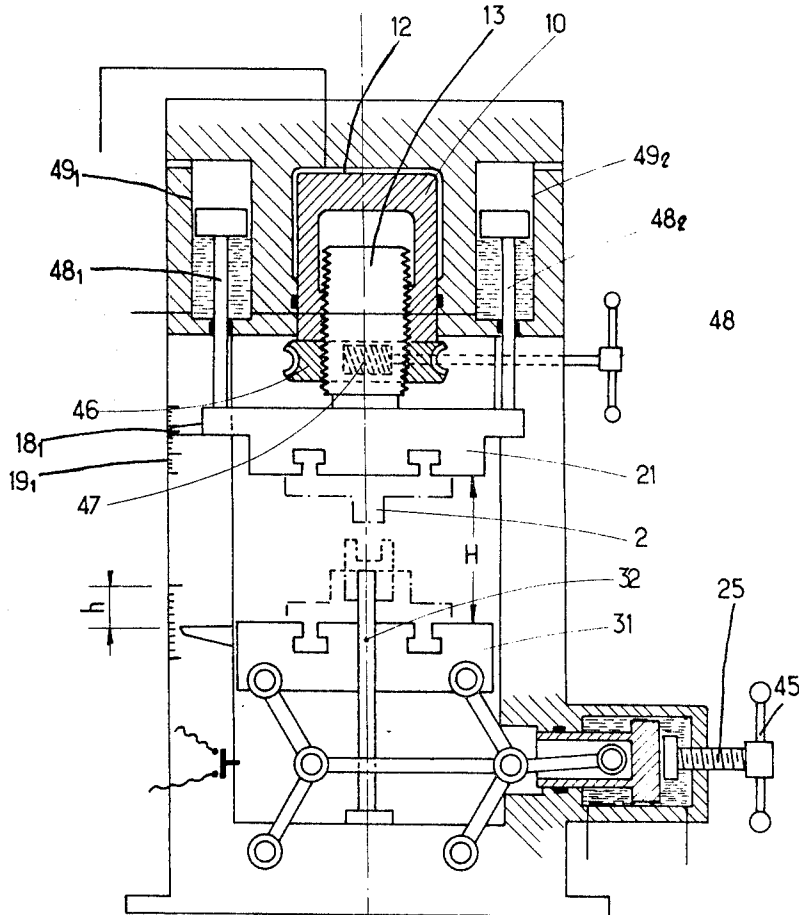
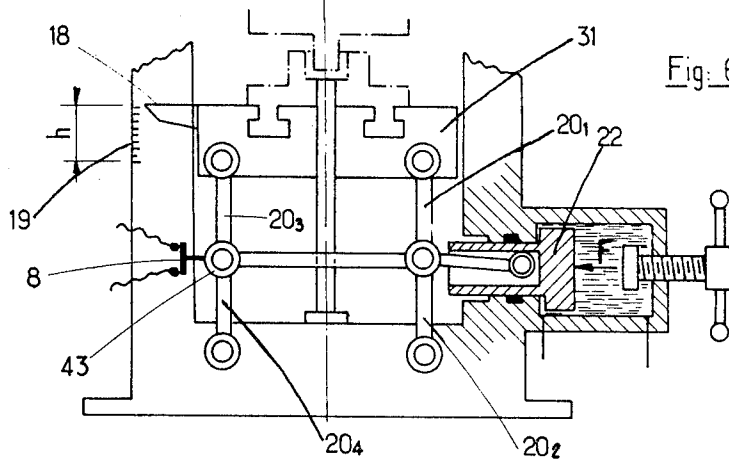


