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Schmoll et al.

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[54] **HYDRAULIC FORGING PRESS**

[75] Inventors: **Heinz Schmoll**, Huckeswagen; **Helmut Robra**, Mulheim/Ruhr, both of Germany

[73] Assignee: **Schloemann Aktiengesellschaft**, Dusseldorf, Germany

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[30] **Foreign Application Priority Data**

May 2, 1972 Germany 2221341

[52] **U.S. Cl.** ..... **72/407**, 72/453, 100/264, 100/269 R

[51] **Int. Cl.** **B21d 7/06**

[58] **Field of Search** ..... 72/407, 453; 100/269 R, 100/264

[56] **References Cited**

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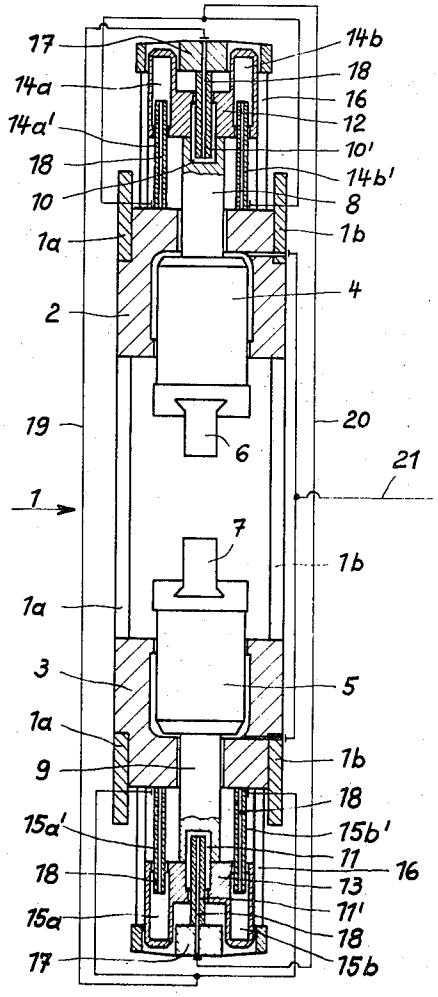
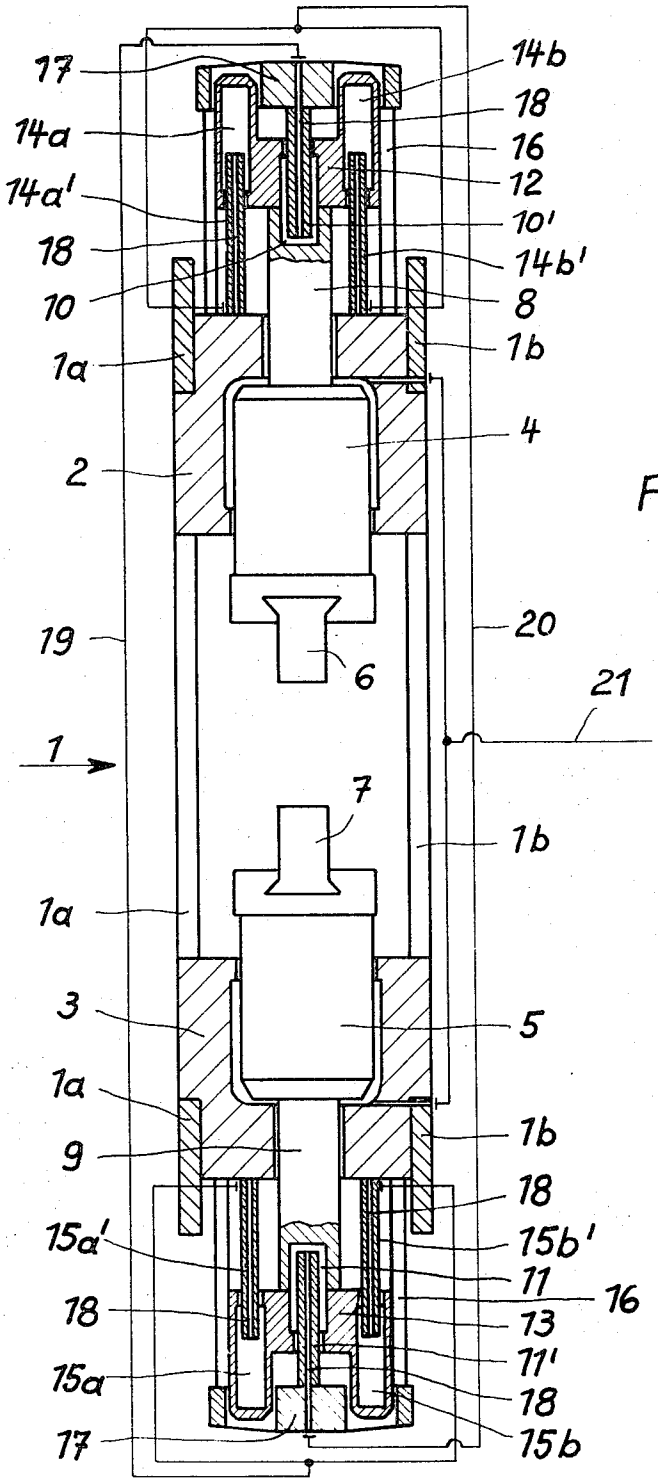
Primary Examiner—C. W. Lanham
Assistant Examiner—Carl E. Hall
Attorney, Agent, or Firm—Holman & Stern

