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(54) **Horizontal-press cold-forging machine with reduced-speed hammering**

(57) Horizontal-press cold-forging machine with a forging zone that comprises at least one unit with a fixed part (1) and a moving part (2), wherein the fixed part (1) comprises a die (3) provided with a cavity (4) in which a billet (5) is introduced, and the moving part (2) comprises a needle (6) that presses the billet (5) causing it to adopt the shape of the cavity (4). The fixed part (1) comprises a speed-reducer system based on the fact that the die (3) moves inside the fixed part (1), so that the effective speed at which the needle (6) presses the billet (5) is lower than the speed at which the moving part (2) impacts on the fixed part (1). This enables the cold forging of complex parts such as helical gears at a high rate of productivity.

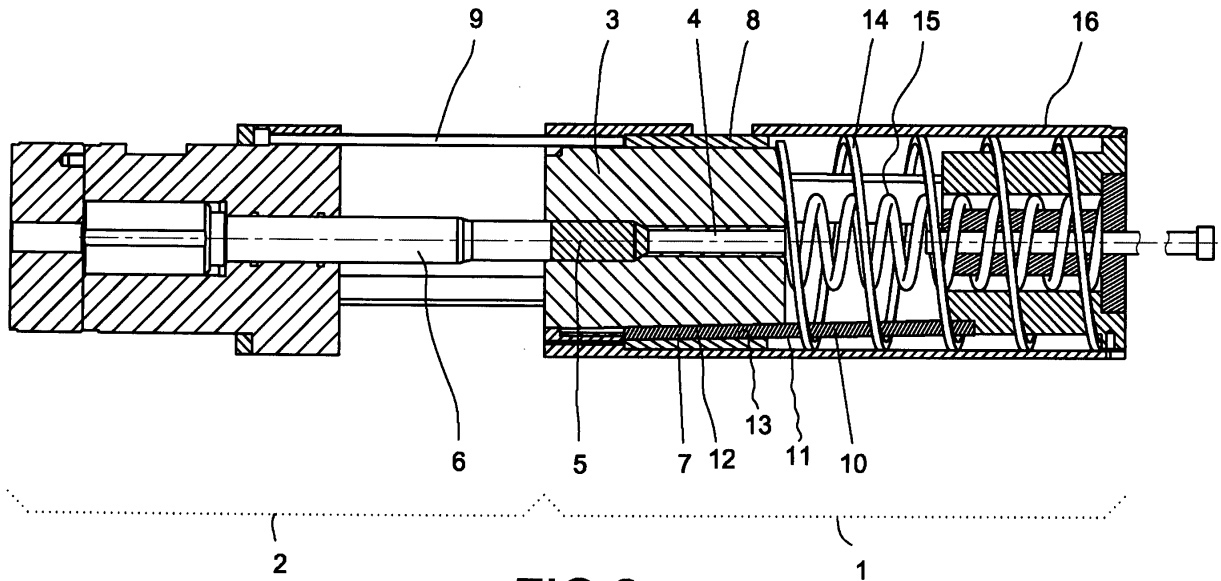

FIG.2

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Description

Technical field

[0001] This invention relates to a horizontal-press cold-forging machine.

Prior art

[0002] Generally speaking, cold-forging machines are forging machines designed to work material that has not been heated beforehand, thus setting them apart from semi-hot or hot-forging machines. Cold-forging machines can essentially be divided into two different types: horizontal and vertical, depending on the direction from which the metal is hammered. Horizontal cold-forging machines generally offer very high pressing speeds and high productivity, and thus produce parts at low cost. In contrast, vertical cold-forging machines generally offer lower pressing speeds.

[0003] Horizontal cold-forging machines (also known as horizontal-transfer machines) usually comprise the following main parts:

- A coil holder, where the coil of wire is placed, wire being the raw material from which parts are made.
- Straighteners for straightening the coiled wire.
- A wire-drawing device, which performs calibrations to eliminate possible defects in the wire (ovalities, defects caused in the preparation of the coil and in other prior treatments, etc.) and to create a perfect cylinder.
- A cutting zone, where the wire is cut into cylindrical portions of the same volume as that of the part to be manufactured.
- A forging zone, comprising a fixed part provided with a series of dies (each comprising a succession of cavities into which the cylindrical portions from the previous die are introduced) and a moving part provided with hammers (whose function is to strike the cylindrical portions so that they gradually take the shape of each die cavity). The forging zone also comprises a transport system (e.g., a finger-type system) for moving the part from one die to the next.

