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[54] **FORGING PRESS HAVING ADJUSTABLE COLUMN GUIDES**

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[52] **U.S. Cl.** **72/456**

[51] **Int. Cl.** **B21j 13/04**

[58] **Field of Search** 72/456, 455, 453

[56] **References Cited**

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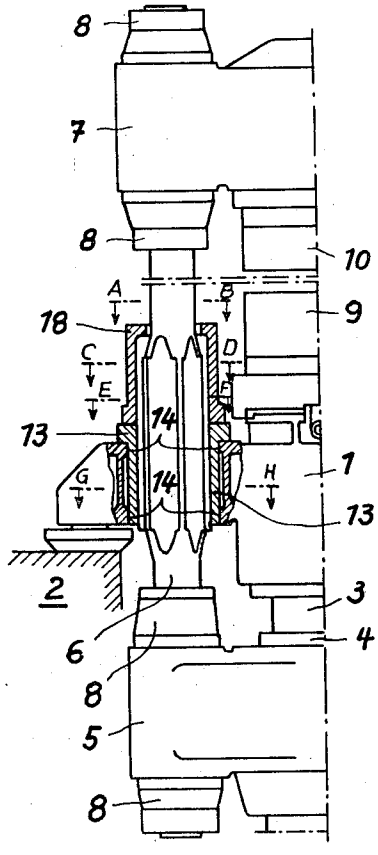
[57] **ABSTRACT**

A four column forging press has a frame formed by a top cross-member, a bottom cross-member and four columns interconnecting the top and bottom cross-members. The columns pass through an intermediate cross-member which is stationary and the frame is moved. In the zone where the columns pass through the intermediate cross-member, each column has two parallel, opposed guide surfaces which are substantially parallel to the plane containing the axis of the respective column and the axis of the diagonally opposite column. To provide adjustable guides, the guide surfaces engage vertically adjustable wedge-shaped members which are supported in two-part bushes with no gaps between the wedge-shaped members and the respective support surfaces of the bushes.

7 Claims, 3 Drawing Figures



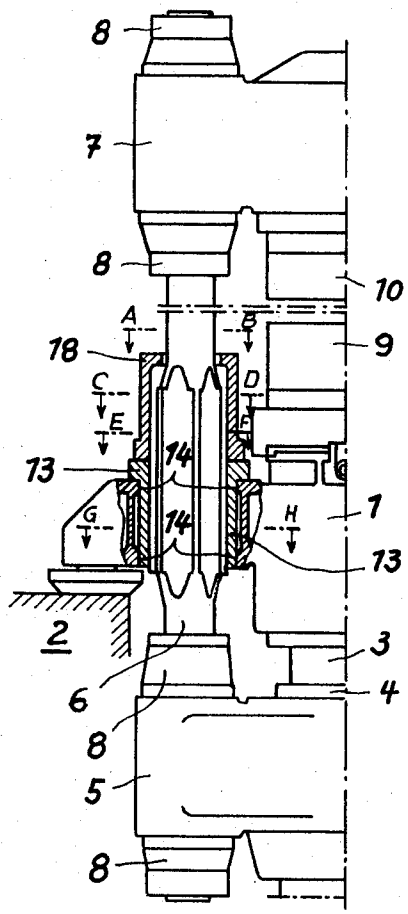


Fig.1.

