June 20, 1939. L. OECKL ET AL 2,163,517

PRESS FOR THE FLAWLESS DEFORMING OF FLAT BLANKS

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Fig.1.

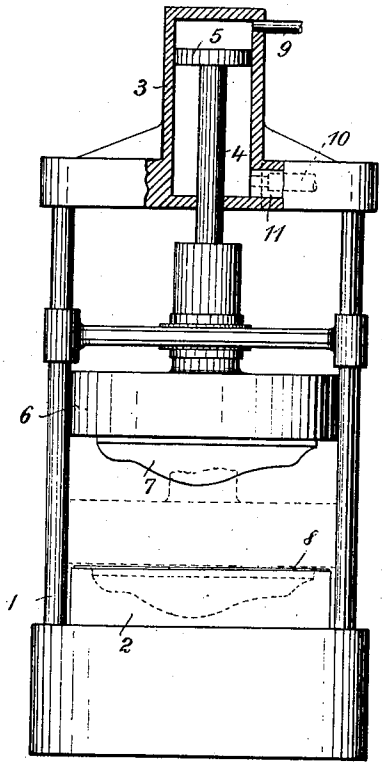


Fig.2.

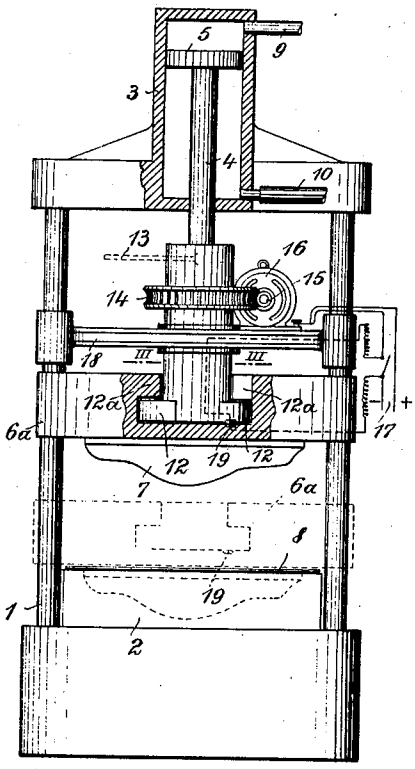
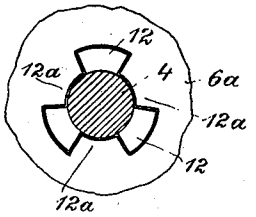


Fig.3.



Inventors:
Ludwig Oeckl and
Erhard Müller
by Carl A. Hellmann,
Attorney.

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Fig.4.

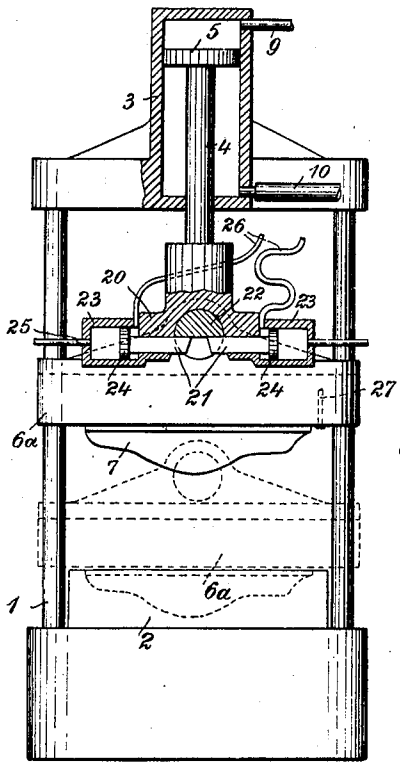


Fig.6.