[0004] The hammers in the moving part usually move at a speed of 60 hammer strokes per minute (approximately 700 mm/s), which explains why horizontal-press cold-forging machines are considered high-speed machines.

[0005] Owing to their geometrical characteristics, some types of parts cannot be pressed in a horizontal-press cold-forging machine at a speed as high as the one mentioned above. This is true of helical gears. Because of the complex shape of the helicoidal cavity in the die and taking into consideration that the material deforming speed is relatively low, when pressed at high speed the die cavity does not fill correctly, resulting in parts with defective helical gears. As a consequence, helical gears and other types of complex parts are usually manufactured by means of high-precision cutting. However, high-precision cutting is very costly and slow, and generates a large amount of residuals and significant wastage of the raw material. It is desirable, therefore, that this kind of part be manufactured in horizontal-press cold-forging machines, as the part would be cheaper to produce, productivity would be higher and the amount of residuals and wastage would be reduced.

[0006] It is an objective of this invention to design a horizontal-press cold-forging machine that enables the manufacture of parts such as helical gears and other parts that cannot be manufactured at present by this type of machine. For this purpose, it is an objective of this invention to bring about a reduction in the speed at which the parts are hammered, without this reducing the productivity of the horizontal-press cold-forging machine.

Brief description of the invention

[0007] It is an object of this invention to provide a horizontal-press cold-forging machine with a forging zone that comprises at least one unit with a fixed part and a moving part, where, as in other horizontal-press cold-forging machines, the fixed part comprises a die provided with a cavity into which a part is introduced, and the moving part is designed to impact on the fixed part and comprises a needle that presses the part, causing it to take on the shape of the cavity. According to the invention, the fixed part comprises a speed-reducer system so that the effective speed at which the needle presses the part is lower than the speed at which the moving part impacts on the fixed part. The reducer system is mainly based on making the die movable in the area inside the fixed part and on limiting said movement so that the effective speed at which the part is hammered is substantially equal to the difference between the speed at which the moving part impacts on the fixed part and the speed of movement of the die.

[0008] The inventive machine enables the needle to hammer the part at a speed of 180 mm/s based on a speed of movement of the moving part in relation to the fixed part of approximately 700 mm/s (60 hammer strokes per minute). This lower speed enables the correct filling of the cavities when manufacturing parts such as helical gears and other parts, which are characterised in requiring lower forge speeds than those provided by conventional horizontal-press cold-forging machines.

Brief description of the drawings

[0009] Details of the invention can be seen in the accompanying non-limiting figures:

- Figure 1 shows an example of a helical gear that requires low forge speeds to be correctly manufactured.
- Figure 2 shows a unit with a fixed part and a moving part of an embodiment of the invention, in a start position.
- Figure 3 shows the unit of the preceding figure, in an end position.

Detailed description of the invention

[0010] Figure 1 shows an example of a helical gear for whoms manufacture the invention is especially useful. This type of part is **characterised in that** it is forged inside a acvity provided with complex shapes. To ensure that said cavity shapes are filled correctly and that the resulting part does not present any defects, the cavity must be filled (as a result of a needle hammering or pressing the part) at a relatively low speed, in the region of 250 mm/s. The forging machine according to the invention enables that the speed of movement of the moving part in relation to the fixed part, which is around 60 hammer strokes per minute (approximately 700 mm/s), to be reduced to a hammering speed of the needle against the part of around said value, i.e. 250 mm/s.

[0011] The horizontal-press cold-forging machine of the invention comprises, similarly to conventional horizontal-press cold-forging machines, a forging zone provided with at least one unit with a fixed part (1) and a moving part (2). Figure 2 shows a unit with a fixed part (1) and a moving part (2) of an embodiment of the machine of the invention. The moving part (2) is capable of impacting on the fixed part (1) to provide the pressing or hammering action. The fixed part (1) comprises a die (3) provided with a cavity (4) in which a part (5) is inserted. The moving part (2) comprises a needle (6) that, when the moving part (2) impacts on the fixed part (1), presses the part (5) causing it to adopt the shape of the cavity (4).