Fig. 6



INVENTOR

Gaston Sébastien Forichon
by *Wolff Greenfield & Hoken*

July 7, 1970

G. S. FORICHON
HYDRAULIC PRESS, MORE PARTICULARLY FOR
TREATING METALS BY SHAPING

3,518,869

Filed June 6, 1967

5 Sheets-Sheet 5

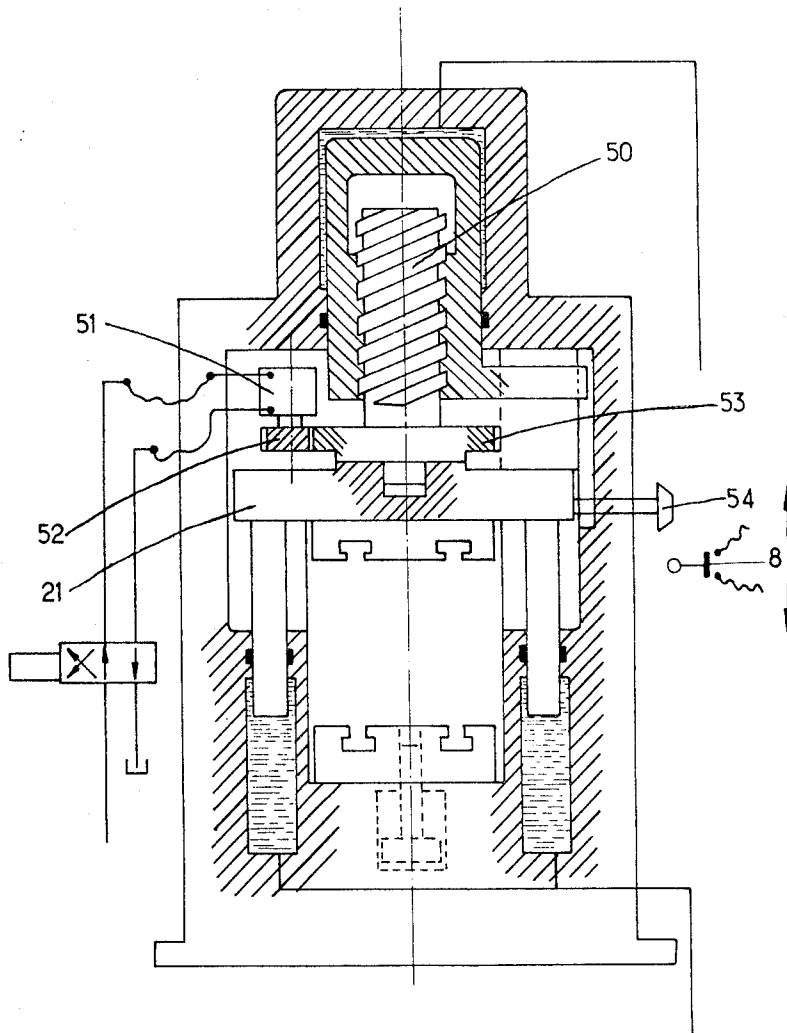


Fig. 7

INVENTOR

Gaston Sébastien Forichon
by *Wm. Greenfield Hickson*

1

2

3,518,869

HYDRAULIC PRESS, MORE PARTICULARLY FOR TREATING METALS BY SHAPING

Gaston Sebastien Forichon, 177 Rue de Billancourt, Boulogne, France

Filed June 6, 1967, Ser. No. 643,903

Claims priority, application France, Mar. 30, 1967, 100,829

Int. Cl. B21j 9/12

U.S. Cl. 72-453

6 Claims

ABSTRACT OF THE DISCLOSURE

Hydraulic press for treating metals comprising an upper punch holder plate and a lower female die holder plate, one of these two plates being mobile in relation to the other by a hydraulic unit, mechanical means such as links or high speed screws replacing the fluid under pressure during the approach and recoil stages of the press piston to reduce the working cycle time which up till now was consistent with the fact of time losses due to the voluminous filling and heavy pressure that must prevail in the work chamber of the press piston.

There are a large number of hydraulic presses on the market today of small, medium and large size, that are generally arranged so that their work cycle is totally subordinated to the employing of a work fluid.

Thus, the pressure of a work fluid is used, both for the approach stage of the press plate as for the work stage itself.

With this idea in mind, FIG. 1 illustrates by means of diagrams the various stages of the operating cycle of known hydraulic presses. To the left of the diagram the press punch 1 is diagrammatized, as well as the billet 2, before treatment.

Before starting up the hydraulic press, the press piston, and hence the punch, are in the top position, i.e., the pressure chamber, delimited between said piston and its cylinder, is reduced to a minimum volume. The billet 2 for treatment is placed on the lower female die plate and the press is ready for operating.

Seeing that this refers to a press working by deformation of the metal, it is necessary, in a first period, called "the approach stage," to bring the punch as quickly as possible, into proximity with the billet, then, in a second period called "the slowing-down stage," brake the punch so as progressively to bring it against the top face of the billet.

These two stages of approach and slowing-down A and R are entirely determined by the delivery of the work fluid, i.e., that the press piston is impelled downwards by the delivery of the fluid, which delivery must be the greater as the pressure chamber, delimited between the piston of the press and the cylinder, progressively increases in volume as the piston descends.

