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(71) Applicant: **FIAT AUTO S.p.A.**
**Corso Giovanni Agnelli 200**
**I-10135 Torino(IT)**

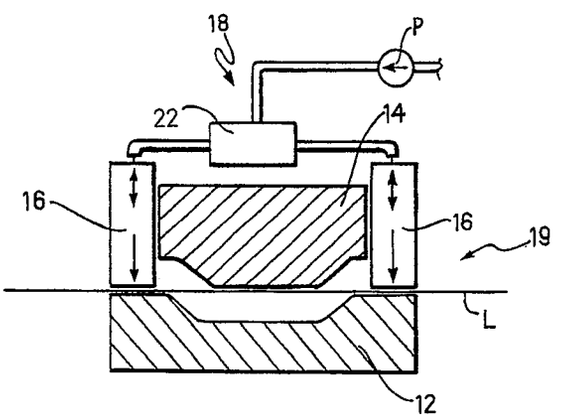
(72) Inventor: **Da Re', Mario**
**Via C. Colombo, 9**
**I-10128 Torino(IT)**

(74) Representative: **Buzzi, Franco et al**
**c/o Jacobacci-Casetta & Perani S.p.A. Via Alfieri, 17**
**I-10121 Torino(IT)**

## (54) A method of pressing sheet metal and a hydraulic press for carrying out the method.

(57) A method of pressing sheet metal provides a system (22) for operating the blank-holder (16) in such a way as alternatively to vary the pressure exerted by the blank-holder (16) during pressing, according to a predetermined law.

FIG. 1




EP 0 438 774 A1

# A METHOD OF PRESSING SHEET METAL AND A HYDRAULIC PRESS FOR CARRYING OUT THE METHOD

The present invention relates to a method of pressing sheet metal, including the steps of providing a press having a punch, a die, and a blank-holder for restraining a metal sheet at an edge region of the die by clamping it between the blank-holder and the edge region.

The present invention also relates to a hydraulic press for pressing sheet metal, of the type including at least one blank-holder operated by actuators through an hydraulic operating circuit.

In known pressing methods, the optimum clamping pressure for the blank-holder is determined empirically and, during normal production, is kept constant throughout the pressing period. With this constant-pressure method, difficulties are encountered with complex dies and deep drawing. Moreover, the characteristics of the metal sheets and their pre-treatment (for example, with lubricants) represent variables which may mean that the clamping pressure, which is determined empirically beforehand, is not at an optimum.

In order to resolve the aforementioned problems, particular attention is currently being paid to the design and construction of the dies with the use of mathematical models to predict the limits of the drawing capability of a given geometry, but not always with satisfactory results.

The object of the present invention is to provide a pressing method of the type specified at the beginning of the description which does not have the aforementioned disadvantages and which is simple and cheap to put into practice.

According to the invention, this object is achieved by virtue of the fact that the blank-holder is clamped onto the metal sheet with a force which can be alternated between minimum and maximum values according to a predetermined law. The alternation of the pressure of the blank-holder between a maximum value and a minimum value at a suitable frequency enables the metal sheet to adapt itself to the requirements of deformation during the pressing regardless of the nature of the metal sheet and its surface treatment. Moreover, with the method according to the invention, the step of adjusting the clamping pressure is eliminated and the drawing depth can be increased.

Further advantages of the method relate to the reduction of the amount of sheet metal affected by the blank-holder, the reduction of the number of rejects, the elimination of the need to use conventional pressing lubricants, the fact that any kind of coating can be used on the metal sheet, and the reduction of the pitting of the pressed pieces.

The method according to the invention can be carried out on a hydraulic press for pressing sheet metal, of the type including at least one blank-holder operated by actuators through an hydraulic operating circuit, in which the hydraulic circuit includes valve means for alternately depressurising/pressurising the actuators of the blank-holder to cause the clamping pressure of the blank-holder to vary according to a predetermined law.

Further advantages and characteristics of the method and the press according to the invention will become clear from the following detailed description, provided purely by way of non-limiting example, with reference to the appended drawings, in which:

Figure 1 is a schematic view which shows the operation of a press according to the invention,

Figure 2 is a schematic view similar to Figure 1 and shows a second embodiment of a press according to the invention, and

Figure 3 is a schematic perspective view of the press of Figure 1.