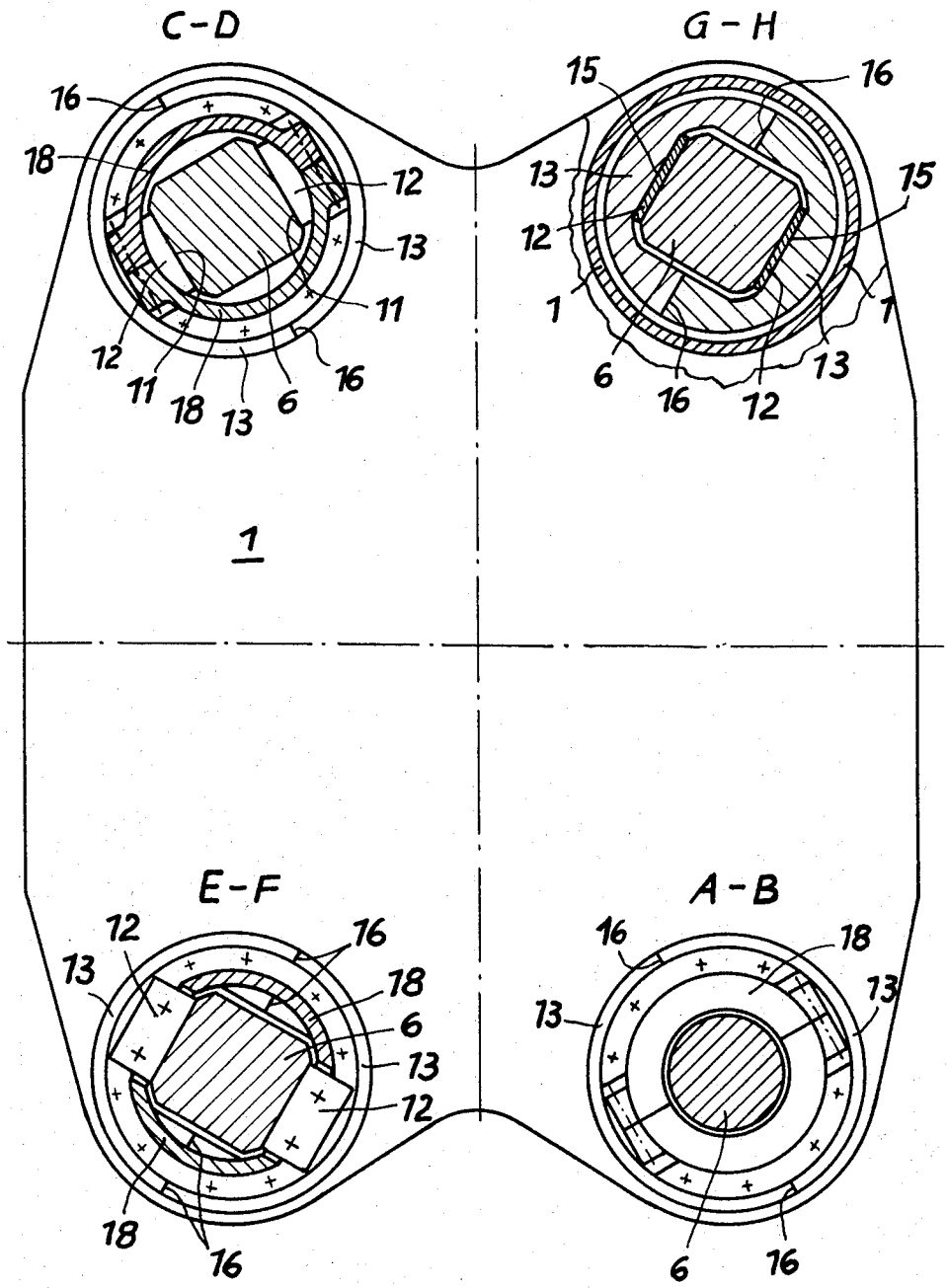
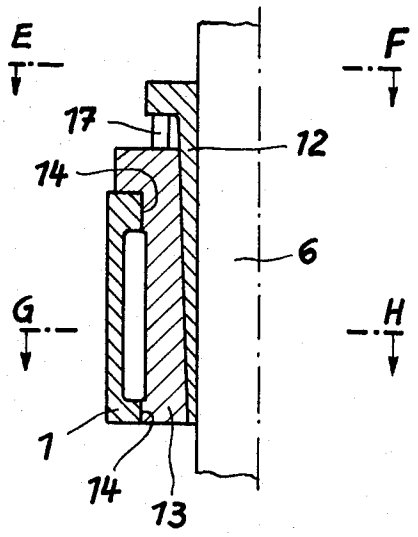


Fig. 2

Fig. 3



FORGING PRESS HAVING ADJUSTABLE COLUMN GUIDES

BACKGROUND OF THE INVENTION

The invention relates to a forging press having a frame comprising a top cross-member, a bottom cross-member and four columns interconnecting the top and bottom cross-members, and an intermediate cross-member through which the columns pass for guided relative sliding in a vertical direction between the columns and the intermediate cross-member. Either the intermediate member will be stationary and the frame vertically movable and guided by the columns sliding through the intermediate cross-member or the frame will be stationary and the intermediate cross-member vertically slidable and guided by sliding along the columns. Each column has two parallel, opposed guide surfaces which are substantially parallel to the plane containing the axis of the respective column and the axis of the diagonally opposite column. The drive of the forging press can be above or below the floor. The columns may have upper and lower parts of circular cross-section and be connected to the top cross-member and to the bottom cross-member by means of nuts; in another construction, the press frame may be pre-stressed with tie members under tension interconnecting the top and bottom cross-members and are surrounded by members under compression which act as the columns referred to above. The top and bottom cross-members may be referred to as top and bottom platens; if the intermediate member is stationary, it may be referred to as a table platen, and when it is movable, it may be referred to as a travelling platen. The guiding arrangement may be referred to as cross-thread or diagonal guiding, and the guided part of the column may be of rectangular or square cross-section.