On this account, and seeing that it refers to a large gauge press, it frequently occurs that the volume of pressure chamber is very considerable, thus necessitating a considerable loss of time, due to the filling of this compression chamber by a fluid which must also be compressed.

The slowing-down stage is also detrimental to the speed of operating the press, owing to braking the punch which, before all things, is necessary if we wish to avoid an abrupt impact of said punch on the billet, which may lead to the damaging of the tools.

It is only after these two preliminary stages A and R, that the work stage T really begins.

This work stage is again also determined by an in-

crease of the pressure of the fluid, so that the punch deforms the billet for modelling it into the required shape.

When the work stage T is finished, a contact, generally situated on the course of the press piston, inverts the electro-valves which effect the decompression of the fluid, initially compressed to comply with the approach stage A and to the work stage T. Actually, it is obvious that it is necessary to ease off the compressed fluid, instead of abruptly releasing it, owing to the heavy pressures to which said fluid is subjected.

When the fluid is sufficiently decompressed, the pressure prevailing in the chamber situated behind the rear face of the press piston then becomes less than that exerted under the peripheral shoulder of the piston, which leads to the upward stage Re of the press piston.

The piston now returns to its initial position. The press is once more ready to operate.

In FIG. 1, displacements D are shown in ordinates, whereas the time T_p , selected as example, is given in abscissae.

In this FIG. 1, the times required for each working stage of the press are given, by way of example, in seconds, and this, so as subsequently to be able to compare these times with those obtained by the press according to the invention.

approach stage $A=0''.25$
slowing-down stage $R=0''.10$
fluid compression stage $CF=0''.45$
work stage $T=1''.90$
fluid decompression stage $DF=0''.30$
press piston rising stage $Re=0''.60$
cycle total $3''.6$.

It is quite clear from this diagram that a considerable amount of time is lost in the stages called approach, slowing-down, compression and decompression of the fluid.

Actually, these four stages, although not directly taking part in the work stage, nevertheless represent in themselves alone, a certain number of inactive periods, namely, in seconds: $0''.25+0''.10+0''.45+0''.30=1''.10$.

This almost useless time thus has the disadvantage of appreciably increasing the duration of the work cycle of the press, which, of course, detracts from its output and hence increases the cost price of the parts to be treated.

The invention has the object of obviating these disadvantages and relates, to this end, to an hydraulic press for treating metals by shaping comprising an upper punch holder plate and a lower female die holder plate, one of these two plates being mobile in relation to each other by a hydraulic unit, adjustable mechanical means ensuring the movement of the press piston in the corresponding stroke at its approach stage, i.e., until it abuts on the face of the rough part, these same mechanical means also acting for returning the press piston to its initial position.

According to one characteristic of the invention, the mechanical means, determining the approach of the press piston, act in relation with a direct reading device.

According to another characteristic of the invention, the reading device consists of a sliding-gauge in front of which a pointer moves integral with an intermediate plate, itself in relation with the adjustable mechanical means, which enables instantaneously the ascertaining of the approach stroke of the press piston.

A press according to the invention is shown by way of non-restrictive example in the attached drawings, in which:

FIG. 1 is a diagram corresponding to the work cycle of known presses.

FIG. 2 is a diagram, showing the possibility of comparing the results obtained with a press according to

the invention in relation to the diagram shown in FIG. 1, and corresponding to the work cycle of known presses.

FIG. 3 is a diagrammatical view showing a method of making the press according to the invention, in which the punch is in the top position.

FIG. 4 is a diagrammatical view corresponding to FIG. 3, in which the punch is in the bottom position.

FIGS. 5 and 6 are diagrammatical views showing an alternative embodiment.

FIG. 7 is a diagrammatical view of a third method of embodiment.

One of the objects of the invention is to make the maximum reduction of the work cycle time of a hydraulic press, so as to increase the rhythm of output of said press, in order to reduce the cost price of treated parts.

To this end, the fundamental idea of the invention essentially lies in the temporary substitution of mechanical means for hydraulic means, more particularly in the approach stage of the punch or press piston, which thus leads to the suppressing of the slowing-down stage F and a considerable reduction of the compression and decompression stages of the fluid.

Of course, these mechanical means, controlling the movement of the press piston and hence, the punch, can be of any kind, some examples being given hereafter by way of information, precisely to show the alternatives that can be applied in this field.

(1) According to FIG. 3, the hydraulic press itself consists of a hydraulic unit comprising a tank 3, from which two pumps P_1 and P_2 draw (P_2 being a reduced pressure pump), said pumps being actuated by a Motor M.