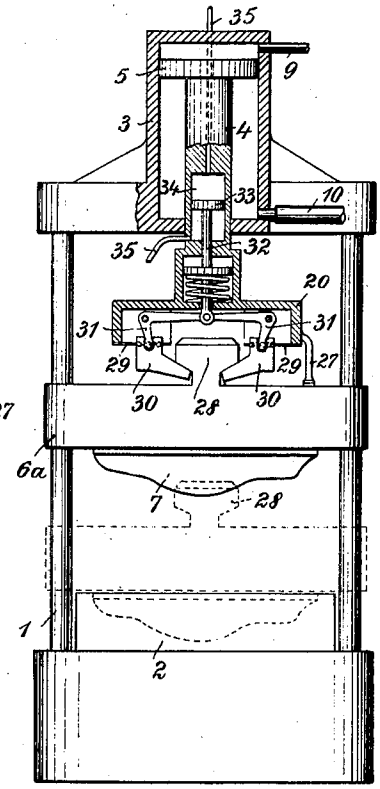
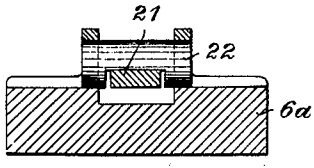


Fig.5.



Inventors:
Ludwig Oeckl and
Erhard Müller
by Carl A. Hellmann,
Attorney.

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PRESS FOR THE FLAWLESS DEFORMING OF FLAT BLANKS

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Fig. 7.

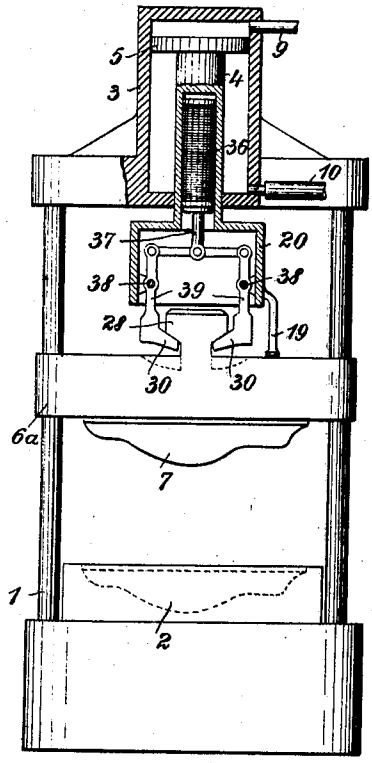
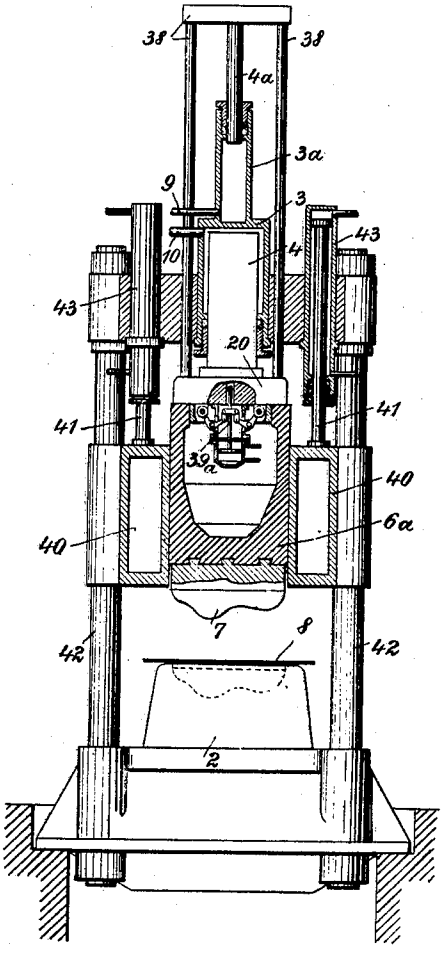


Fig. 8.



Inventors:
Ludwig Oeckl and
Erhard Müller
by Carl A. Hellmann,
Attorney.

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PRESS FOR THE FLAWLESS DEFORMING OF FLAT BLANKS

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Fig.9.