PRIOR ART

Fixed and adjustable column guides on forging presses are known. They may be circular cross-section guides constructed as ordinary bushes. It is also possible to use circular cross-section guides whose bushes are constructed as so-called ball cups which have spherical support surfaces on their exterior. Such ball cups have the advantage of avoiding edge or canting pressures which result from the non-symmetrical loading of the press. To compensate for wear, slight re-adjustability of the guides by using conical or split bushes is possible in both cases.

Designs have also been published in which polygonal or flattened cross-section columns have adjustable guides.

In the pre-stressed frame design referred to above, guidance is provided by the compression members referred to above, which act as spacer sleeves which are tightened against the top and bottom cross-members by means of the tie members. The spacer sleeves of these designs may be of polygonal cross-section and can have adjustable guides.

It is known that columns as well as column guides are stressed on the one hand by asymmetrical loading of the press and on the other hand by unequal thermal expansion resulting from temperature differences between pressure fluid cylinders for the press drive, the intermediate cross-member, the top cross-member and the bottom cross-member. The stresses resulting from differential thermal expansion necessarily causes severe wear of guide elements if these are not adjusted in accordance with the operating condition and the thermal state of the press. To prevent temperature differences from causing wear in adjustable guides, these are therefore set when the press is warm.

A suitable clearance is already provided in circular cross-section guides at the design stage. However, disadvantages occur both in adjustable guides as well as in circular cross-section guides. In the first case, the guide geometry is not maintained if the principal components of the press are subjected to widely fluctuating temperatures. In the case of circular cross-section guides, the excessive clearance means that precise guidance of the press is impossible.

SUMMARY OF THE INVENTION

According to the invention, there is provided a forging press having a frame comprising a top cross-member, a bottom cross-member and four columns interconnecting the top and bottom cross-members, and an intermediate cross-member through which the columns pass for guided relative sliding in a vertical direction between the columns and the intermediate cross-member, each column having two parallel, opposed guide surfaces which are substantially parallel to the plane containing the axis of the respective column and the axis of the diagonally opposite column, the guide surfaces engaging and being slidable relative to respective vertically adjustable wedge-shaped members which have guide surfaces substantially parallel to said plane and are supported by multi-part bushes with no substantial gaps between the wedge-shaped members and the respective support surfaces of the bushes which support the wedge-shaped members.

The invention can provide a guidance arrangement which is always correctly adjusted despite different temperatures of pressure fluid cylinders, the intermediate cross-member and the top cross-member. If the press has an under-floor drive, expansion of the top cross-member can be assumed to occur radially from the axis due to temperature differences; the guided column may, however, move freely in the radial direction from the axis of the press. If the press columns are differently spaced and such spacing necessarily varies with changing temperature differences, the guiding system in accordance with the invention need not impose any force on the column guides and the columns can always be accurately guided in any operating state and without additional clearances due to the vertically adjustable wedge-shaped members which can be guided in guides that may be manufactured with great accuracy.

The bushes will be mounted on the intermediate cross-member and are preferably mounted in circular bores in the intermediate cross-member and are surrounded on all sides by such bores. The circular external shape of the bushes and their arrangement in corresponding bores in the intermediate cross-member simplifies manufacture. The asymmetrical forces resulting from the forging operation act in the form of bending stresses on the columns in the same way as previously.

The bushes are suitably two-part bushes and the wedge-shaped members can be wedge strips. If the bush is a two-part bush, the parts preferably engage along one or more parting planes which is (are) substantially parallel to the surfaces on the bush which support the respective wedge-shaped members. As the

joints of the two-part bushes are offset by about 90° relative to the support surfaces, it is possible for the support surfaces to be produced by simple mechanical means in the appropriate bush half while the wedge-shaped member is supported (and guided) in the undivided part of the bush.

One embodiment of the invention is particularly described, by way of example, with reference to the accompanying drawing, in which:-

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partial view of a forging press with an under-floor drive, the guide being shown in section;

FIG. 2 shows four different horizontal cross-sections (A-B, C-D, E-F and G-H, as indicated in FIG. 1, E-F and G-H also being indicated in FIG. 3) through the columns and guides; and

FIG. 3 is a vertical section through the adjustable guides.

DETAILED DESCRIPTION OF THE INVENTION

A stationary table platen 1 of a forging press of four-column construction with an under-floor drive is supported on a foundation 2. A downwardly directed stationary piston 3 is mounted on the table platen 1 while a main drive cylinder 4, which co-operates with the piston 3, is provided in a bottom cross-member in the form of a bottom or cylinder platen 5. The cylinder platen 5 is connected via columns 6 to a top cross-member or platen 7 by means of column nuts 8. The cylinder platen 5, the columns 6 and the top platen 7 form a movable press frame. A bottom die 9 of the press is carried by the table platen 1 while a top die 10 is carried by the top platen 7.