It is from these pumps P_1 and P_2 that the dispatching of the work fluid takes place, and this by means of a series of electro-valves EVa, EVb, EVc, EVd, which direct the fluid in a direction pertinent to the stage that it must fulfill at a precise moment, of the work cycle.

The work of these electro-valves is moreover completed by safety valves 4, 5 and 6, a pressure gauge contact unit 7 acting for stopping the work operation, whereas a contact 8 enables, on the other hand, the triggering of the work stroke.

At a construction level, the press is made of a partially hollowed out frame 9, so as to form a cavity in which the press piston 10 can move in a vertical plane, which delimits, in relation to the cavity 11 forming the cylinder, a chamber 12, called the pressure chamber.

The piston 10 is also hollowed out so as to accommodate the body of a displaceable screw 13, whose base is provided with a pinion 15 actuated by an auxiliary electric motor 16.

This screw 13 is connected to an intermediate plate 17, which comprises a pointer 18, able to move in front of a graduated scale 19.

The mechanical means causing the movement of the work piston 10, and hence that of the intermediate plate, are made, in this example of embodiment, from two jointed links 26₁ and 20₂, the first one 26₁ being connected to the intermediate plate 17, whereas the second 20₂ is connected to the upper punch holder plate 21.

The angle of opening or closing, formed by the two jointed links 20₁ and 20₂, is ensured by an auxiliary piston 22, connected to the latter by a third link 23, said intermediate piston being movable crosswise in a cylinder 24 filled with fluid.

A first adjustment of the position of the jointed links 20₁ and 20₂ is ensured by a screw stop 25, maneuvered by a second auxiliary motor 26, whose driving pinion 27 constantly meshes with a lock-nut 28 connected to the screw stop 25.

The guiding and recoil of the upper punch-holder plate 21 is ensured by two small jacks, formed by the pistons 29₁ and 29₂, which move in the cylinders 30₁ and 30₂. The lower female die holder plate of the press 31 is, more-

over, provided with an ejector 32 for withdrawing the finished parts.

In this FIG. 3, the pump P_1 delivers at low pressure (adjusted by the valve 6₁) in the rising cylinders 30₁ and 30₂, so that the pistons 29₁ and 29₂ hold the upper punch-holder plate 21 in its top position, in like manner as the auxiliary piston 22 is kept in a retracted position, i.e., pressed against the screw stop 25, owing to the electrovalve EVd being positioned for affording free passage for the fluid delivered by the pump P_2 to the chamber 24₁, situated in front of the piston 22, the chamber 24₂, situated behind the piston, being, on the contrary, connected by the electro-valve EVd, to the tank 3, so that the pressure proportionally lowers in this chamber.

FIG. 4 is a view corresponding to FIG. 3, the upper punch holder press plate being nevertheless in its end of stroke position.

The approach stake of the upper punch-holder plate, which is essentially ensured by mechanical means, takes place in the following manner:

The position of the electro-valves EVb and EVd shown in FIG. 1 has been inverted, which leads to:

(a) The introducing of the fluid delivered by the pump P_2 into the chamber 24₂, situated behind the auxiliary piston 22, and this by means of ducts 33 and 34, put into communication by the electro-valve EVd.

(b) The uniting of the chamber 24₁ with the tank 3, by the ducts 35 and 36 put into communication, here also, by the valve EVd.

(c) The return of the fluid (contained in the cylinders 30₁ and 30₂) to the tank 3, by means of ducts 37 and 38, which converge for uniting in a duct 39 going to the tank through the electro-valve EVb.

Thus, the pressure increasing in the chamber 24₂ and proportionally diminishing in the chamber 24₁, the auxiliary piston 22 is moved in the direction of the arrow F, this movement being the more favored in that the pressure initially prevailing in the cylinders 30₁ and 30₂ diminishes and that, hence, the upper punch-holder plate 21 is free to move downwards (in a vertical plane), the displacement of the auxiliary piston 22 (in the direction of the arrow F) progressively determining the alignment of the links 20₁ and 20₂ and hence, the downward movement of the upper punch-holder plate 21, until it abuts against the billet 2 to be treated.

This stroke, forming the approach stage, is pre-regulated by means of the stop screw 25, whereas the possible displacement of the intermediate plate 17, whose stroke can be ensured by the auxiliary motor 16, enables the upper face of the piston 10 to be correctly pressed against the bottom of the cylinder 11, for preserving, before the piston is displaced, a minimum volume in the pressure chamber 12.