[57] **ABSTRACT**

A horizontal hydraulic forging press has counteracting forging pistons which are coupled so that the forging movements of the forging pistons are coupled together. The coupling is done by each forging piston having a step and a rearwardly-extending shank, at least two coupling-cylinder units being connected to each shank. For each shank, at least one piston-cylinder unit increases in volume and at least one piston-cylinder unit decreases in volume as the forging pistons make a forging stroke. The piston-cylinder unit which increases in volume is connected to a piston-cylinder unit which decreases in volume and is associated with the other piston, and vice versa, in order to obtain proper coupling.

5 Claims, 4 Drawing Figures




17
14a
14a'
18
10
1a
2
19
1
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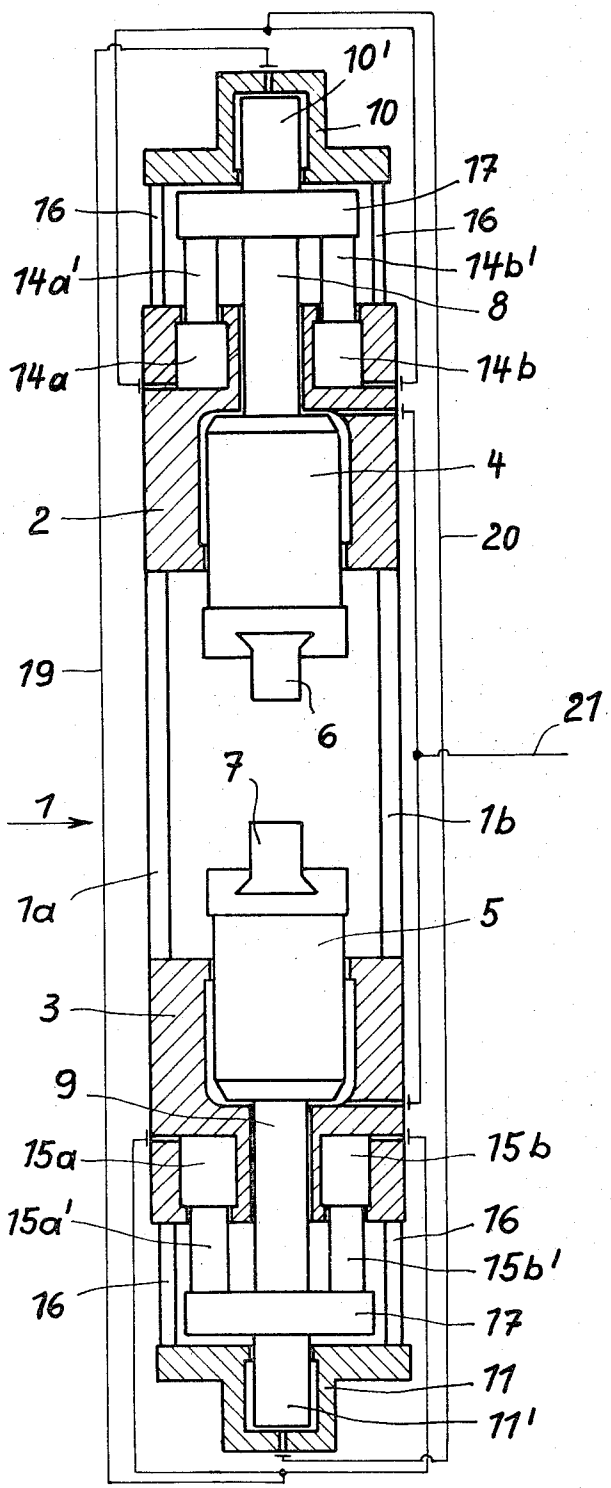
3
1a
9
15a'
18
15a
17
14b
18
16
12
10'
14b'
8
1b
4
6
20
21
7
1b
5
1b
18
15b'
11
16
13
11'
18
15b