With reference to the first embodiment illustrated in Figures 1 and 3, a hydraulic press, indicated 10, includes a die 12, a punch 14 and a blank-holder 16. A flat metal sheet L is interposed between the blank-holder and the die 12 for drawing. Compared with known presses, the press 10 has a special hydraulic circuit 18 for operating actuators 20 associated with the blank-holder 16. In fact, the hydraulic circuit 18 includes a valve unit 22 for cutting off the flow supplied by a pump p for very short periods at a frequency which is variable in dependence on the type of die but is preferably between 20 and 30 Hz. The valve unit 22 is not discussed in detail herein since it is of substantially the same type as is used, for example, in anti-lock braking systems for automatically pressurising/depressurising the hydraulic circuit associated with the brakes.

The pressure for operating the blank-holder 16 is applied and released within a range defined by a maximum value and a minimum value, or within a suitable interval between these values. To advantage, the valve means 22 may be associated with an electronic control system for modulating the pressurisation/ depressurisation frequency in dependence on the various geometries of the dies, acting separately on the actuators 20 of the blank-holder 16. In this case, the optimum pressure interval and the individual control of the actuators 20 will be determined in dependence on the various geometries of the dies.

Figure 2 shows a second embodiment of the invention which uses a die 25 with two superposed cavities 25a acted on by two opposed punches 14.

In this embodiment, the operation of the two blank-holders 16 is essentially identical to that described for Figures 1 and 3.

Naturally, it is understood that, the principle of the invention remaining the same, the details of construction and forms of embodiment may be varied widely with respect to those described and illustrated in the drawings, without thereby departing from the scope of the present invention.

## Claims

1. A method of pressing sheet metal, including the steps of providing a press having a punch, a die, and a blank-holder for restraining a metal sheet at an edge region of the die by clamping it between the blank-holder and the edge region, characterised in that the blank-holder (16) is clamped onto the metal sheet (L) with a force which can be alternated between minimum and maximum values according to a predetermined law.

2. An hydraulic press for pressing sheet metal, of the type including at least one blank-holder operated by actuators through an hydraulic operating circuit, characterised in that the hydraulic circuit (18) includes valve means (22) for alternately depressurising/pressurising the actuators (20) of the blank-holder (16) in order to alternate the clamping pressure of the blank-holder (16) according to a predetermined law.

3. An hydraulic press according to Claim 2, characterised in that the valve means (22) are adapted to alternate the operating pressure of each actuator (20) of the blank-holder (16) according to a different law from that of any other actuator (20).