The approach travel corresponds to the distance "h" checked, by direct reading on the graduated scale 19, by means of the pointer 18 integral with the intermediate plate, whereas the distance H (FIG. 3) between the plates is checked by the pointer 18₁ on the graduated scale 19₁.

When the approach stage is thus finished, the swivel-joint 43 comes into contact with the electric switch 8 which inverts the electro-valve EVa; it then suffices to invert it, from the position it occupies in FIG. 3, to bring it to the position that it occupies in FIG. 4.

We note that in this new position, the electro-valve EVa directly connects the pump P_1 to the work chamber 12; situated behind the upper face of the press piston 10, and this by means of ducts 41 and 42 put into relation.

Form then onwards, the pressure increases in the chamber 12 (whose volume is reduced to the maximum so as to gain time) and the press piston 10 is driven downwards.

As the upper punch-holder plate 31 is pressed against the billet to be treated, the hydraulic pressure, ensured in the chamber 12, causes the crushing, i.e., the deform-

ing of the billet, until the latter is modeled to the required shape, by the cooperation of the die integral with the lower plate 31 and the punch integral with the upper plate 21.

When the shaping operation itself is terminated, the pressure having reached the required value, the pressure-gauge contact 7 immediately operates the inversion of the electro-valves to bring them back to the position that they originally occupied, i.e., that shown in FIG. 3.

From then onwards, the auxiliary jack 22 recoils, to become pressed against the screw stop 25. The articulation points of the links come close to each other, corresponding to the rise of the upper punch-holder plate, this action being moreover favored by the electro-valve EVd which enables the fluid to enter, delivered by the pump P₁, into the cylinders 30₁ and 30₂, where the lifting pistons 29₁ and 29₂ of the plate are found.

Simultaneously with this action, the pump P₁ ensures, by means of the duct 44, the working of the ejector 32 which enables the shaped part to be withdrawn.

(2) FIGS. 5 and 6 show an alternative embodiment, in which it is not the upper punch-holder plate 21 that is displaced by mechanical means, but on the contrary, the lower female die-holder plate 31.

On the other hand, the links, which, here again, determine the approach stage of the plate, are no longer two in number, but four, symmetrically distributed so as to enable a regular ascensional displacement in a horizontal plane, of the press plate 31.

In addition, the screw stop 25 is, according to this embodiment, no longer driven as in FIGS. 3 and 4 by means of an intermediate motor 26, but by hand by means of a winch 45.

At the top part of the press there is an adjustment screw 13, but this is no longer actuated by an auxiliary motor 16, as in FIGS. 3 and 4, but by means of a nut 46, represented by a tangent wheel, that can be operated by a worm 47 and its winch 48.

The punch-holder plate 21 is moreover returned to the top position by recoil pistons 48₁ and 48₂, which move in cylinders 49₁ and 49₂ made in the frame of the machine.

As in FIGS. 3 and 4, the auxiliary piston 22 ensures, by moving in the direction of the arrow F, the alignment of the links 20₁, 20₂, 20₃ and 20₄, which determines the displacement of the female die-holder lower plate 31, whose travel corresponds to the approach stage *h*, checked by direct reading on the graduated scale 19, by means of the pointer 12 integral with the lower female-die-holder plate 31. The distance H between the plates is always checked by a pointer 18, moving in front of the sliding-gauge 19₁.

When the female die carried by the press plate 31 is pressed against the billet to be treated 2, which corresponds to the alignment of the links 20₁, 20₂, 20₃, 20₄, and the engaging of the switch 8, one acts on the electro-valve EVa, shown in FIGS. 3 and 4, which ensures the sending of the fluid delivered by the pump P₁ into the pressure chamber 10, thus effecting the shaping of the part to be obtained.

In this embodiment, the ejector 32 need not be driven, and in this case it is the return of the lower female die-holder plate 31 which ensures the ejecting of the finished part.

At the end of this operation, the inverting of the electro-valves is effected by the pressure-gauge contact unit 7, as in FIG. 4.

(3) Finally, FIG. 7 shows another alternative embodiment, in which the links of the knuckle-joint type are replaced by a high-speed screw 50, this screw being maneuvered by an auxiliary motor 51 (electric or hydraulic) whose driving pinion 52 continually meshes with a toothed crown wheel 53, integral with the screw 50 of the punch-holder upper press piston 21.

The remainder of the working of this alternative em-

bodiment is identical to that shown in FIGS. 3 and 4, with the exception that the drive of the work stage is not ensured by the aligned position of the links acting on the contact 8, but by a projecting cam 54 placed on the course of the switch 8.