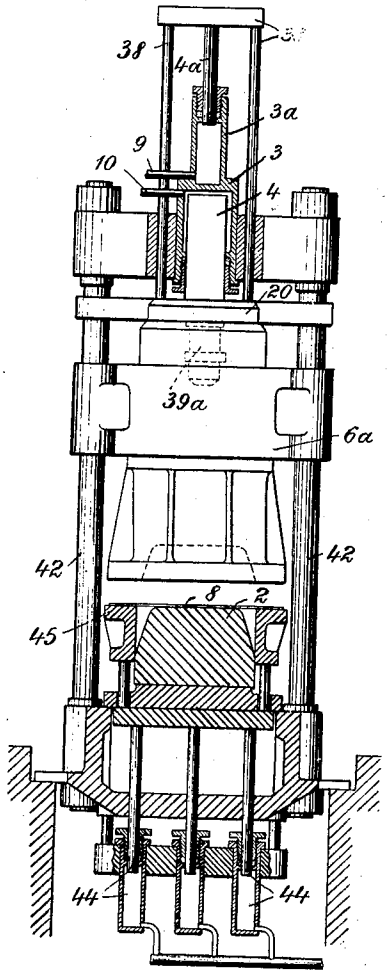
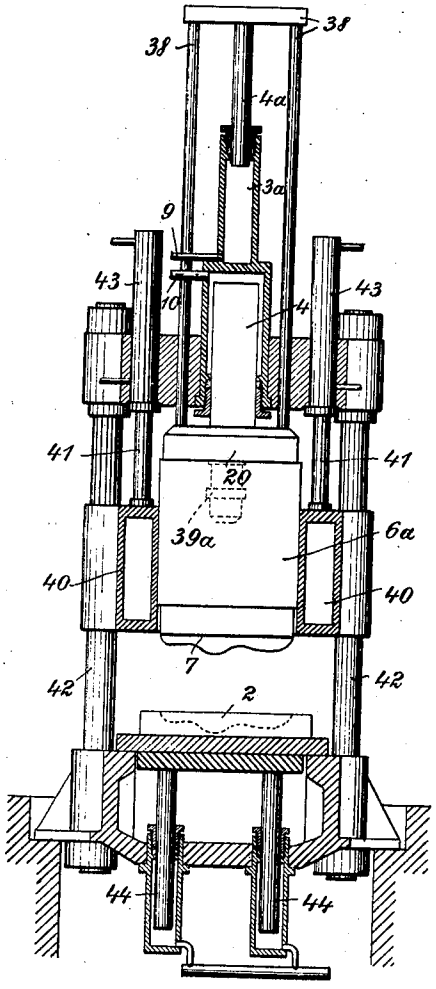


Fig.10.



Inventors:
Ludwig Oeckl and
Erhard Müller
by Carl A. Hellmann,
Attorney

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PRESS FOR THE FLAWLESS DEFORMING OF FLAT BLANKS

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Fig.11.

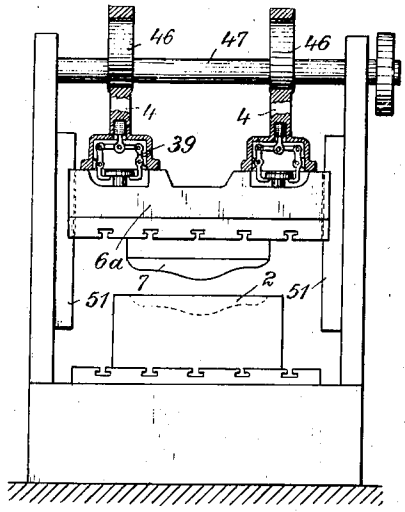


Fig.12.

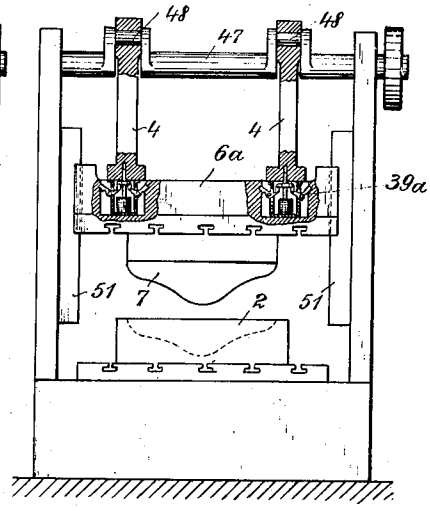


Fig.13.