FIG. 1

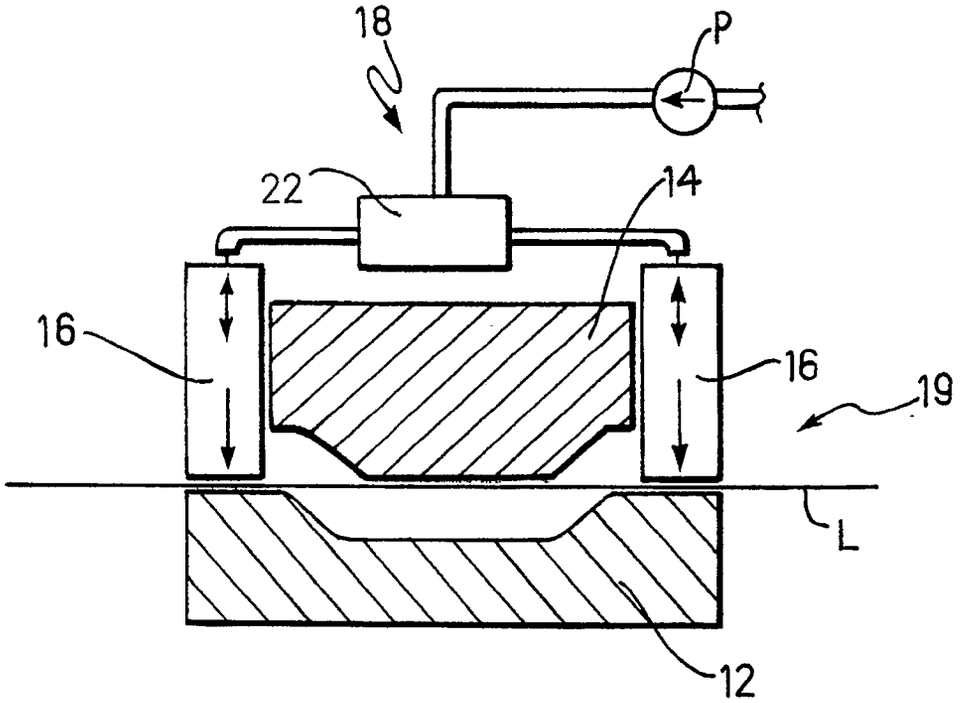



FIG. 2

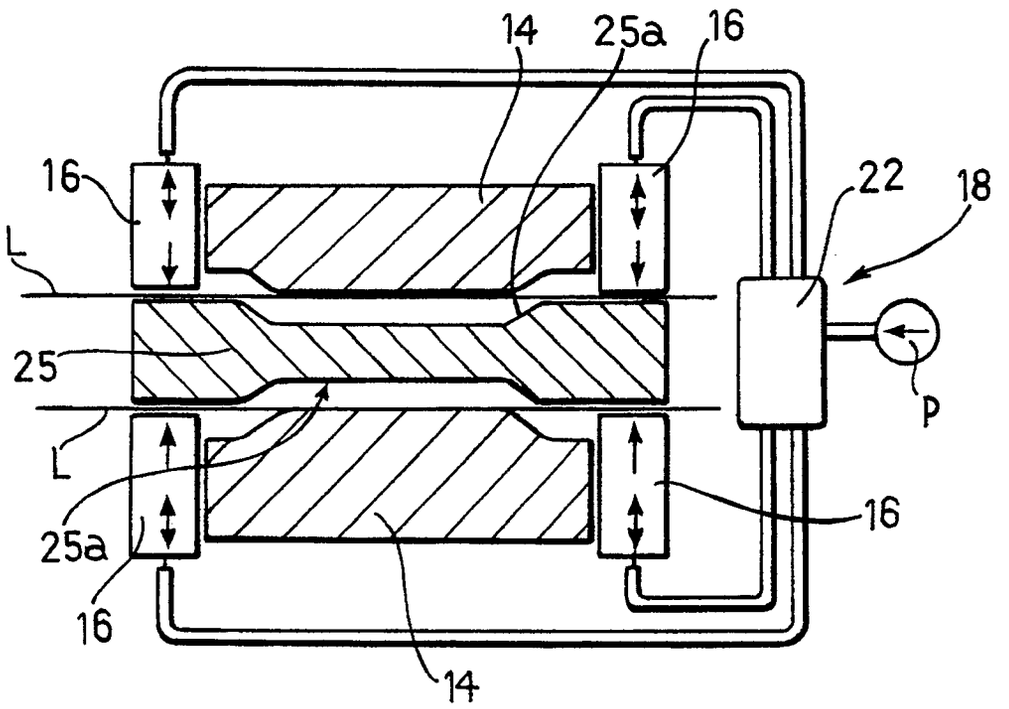
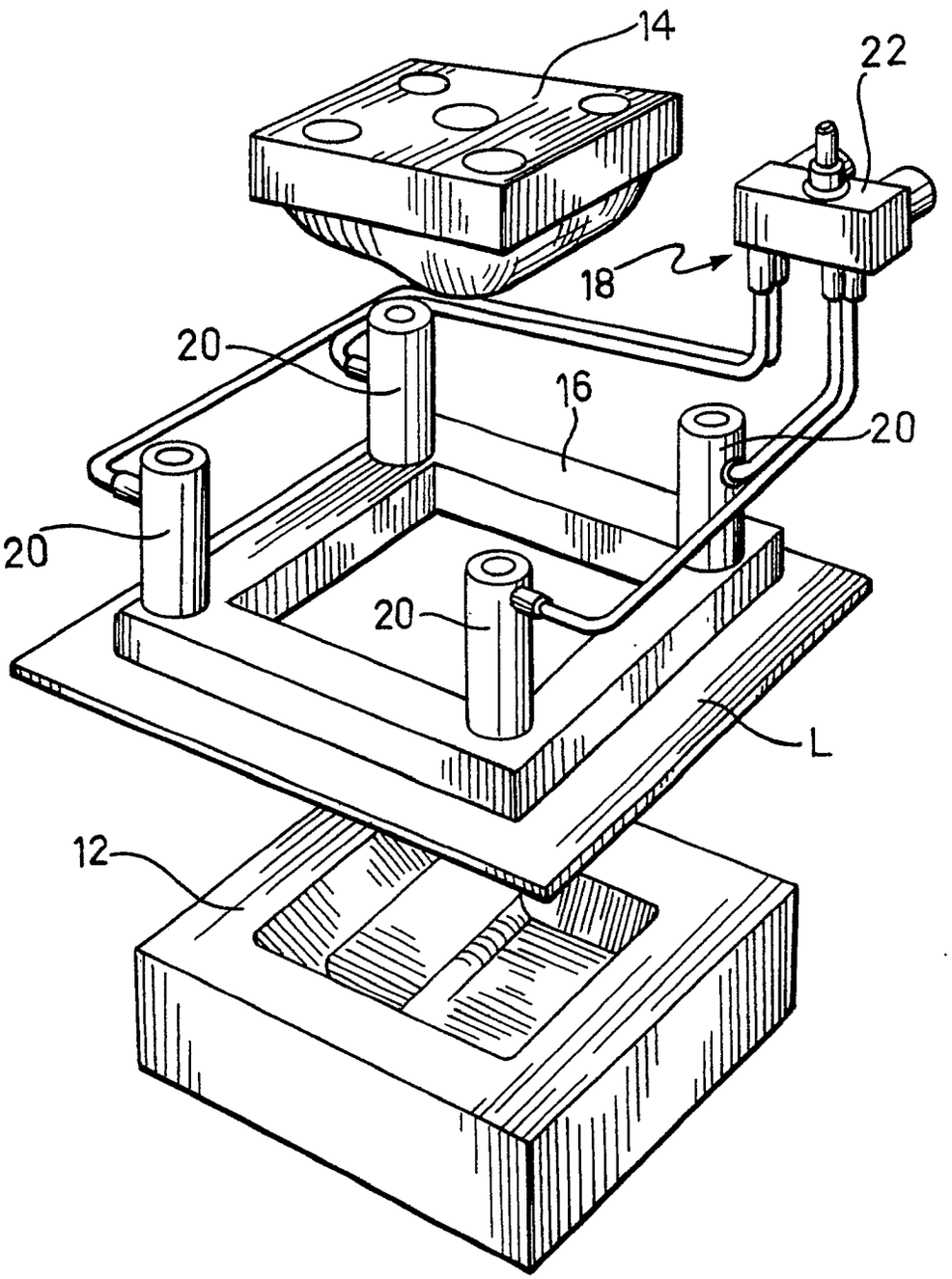


FIG. 3



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# EUROPEAN SEARCH REPORT

Application Number

EP 90 12 5420

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (Int. Cl.5) |
|---|---|---|---|
| X | DE-A-3 744 177 (AUDI AG)<br>* column 3, line 34 - column 9, line 35; figures * | 1-3 | B<br>21 D 24/14<br>B 21 D 24/10 |
| X | GB-A-2 197 813 (MASCHINENFABRIK MULLER-WEINGARTEN AG)<br>* page 1, line 3 - page 4, line 7; claims 1-4; figures * | 1-3 | B 21 D 24/08 |
| X | EP-A-0 312 808 (DAIMLER-BENZ AG)<br>* column 1, line 30 - column 5, line 53; figures 1-4 * | 1-3 | |
| X | DE-C-3 735 582 (DAIMLER-BENZ AG)<br>* column 3, line 15 - column 7, line 25; figures 1-3, 7, 8 * | 1-3 | |

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

B 21 D

The present search report has been drawn up for all claims

| Place of search | Date of completion of search | Examiner |
|---|---|---|
| The Hague | 15 February 91 | GARELLA M.G.C.D. |

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
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