Fig. 1


10'
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16
14a'
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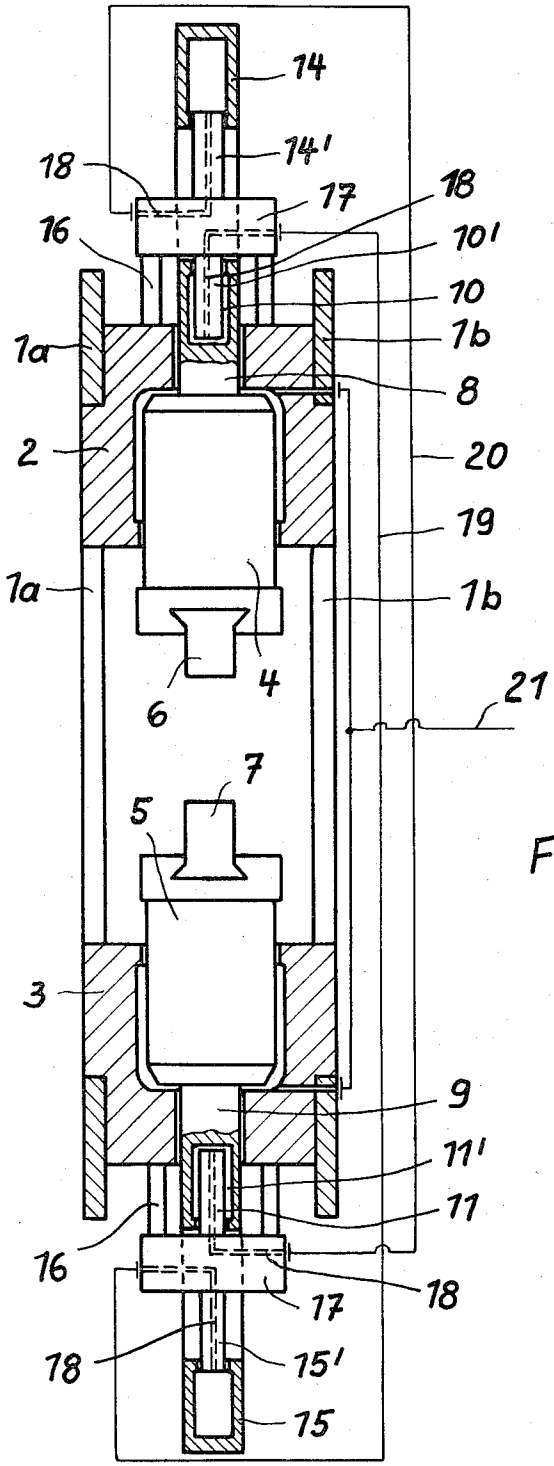
15b'
17
11
11'

Fig. 2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7
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11'
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15'
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Fig. 3