[0012] In accordance with the invention, the die (3) moves inside the fixed part (1), i.e. it may move in a longitudinal direction (X) in relation to the fixed components of the fixed parts (1), such as the cover (16). The fixed part (1) also comprises a moving bushing (8) disposed around at least part of the die (3) and capable of moving in a longitudinal direction (X) in relation to said die (3). In addition, the fixed part (1) comprises a wedge (7) situated between the moving bushing (8) and the die (3), said wedge (7) being fixed in a longitudinal direction (X) and mobile in a radial direction (Y). The wedge (7) comprises an inner wedge-shaped surface (10) and an outer wedge-shaped surface (11). For its part, the die (3) comprises an outer wedge-shaped surface (12) similar to the inner wedge-shaped surface (10) of the wedge (7), with friction occurring between both surfaces (10, 12). Similarly, the moving bushing (8) comprises an inner wedge-shaped surface (13) similar to the outer wedge-shaped surface (11) of the wedge (7), with friction occurring between both surfaces (11, 13). Furthermore, the moving part (2) comprises a pushing element (9) capable of pushing the moving bushing (8) when the needle (6) impacts on the part (5).

[0013] Figures 2 and 3 show the unit, comprising a fixed part (1) and a moving part (2), in a start and end position, respectively.

[0014] The unit functions as follows. The moving part (2) impacts on the fixed part (1) at a certain speed 'v1', so that the needle (6) hammers the part (5) and the pushing element (9) pushes the moving bushing (8). Figure 1 shows the unit at the point immediately before this occurs. The moving bushing (8) moves in the longitudinal direction (X) but not in the axial direction (Y), a gap appearing between the moving bushing (8) and the wedge (7). As a result of this gap, the wedge (7) moves in relation to the die (3) in the radial direction (Y); in other words a gap appears between the wedge (7) and the die (3). As a result of this second gap, the die (3) is freed and may move in a longitudinal direction (X), at a speed 'v2', until it reaches a limit, when its outer wedge-shaped surface (12) comes into contact again with the inner wedge-shaped surface (10) of the wedge (7), this exact point being shown in Figure 3. The effective speed at which the needle (6) hammers or presses the part (5) is therefore v1-v2; in other words it is less than 'v1'. The inventive machine thus allows the parts (5) to be hammered at a relatively low speed while the moving part (2) continues to move at a high speed. Put another way, it is possible to hammer the parts (5) at a relatively low speed without the need to reduce the speed of the moving part (2), which would lead to fewer pressing cycles per time unit and a lower machine productivity.

[0015] The friction between the surfaces (10, 12) allows the speed 'v2' of movement of the die (3) to be lower than the speed 'v1' of movement of the needle (6). If there were no friction, both speeds would be equal and the needle (6) would not be able to hammer the part (5). The friction is determined by the angle both surfaces form (10, 12) with the longitudinal direction (X), as a result of which said angle is decisive in obtaining the required gear-down ratio.

[0016] Preferably, the unit also comprises a spring (14) that pushes the moving bushing (8) in a longitudinal direction (X), in a direction opposite to the direction in which the needle (6) hammers, towards its start or rest position shown in Figure 2. Similarly, the unit shown also comprises a spring (15) that pushes the die (3) in a longitudinal direction (X), in a direction opposite to the direction in which the needle (6) hammers, towards its start or rest position shown in Figure 2.

Claims

1. Horizontal-press cold-forging machine that comprises a forging zone, wherein said forging zone comprises at least one unit with a fixed part (1) and a moving part (2), wherein the fixed part (1) comprises

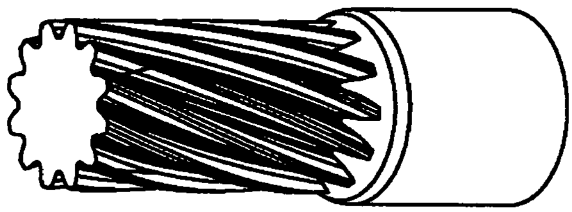
a die (3) provided with a cavity (4) in which a part (5) is introduced, and the moving part (2) is capable of impacting on the fixed part (1) and comprises a needle (6) that presses the part (5) causing it to adopt the shape of the cavity (4), **characterised in that:**

- the die (3) is moveable inside the fixed part (1),
- the fixed part (1) also comprises a moving bushing (8) around at least part of the die (3) and capable of moving in a longitudinal direction (X) in relation to said die (3),
- the fixed part (1) also comprises a wedge (7) situated between the moving bushing (8) and the die (3), wherein said wedge (7) comprises an inner wedge-shaped surface (10) and an outer wedge-shaped surface (11), wherein said wedge (7) is fixed in a longitudinal direction (X) and mobile in a radial direction (Y),
- the die (3) comprises an outer wedge-shaped surface (12) similar to an inner wedge-shaped surface (10) of the wedge (7), with friction occurring between both surfaces (10, 12), and the moving bushing (8) comprises an inner wedge-shaped surface (13) similar to the outer wedge-shaped surface (11) of the wedge (7), with friction occurring between both surfaces (11, 13),
- the moving part (2) comprises a pushing element (9) capable of pushing the moving bushing (8) when the needle (6) impacts on the part (5).