The columns 6, which function as tie elements for the press frame, are disposed in a rectangle, as shown in FIG. 2. The successive workpieces, not shown, are passed in between one of the wider-spaced pairs of columns.

The columns 6 have upper and lower parts of circular cross-section, but the guiding parts of the columns 6, i.e. the parts adjacent the table platen 1, are of substantially square cross-section. Two oppositely disposed sides 11 of the square guiding part of each column 6 act as the guide surfaces (i.e. there are no other guide surfaces for engaging the table platen) and are parallel to each other and are parallel to the respective plane which contains the axis of the press, the axis of the respective column and the axis of the diagonally opposite column.

Vertically adjustable wedge-shaped members in the form of gibs 12 are disposed on the parallel sides 11 of the column 6 (omitted in FIG. 1, but see FIG. 3) and are supported and guided in two-part (split) bushes 13. The parts of each bush 13 abut and are in contact with one another. The two-part bushes 13 are of circular cross-section and are inserted without clearance in round bores 14 in the table, i.e. as can be seen in FIG. 1, there are no gaps between two axially spaced peripheral or circumferential zones of each bush 13 and respective zones or bores 14 of the table platen 1. One support surface 15 for a respective gib 12 is formed in each half of the each two-part bush 13. This aids manufacture because each support surface 15 may be machined by open cuts into a respective half of the bush 13. As can be seen in FIG. 3, there is no gap between the support surface 15 and the respective gib 12. The plane of the joints 16 in each two-part bush 13 is when viewed as in FIG. 2 a parting line which is parallel to and half-way between the respective support surfaces 15. Vertical adjustment of the gibs 12 is performed in a usual manner by means of screw-threaded bolts 17. The bushes 13 are provided with split stroke-limiting or spacer sleeves 18 bolted down to the tops of the bushes 13. The sleeves 18 would be abutted by the column nuts 8 if the press were operated without the tools 9, 10 in position in their holders. The sleeves 18 also protect the guides from, for instance, scale broken off the workpiece. Each sleeve 18 has a window for the vertical adjustment of the gibs 12.

In its guiding part, each column may have any rectangular cross-section instead of the solid square cross-section. In one pre-stressed frame construction, rectangular cross-section members in compression surround circular cross-section tie members which are in tension, the members in compression acting as the columns referred to above.

We claim:

1. In a forging press comprising a frame having a top cross-member, a bottom cross-member and four columns interconnecting said top and bottom cross-members, each said column having two parallel, opposed guide surfaces which are substantially parallel to a plane containing the axis of the respective said column and the axis of the diagonally opposite column, an intermediate cross-member through which said columns pass for guided vertical sliding movement of said columns in relation to said intermediate cross-member, said opposed guide surfaces providing the only substantial guidance between said columns and said intermediate cross-member, forging tool holding means for holding upper and lower forging tools for forging a workpiece, and drive means for driving said press for forging; the provision of adjustable guide means comprising respective vertically adjustable wedge-shaped members having guide surfaces which are substantially parallel to said plane and engage and are slidable relative to respective and column guide surfaces, and multi-part bushes defining support surfaces supporting respective said wedge-shaped members with no substantial gaps between said wedge-shaped members and respective said support surfaces, said bushes being mounted on said intermediate cross-member.

2. A forging press as claimed in claim 1, wherein said bushes are mounted in apertures in said intermediate cross-member, each said bush having two axially spaced peripheral zones which are substantially in contact with said intermediate cross-member all the way around each zone, there being no substantial gaps between said zones and said intermediate cross-member.

3. A forging press as claimed in claim 1, wherein said bushes are mounted in apertures in said intermediate cross-member, each said bush having two axially spaced peripheral zones which are in contact with said intermediate cross-member.

4. A forging press as claimed in claim 1, wherein said bushes are mounted in circular bores in said intermediate cross-member and are surrounded on all sides by said bores.

5. A forging press as claimed in claim 2, wherein each said bush comprises two parts engaging along at least one parting plane, which as seen in horizontal section

is a line which is substantially parallel to said support surfaces.

6. A forging press as claimed in claim **1**, wherein each said bush comprises two parts engaging along at least one parting plane, which as seen in horizontal section is a line which is substantially parallel to said support

surfaces, as seen in horizontal section.

7. A forging press as claimed in claim **4**, wherein there is a single said parting plane substantially halfway between said support surfaces.

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