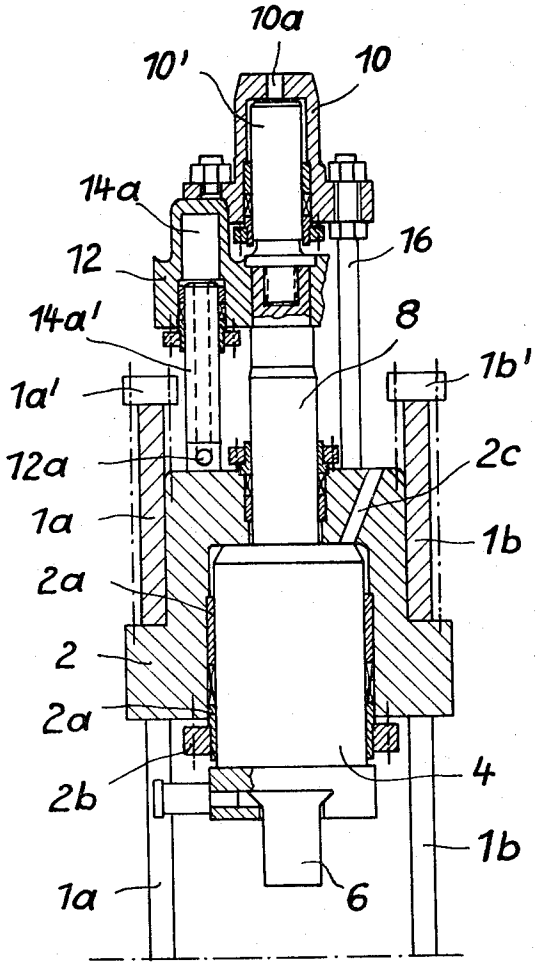

Fig. 4

HYDRAULIC FORGING PRESS

BACKGROUND OF THE INVENTION

The invention relates to a horizontal hydraulic forging press for forging billets or the like with coupled, counter-acting forging pistons and cylinders which operate in opposition to each other and with retracting means.

Forging presses for the application described above are known. In general, they forge from four sides, i.e. in four equiangularly-spaced directions in one plane. To this end, the forging tools normally each have their own individual drives, which can be mechanical or hydraulic; the drives are positively interlinked by mechanical elements such as gear wheels, or multi-piston pumps. These known forging presses are expensive to construct. The relatively enclosed working space of these machines makes it difficult to discharge the scale coming from the workpieces and exposes the high-grade components in the forging space to increased wear. Moreover, the accessibility to the tools and other components of the working space in such forging presses is limited.

SUMMARY OF THE INVENTION

The present invention provides a horizontal hydraulic forging press comprising:

counter-acting first and second forging pistons, each said piston having a step and having a rearwardly-extending shank;

respective cylinders receiving the forging pistons, the steps being within the respective cylinders and the shanks projecting rearwardly out of the respective cylinders;

retracting means for retracting the forging pistons after a forging stroke;

at least two coupling piston-cylinder units connected to each shank, at least one of the piston-cylinder units having a cylinder volume which increases with progressive motion of the shank in the forging direction and at least one of the piston-cylinder units having a cylinder volume which decreases with progressive motion of the shank in the forging direction; and

ducts intercommunicating at least one of the coupling piston-cylinder units which is connected to the first forging piston and has said increasing cylinder volume with at least one of the piston-cylinder units which is connected to the second forging piston and has said decreasing cylinder volume, and also intercommunicating at least one of the coupling piston-cylinder units which is connected to the second forging piston and has said increasing cylinder volume with at least one of the piston-cylinder units which is connected to the first forging piston and has said decreasing cylinder volume, whereby the coupling piston-cylinder units couple together the forging movements of the forging pistons.

The invention can provide a press with good accessibility to the working space and reliable discharge of scale with corresponding facilities for forging the workpiece, and the press can therefore be of simpler and less expensive construction.

The horizontal arrangement of the two oppositely operating forging pistons gives a working space which is open on both sides and therefore ensures reliable discharge of scale and convenient accessibility. The hydraulic coupling between the two forging pistons ensures synchronism of the two forging pistons with simple components such as pistons and cylinders and, having regard to the number and design of machine parts required, the forging press of the invention can be less expensive than conventional forging presses, which usually have four forging slides and a correspondingly complex arrangement of the machine parts.

Normally, the surface areas of the coupling pistons associated with one forging piston will be identical to the surface areas of the coupling pistons associated with the other forging piston so that the movements of the two forging pistons will be constrained to be substantially identical.

In one embodiment of the invention, the shank of each forging piston has a central coupling cylinder, and two or more coupling cylinders which act in the opposite direction to the central coupling cylinder are equi-spaced around the shank, the respective coupling pistons of the central coupling cylinder and of the coupling cylinders therearound being fixed in position, i.e. fixed to the frame of the forging press.