2. Horizontal-press cold-forging machine, according to claim 1, **characterised in that** it comprises a spring (14) that pushes the moving bushing (8) in a longitudinal direction (X), in a direction opposite to the direction in which the needle (6) hammers, towards its rest position.

3. Horizontal-press cold-forging machine, according to claim 1, **characterised in that** it comprises a spring (15) that pushes the die (3) in a longitudinal direction (X), in a direction opposite to the direction in which the needle (6) hammers, towards its rest position.

FIG.1



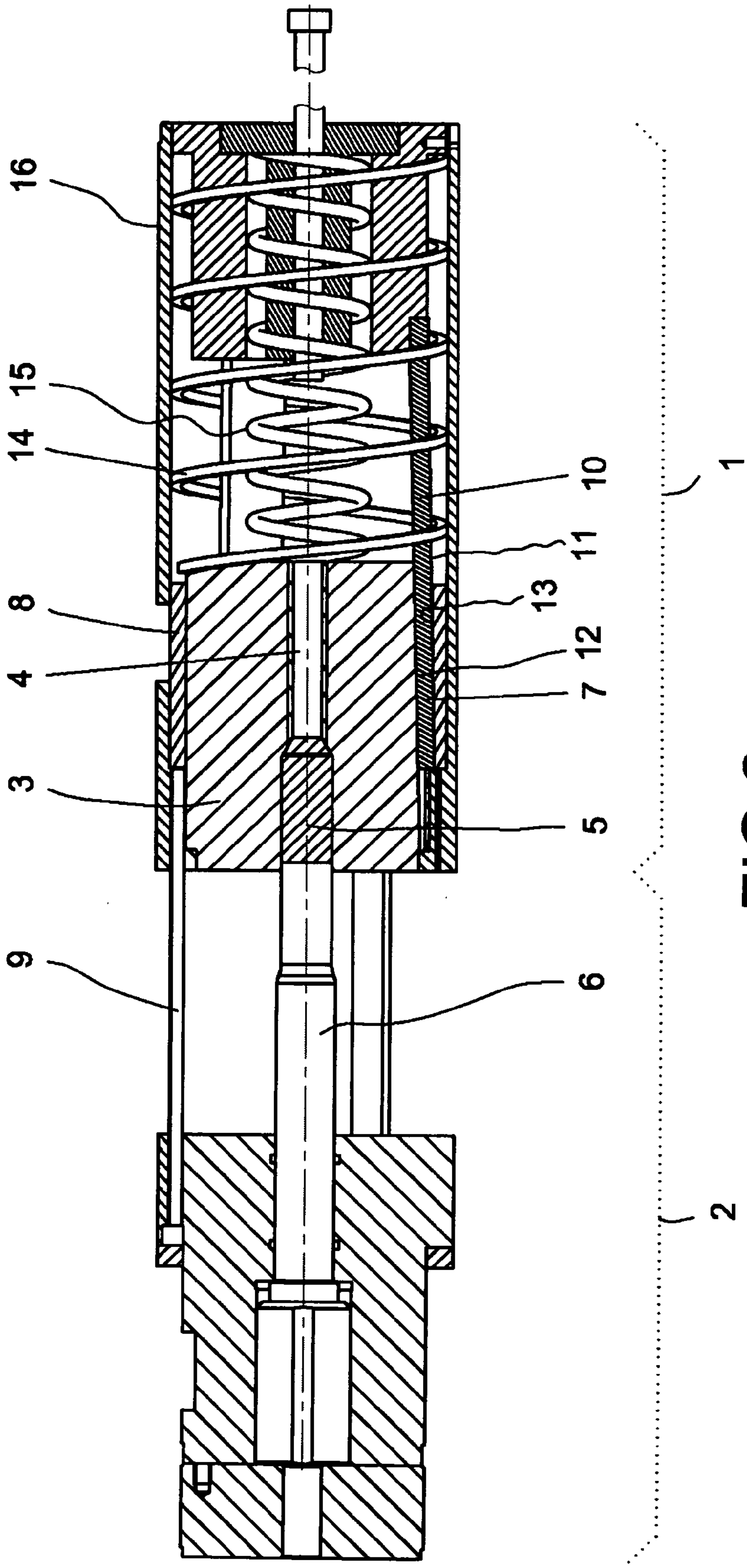


FIG.2

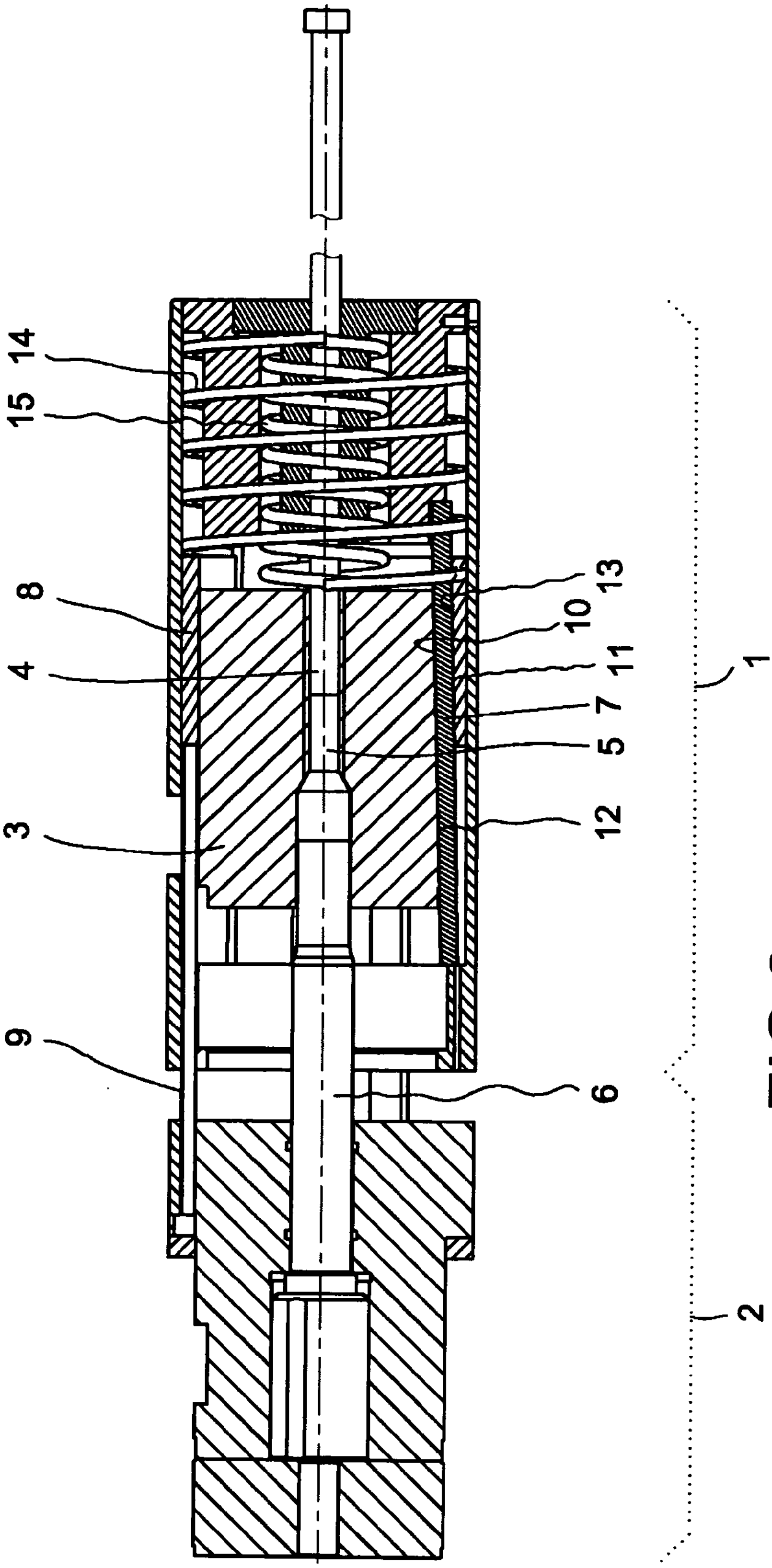


FIG.3

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EUROPEAN SEARCH REPORT

Application Number
EP 09 38 0093

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	DE 34 09 600 A1 (TOYODA GOSEI KK [JP]) 20 September 1984 (1984-09-20) * page 7, line 4 - page 8, line 34; figures 2,3 * -----	1	INV. B21J13/03 B21K27/00
			TECHNICAL FIELDS SEARCHED (IPC)
			B21J B21K

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	11 November 2009	Augé, Marc

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 09 38 0093

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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11-11-2009

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82