This switch 8 must be positioned so as to start up the work operation at the end of the approach travel.

These various alternative embodiments show that the invention is not restricted to the mechanical means used for rapidly obtaining the approach of the punch in relation to the billet to be treated, but that they can be varied to infinity, without going outside of the scope of the invention for that purpose.

Thus, and by the mechanical means employed, we obtain an appreciable reduction in the work cycle time, as explained in FIG. 2.

The diagram of this figure, which shows, in abscissae the operation time TP, and in ordinates, the movements of the tool, shows that the times initially necessary for compressing the fluid, for that the times initially necessary for compressing the fluid, for the approach and slowing-down of the punch, are suppressed, that of the decompression of the fluid is very greatly reduced owing to the minimum of fluid solely used for the work, which, for a press identical to that shown in FIG. 1, enables the following times to be obtained:

approach stage A=0".20
work time T=1".90,
decompression Df=0".10
raising time Re=0".20

The addition of these times shows that the total time T_t has dropped to 2".4, instead of 3".6, which, on the complete cycle, enables a gain of time TG of 1".2 to be obtained, being 1/3.

This is the more interesting seeing that the power, which was, up till then necessary for compressing the work fluid in the voluminous chamber left by the displacement of the piston, has been partly suppressed, from which it results that one can, by means of the press according to the invention, not only considerably reduce the work cycle time, but also the power of the press.

Of course, the invention is not restricted to the examples of embodiment described and shown above, for which other alternatives can be provided, without going outside of the scope of the invention for that purpose.

What I claim is:

1. A hydraulic press comprising, first and second holder plates adapted for relative movement from an open position to an approach position of reduced separation, and from said approach position to a closed position of yet further reduced separation, approach-recoil drive means for effecting approach movement between said open position and said approach position and for effecting recoil movement between said approach position and said open position, work-stroke drive means for effecting work-stroke movement between said approach position and said closed position, adjustable control means for determining the amplitude of movement between said open position and said approach position and for determining the separation of said holder plates at said approach position, and indicator means to provide a visual indication of the setting of said control means.
2. The press of claim 1 wherein said work-stroke drive means comprises a hydraulic cylinder and a cooperating piston, said piston is connected to said first holder plate through a first adjustable linkage and having a second linkage capable of variable positioning, said first linkage serving to determine the separation of said holder plates at said approach position, said sec-

7

ond linkage being controlled by said approach-recoil drive means,
said control means comprising means to determine amplitude of variation in positioning of said second linkage produced by operation of said approach-recoil drive means,
said indicator means comprising a first visual indicator for indicating the amplitude of said approach movement and a second visual indicator for indicating the amplitude of said work-stroke movement.
3. The press of claim 2 wherein said indicator means comprises a first pointer integral with said first holder plate and adapted to indicate the absolute position of said plate with respect to said press, and a second pointer integral with said piston and adapted to indicate the relative separation of said piston and said first holder plate.
4. The press of claim 2 wherein said approach-recoil drive means comprises an auxiliary hydraulic cylinder, a cooperating auxiliary piston, and an adjustment screw to regulate the initial position of said auxiliary piston and to thereby determine the amplitude of said approach movement.
5. The press of claim 1 wherein said work-stroke drive means comprises a hydraulic cylinder and a cooperating piston,
said piston is connected to said first holder plate through an adjustable linkage,
said second holder plate is driven by said approach-recoil drive means,
said indicator means comprises a first pointer integral

8

with said first holder plate, and a second pointer integral with said second holder plate.
6. The press of claim 5 wherein said approach recoil drive means comprise a plurality of articulated links connecting said second holder plate to the frame of said press and actuated by a hydraulic jack having a piston adapted to have its initial position manually pre-regulated.

References Cited

UNITED STATES PATENTS

1,007,792	11/1911	Orton	100—272
1,696,849	12/1928	Kelleher	72—451
1,956,658	5/1934	Schmidt	72—451
2,087,811	7/1937	Patrick	72—451
2,339,855	1/1944	Hodil	72—454
2,353,895	7/1944	Mursch	72—449
2,962,960	12/1960	Salter	100—256
3,162,232	12/1964	Munschauer	72—441
3,373,596	3/1968	Moeller	72—453

FOREIGN PATENTS

782,948 9/1957 Great Britain.

CHARLES W. LANHAM, Primary Examiner
G. P. CROSBY, Assistant Examiner

U.S. Cl. X.R.

72—451, 32; 100—272