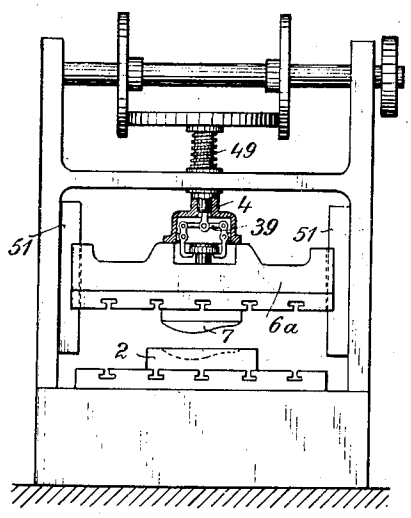
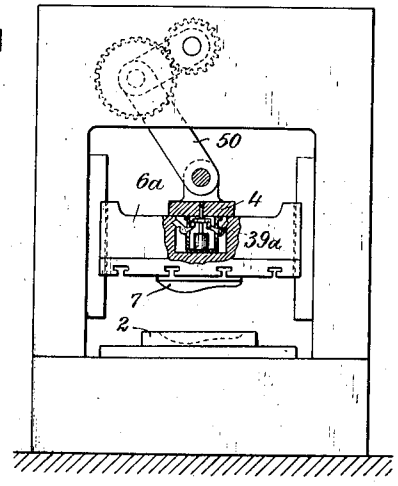


Fig.14.



Inventors:
Ludwig Oeckl and
Erhard Müller
by Carl A. Hellmann,
Attorney.

Patented June 20, 1939 2,163,517

UNITED STATES PATENT OFFICE

2,163,517

PRESS FOR THE FLAWLESS DEFORMING OF FLAT BLANKS

Ludwig Oeckl, Dessau, and Erhard Müller, Esslingen-Neckar, Germany, assignors to the firm Henschel Flugzeug-Werke A. G., Schonefeld, Teltow, Germany

Application February 4, 1938, Serial No. 188,802
In Germany April 14, 1936

9 Claims. (Cl. 113—38)

If a press is used for converting substantially flat blanks, particularly metal sheets, into the form of hollow bodies, this has the disadvantage that heavy wrinkles arise, particularly at the edge of the hollow body, and undulations form at its bottom.

For preventing the formation of wrinkles, special wrinkle restrainers have already been proposed, which, however, are very expensive, because they must fit exactly to the tool, such as punch and/or die. It has also been endeavored to obviate the formation of undulations by allowing the press to exert a particularly high final pressure. This high final pressure is required, above all, in the case of drawn parts which, in the finished condition, have a flat unstrengthened form, exhibit grooves or some kind of sharp impressions, or the material of which is to be compressed during drawing to provide strength. The higher final pressure, which is considerably above the actual drawing pressure, necessitates a very powerful and consequently expensive construction of the press.

If the heavy deformation of the metal sheet is effected only by percussive action with the aid of a drop hammer, then breaking of the metal sheet usually occurs. Moreover, in this case, the formation of wrinkles is not always avoidable. The percussive pressing action, however, produces in a simple manner very high final pressures for shaping the work-piece into the desired form of work-piece.

The object of the invention is to avoid the disadvantages of both methods of forming, while retaining their advantages. According to one feature of the invention, the metal sheet or other flattened work-piece or blank is preliminarily drawn or pressed by a slow pressing operation to a form which exhibits only small wrinkles or none at all, and is then brought to the final hollow form by percussive action of the pressing member. The uniform small wrinkles which sometimes arise during the slow preliminary drawing are smoothed by hand, for instance, with a wooden hammer, before the percussion. During the percussive conversion of the work-piece into its final form, wrinkles no longer arise and also no cracks are formed. The percussive treatment has the effect, in addition, that the pieces produced permanently retain their form, receive sharp contours of the swage and have a well-compressed material structure.

By practice of the new invention, hollow bodies of any desired depth can be manufactured without difficulty from sheet metal or the like, which hitherto frequently could be made only by rolling the sheet metal. The present invention saves about 60% of the pressing pressure which would have to be expended if the forming were effected only by pressing. Since, in addition, the new method can be performed easily and the presses necessary for this purpose remain light and cheap, the manufacture of the work-pieces, particularly deep sheet-metal hollow bodies, is very cheap.

The press according to the invention has its ram or piston rod, which can be independently moved up and down by the pressing force, terminated in a heavy tool-holder which is provided with the upper swage and to which both a slowly-pressing and freely-falling movement can be imparted. The upper tool can thus deform the work-piece, firstly, by pressing it under the action of the pressing force and then by striking it. As a result of the invention, drawing presses need be constructed only with the actual drawing pressure that is necessary. Due to the weight and drop of the tool-holder, a great percussive energy is obtained, which has to be withstood by only the lower part of the press, while the upper part of the press, which is provided with the drive, has to withstand merely the stresses arising from the actual drawing work.

Several constructional examples of the press are illustrated diagrammaticaly in the accompanying drawings, in which:

Fig. 1 shows a press operated hydraulically or by compressed air.

Figs. 2–14 illustrate presses in which the piston, piston rod; and tool-holder are connected together so that they can be decoupled. In these figures,

Figs. 2 and 3 show a press with a piston and rod which are rotatable for the purpose of coupling.

Figs. 4 and 5 show a press with a bolt-coupling.

Figs. 6 and 7 show a press with a claw-coupling.

Fig. 8 illustrates a press with an independently movable hold-down which also guides the tool-holder.

Fig. 9 shows a press with a resiliently-mounted hold-down.

Fig. 10 shows a press with an independently movable hold-down which also guides the tool-holder, and an adjustable lower die.

Figs. 11 to 14 show respectively an eccentric press, a crank press, a screw press and a toggle-lever press.

In Fig. 1, numeral 1 indicates the press frame with the lower swage 2 at the bottom and the

cylinder 3 at the top, containing a piston rod 4 having a piston 5 connected thereto. The rod 4 terminates in a heavy tool-holder 6, which carries the upper punch or die 7. 8 denotes the substantially flat work-piece or blank which is to be deformed. The liquid or gaseous pressure medium for imparting a pressing movement to the rod 4 is supplied and discharged by means of a control (not shown) through the conduit 9 above the piston 5. 10 is the supply and discharge conduit for the pressure medium for lifting the rod 4. 11 denotes a conduit having a large cross-section in order to make it possible suddenly to discharge from the cylinder 3 the pressure medium below the piston 5. The conduit 10 may coincide with the conduit 11, if control members are provided for slow and rapid flow of the pressure medium.

The press operates as follows: By admission of the pressure medium above the piston 5, the rod 4, tool-holder 6 and upper die or punch 7 are moved with a pressing movement against the work-piece 8, which is thereby preliminarily partially drawn into its hollow form. The parts are then returned by the admission of pressure medium below the piston 5 and any wrinkles in the work-piece 8 are smoothed by hand-working. Now, by opening the conduit 11, the pressure medium below the piston 5 is suddenly allowed to discharge from the cylinder 3, which results in the free fall of the rod 4 and the heavy tool-holder 6 with the upper punch or die 7. The work-piece is thereby converted percussively with great pressure into its final form. By re-admission of pressure medium below the piston 5, the rod and upper tool carried thereby are again brought into the initial position.

The above described mode of operation applies equally to the presses hereinafter described, the particular feature of which consists in that the guided tool-holder is connected to the piston rod of the press by a manually or mechanically disconnectable coupling, so that it can be decoupled, the coupling acting only between the rod and tool-holder, so that the decoupling of the latter can be effected in any position of the rod.

In the press according to Figs. 2 and 3, the tool-holder 6a is independently guided at suitable parts of the frame 1 and forms a part of the rod 4 which can be decoupled. The coupling consists of bosses 12 arranged at the enlarged foot of the rod 4 and having an embracing arc of about 60°, which, on the one hand, can pass through between corresponding projections 12a, of the tool holder 6a and, on the other hand, can engage under these projections 12a. The coupling and decoupling are effected by progressive 60° rotation of the rod 4, which can be effected by hand, for instance, by means of a lever 13 (indicated in dotted lines), or mechanically. The mechanical arrangement consists, for example, of a worm-wheel 14 rigidly connected to the rod 4, worm 15, electric motor 16 and current source 17. The motor 16 is mounted on a yoke 18 guided in the press and carried by the rod 4. 19 denotes an electric contact which closes on mounting the foot of the rod on the tool carrier and which serves for starting the motor 16.

The preliminary drawing of the work-piece 8 by pressing movement of the members 4, 6a and 7 coupled together and the return of the members to the initial position are effected in the above-described manner. If the upper tool 7 is to have a percussive action, then the rod 4 is rotated by 60° by switching on the motor 16 for example, by hand, whereby the coupling 12, 12a is released and the tool-holder 6a with the tool 7 descends freely and effects the final deformation of the work-piece 8. The rod 4 is made to follow by corresponding control of the conduits 9 and 10 and comes to rest with its root on the tool-holder 6a. Thereby, the contact 19 closes automatically, which results in starting the motor 16 and coupling together the members 4 and 6a by rotation of the rod 4. Thereupon, the rod 4, tool-holder and tool are returned, the initiation of this movement being automatically controllable, for example, by the rod 4.

In the construction according to Figs. 4 and 5, the coupling arrangement consists of bolts 21 which are displaceable in the foot 20 of the rod 4 and which can engage behind a carrying piece 22 of the upper tool holder 6a. The bolts are driven hydraulically or pneumatically with the aid of pistons 24 moving in cylinders 23, in which case, for instance, the same pressure medium is employed for the cylinders 3 and 23. The mode of operation of the press corresponds to that of the construction according to Figs. 2 and 3. The pressure-medium conduits belonging to the cylinders 23 are, for instance, telescopically displaceable tubes or flexible tubes 25, 26. In this case also, the coupling movement of the bolts 21 after the descent of the rod 4 has terminated may be automatically controlled by a striking body or abutment 27 acting, for instance, on a valve, whereby the pressure-medium supply or discharge through the conduits 25, 26 is regulated. The bolts 21 may also be driven by solenoids or magnets.

In the form of construction according to Fig. 6, the tool-holder 6a has a coupling projection 28 behind which can engage two lugs 30 which are displaceable on slides 29 at the piston rod foot 20. For effecting the displacement the slides 29 are coupled to levers 31 which are driven by piston rod 32 with piston 33 which moves in a pressure-medium cylinder 34 in the hollow rod 4. Pressure-medium conduits 35 are indicated schematically. By displacement of the piston 33 in one or the other direction, the tool-holder 6a is released from the rod 4 or coupled thereto. Here also, as in the previous case, the control of the coupling and of the return movement of the rod 4 can be automatically effected by means of suitable members 27.

Fig. 7 shows an electro-magnetic coupling arrangement, in which the core 37 of a solenoid 36 arranged in the rod 4 is connected to two double-armed levers 39, pivoted at 38 in the rod foot 20 and carrying lugs 30. On the solenoid being energized and its core 37 attracted, the lugs 30 engage behind the projection 28. When the solenoid is deenergized, the coupling between the rod 4 and the upper tool carrier 6a is released. 19 is the electrical contact controlling the coupling.

Figs. 8–10 illustrate a press operating with a pressure medium, in which the rod 4 is moved by the pressure medium only into the pressing position, whereas for its return, a separate piston 4a is provided in a cylinder 3a arranged above the cylinder 3, the piston 4a being connected by rods 38 to the rod-foot 20. 39a denotes a suitable, manually or mechanically operated coupling between the rod-foot 20 and tool-holder 6a. It consists, for example, of double-armed levers pivotally mounted in the rod-foot 20, one arm of each lever engaging, in the coupling position, under a roller of the tool-holder, while the other arm is pivotally connected to a driving

device which is operated, for instance, by the pressure medium.

According to Figs. 8 and 10, the tool-holder 6a is guided in a lower holder 40, which is driven by plungers 41 and which can be moved up and down on guide pillars 42. The plungers 41 provided with pistons move in pressure medium cylinders 43.

After placing the work-piece in the press according to Fig. 8, the hold-down 40 and the upper tool carrier 6a are run down successively or simultaneously, whereupon after application of the hold down 40 to the lower tool 2, the preliminary drawing is effected by tool 1. By means of the restoring device 3a, 4a, 38, the rod 4 and the tool-holder 6a are then lifted and separated by release of the coupling 39, whereupon the tool-holder 6a falls and converts the work-piece 8 by percussive action into the final form.

In the construction according to Fig. 9, the rod-foot 20 and the tool-holder 6a holding the upper tool 1 are each separately guided on the pillars 42 of the press. The lower tool 2 is raised and surrounded by a rest 45 which supports the edge of the work-piece 8 and which can follow the movements of the recessed upper tool 1 by means of the pressure medium cylinders 44. 39a denotes the coupling which is illustrated only diagrammatically.

The construction illustrated in Fig. 10 has a lower tool 10 adjustable in height by pressure medium cylinders 44.

In these types of construction, the rod 4, the hold-down 40, the rest 45 and the lower tool 2, instead of being moved hydraulically or pneumatically may be moved mechanically, for instance, by a crank, double-lever, eccentric, toggle-lever and spindle, which is driven mechanically or by hand. Also, any desired combination of hydraulic, pneumatic and mechanical drives may be employed.

In the various types of construction, the control device of the coupling arrangement, in the case of an automatic arrangement, may be operatively connected to the tool-holder 6a, the hold-down 40, the rest 45 or the lower tool 2 in such a manner that, on application of the hold-down or the upper tool to the lower tool or rest, a releasing device of the coupling is brought into such a position that this releasing device comes into action on the ascent of the rod 4 after reaching a certain position and releases the coupling.

Figs. 11–14 show the application of the invention to presses with mechanically-driven pressing rods.

In the press according to Fig. 11, two rods 4 are driven by eccentrics 46 of a shaft 47. According to Fig. 12, cranks 48 serve for driving the rods 4. According to Fig. 13, the rod 4 is connected to the spindle 49 of a friction-screw press. Fig. 14 shows driving of the rod 4 by the toggle-lever 50 of a toggle-lever press. In each case, the tool-holder 6a is slidably arranged in the press frame on guides 51 and is connected to the rod or rods 4 through a suitable controllable coupling device 39, 39a so that it can be decoupled. The mode of operation of these presses, which may also be driven by hand, is the same as hereinbefore described.

The invention can be used in drawing wide (i. e., stretched) sheet-metal parts and in hot and cold working.

The operations of the press, consisting of pressing and striking or percussion, may take place in alternating sequence.

We claim:

1. A press of the character described, comprising a support, a lower die, a rod movable vertically above said support, fluid-pressure actuated means for raising and lowering said rod, and for applying downward pressure thereto when lowered, a heavy tool-holder for holding an upper die, means releasably coupling said tool-holder to said rod so that it may be raised and lowered therewith, and fluid-pressure actuated control means for releasing the coupling between said rod and said tool-holder whereby said tool-holder will drop freely, independently of said rod.

2. A press of the character described, comprising a support, a lower die, a rod movable vertically above said support, fluid-pressure actuated means for raising and lowering said rod, and for applying downward pressure thereto when lowered, a heavy tool-holder for holding an upper die, means releasably mechanically coupling said tool-holder to said rod so that it may be raised and lowered therewith, and fluid-pressure actuated control means carried by the rod for releasing the coupling between said rod and said tool-holder whereby said tool-holder will drop freely, independently of said rod.

3. A press of the character described, comprising a support, a lower die, a piston rod movable vertically above said support, fluid-pressure actuated means comprising a cylinder and a piston therein for raising and lowering said rod, and for applying downward pressure thereto when lowered, a heavy tool-holder for holding an upper die, a bayonet-joint coupling securing it to said rod so that it may be raised and lowered therewith, control means for supplying pressure-fluid to either end of the cylinder for raising and lowering the piston and means for rotating said rod to disengage the bayonet joint whereby said tool-holder will drop freely.

4. A press of the character described, comprising a support, a lower die, a piston rod movable vertically above said support, fluid-pressure actuated means comprising a cylinder and a piston therein for raising and lowering said rod, and for applying downward pressure thereto when lowered, a heavy tool-holder for holding an upper die, a bayonet-joint coupling securing it to said rod so that it may be raised and lowered therewith, control means for supplying pressure-fluid to either end of the cylinder for raising and lowering the piston and means comprising a worm wheel carried by the rod and an electric motor having a worm, cooperating with said wheel, for rotating said rod to disengage the bayonet joint whereby said tool-holder will drop freely.

5. A press of the character described, comprising a support, a lower die, a piston rod movable vertically above said support, fluid-pressure actuated means comprising a cylinder and a piston therein for raising and lowering said rod, and for applying downward pressure thereto when lowered, a heavy tool-holder for holding an upper die, a bayonet-joint coupling securing it to said rod so that it may be raised and lowered therewith, control means for supplying pressure-fluid to either end of the cylinder for raising and lowering the piston, means comprising a worm wheel carried by the rod and an electric motor having a worm, cooperating with said wheel, for rotating said rod to disengage the bayonet joint whereby said tool-holder will drop freely, and cooperating electric contacts carried

by the respective members of the coupling, for controlling the said motor automatically.

6. A press of the character described, comprising a support, a lower die, a piston rod movable vertically above said support, fluid-pressure actuated means comprising a cylinder and a piston therein for raising and lowering said rod, and for applying downward pressure thereto when lowered, a heavy tool-holder for holding an upper die, a releasable coupling securing it to said rod so that it may be raised and lowered therewith, said coupling comprising an under-cut head on the tool-holder and movable bolts engageable under the said head, control means for supplying pressure-fluid to either end of the cylinder for raising and lowering the piston and means for controlling said bolts to engage or disengage the said head at will, and thus to operate the said coupling.

7. A press of the character described, comprising a support, a lower die, a piston rod movable vertically above said support, fluid-pressure actuated means comprising a cylinder and a piston therein for raising and lowering said rod, and for applying downward pressure thereto when lowered, a heavy tool-holder for holding an upper die, a releasable coupling securing it to said rod so that it may be raised and lowered therewith, said coupling comprising a slot in the tool-holder and movable bolts engageable in said slot, control means for supplying pressure fluid to either end of the cylinder for raising and lowering the piston and means comprising fluid-pressure actuated mechanism for controlling said bolts to enter or leave the slot at will, and thus to operate the said coupling.

8. A press of the character described, comprising a support, a lower die, a piston rod movable vertically above said support, fluid-pressure actuated means comprising a cylinder and a piston therein for raising and lowering said rod, and for applying downward pressure thereto when lowered, a heavy tool-holder for holding an upper die, a releasable coupling securing it to said rod so that it may be raised and lowered therewith, said coupling comprising an under-cut head on the tool-holder and movable bolts engageable under the said head, control means for supplying pressure-fluid to either end of the cylinder for raising and lowering the piston and electromagnetic means for controlling said bolts to engage or disengage the said head at will, and thus to operate the said coupling.

9. A machine for deforming sheet material by first pressing it partially into shape and thereafter applying a percussive blow thereto to complete the shaping of the material, which comprises a support, a lower die mounted thereon, a rod movable vertically above said support, a heavy tool-holder for holding an upper die, coupling means releasably connecting said tool-holder to said rod so that it may be raised and lowered therewith, fluid-pressure actuated means for raising and lowering said rod, to press the material partially into shape, and control means for actuating the said coupling means to release said tool-holder, whereby it will drop freely and apply a percussive blow to the material.

LUDWIG OECKL.
ERHARD MÜLLER.