In another embodiment of the invention, the rear end of the shank of each forging piston has a central coupling piston, and two or more coupling pistons which act in the opposite direction to the central coupling piston are equi-spaced around the shank, the respective coupling cylinders of the central coupling piston and of the coupling pistons therearound being fixed in position.

In a third embodiment of the invention, the shank of each forging piston has a central coupling cylinder, and another coupling cylinder, which acts in the opposite direction to the central coupling cylinder, is disposed coaxially with and spaced to the rear of the rear end of the shank and is connected to the shank, the respective coupling pistons of the central and coaxial coupling cylinders being fixed in position.

BRIEF DESCRIPTION OF THE DRAWINGS

Three embodiments of the invention are particularly described, by way of example, with reference to the accompanying drawings, in which:

FIG. 1 is a plan, mainly in horizontal section, of part of a forging press in accordance with the invention;

FIG. 2 is a like view of part of another forging press in accordance with the invention;

FIG. 3 is a like view of part of a third forging press in accordance with the invention, the coupling pistons adapted to act in the working and reverse direction being disposed in tandem in the forging axis; and

FIG. 4 is a plan, mainly in horizontal section along two different, parallel plan of half of a fourth forging press in accordance with the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In FIG. 1 the frame 1 of a horizontal forging press comprises two frame members 1*a* and 1*b*, each of which lies in a vertical plane and is in the shape of a chain link. At one end, the respective internal end faces of the frame members 1*a* and 1*b* abut a hydraulically-actuated forging cylinder 2, and at the other end, the respective internal end faces of the frame members 1*a* and 1*b* abut a hydraulically-actuated forging cylinder 3.

Forging pistons 4 and 5 slide in opposite directions in the forging cylinders 2 and 3, the end faces of the forging pistons being provided with forging tups, saddles or tools 6 and 7. The forging pistons 4 and 5 are constructed as stepped pistons within the cylinders 2 and 3, the piston shanks 8 and 9 extending rearwardly from the rear surfaces of the forging cylinders 2 and 3.

Coupling cylinders 10 and 11, which are open to the rear, are provided in the end faces of the piston shanks 8 and 9. The ends of the piston shanks 8 and 9 have cross members 12 and 13 mounted thereon to accommodate further coupling cylinders 14*a*, 14*b* and 15*a*, 15*b* which are open to the front (to the forging direction).

Coupling pistons 10′ and 11′ are fixed to the frame 1 by means of tie rods 16 and cross-members 17 which connect the coupling pistons 10′ and 11′ to the cylinders 2 and 3 respectively. The coupling pistons 10′ and 11′ are adapted to plunge into the coupling cylinders 10 and 11 and have identical end faces. The coupling cylinders 14*a*, 14*b* and 15*a*, 15*b* which are open to the front are connected to the shanks 8 and 9 of the forging pistons and operate with coupling pistons 14*a*′, 14*b*′ and 15*a*′, 15*b*′, which are fixed to the cylinders 2 and 3.

The coupling pistons 10′, 14*a*′, 14*b*′ as well as 11′, 15*a*′, 15*b*′ are provided with longitudinal bores 18. The coupling cylinder 10 is connected via the bore 18 in the coupling piston 10′, ducts 19 and bores 18 in respective coupling pistons 15*a*′ and 15*b*′ to the coupling cylinders 15*a* and 15*b*, which are disposed on the side of the opposite forging cylinder 3 and act in the reverse direction on the forging piston 5. The area of the end face of the coupling piston 10′ is equal to the sum of the areas of the end faces of the coupling pistons 15*a*′ and 15*b*′.

The coupling cylinder 11 is connected in like manner via ducts 20 to the coupling cylinders 14*a* and 14*b*. In like manner, the area of the end face of the coupling piston 11′ is equal to the sum of the areas of the end faces of the coupling pistons 14*a*′ and 14*b*′.

The forging pistons 4 and 5 are positively controlled because of the aforementioned connections between the appropriate coupling pistons and cylinders and therefore always operate precisely and uniformly on the workpiece (not shown) which is to be forged. The forging cylinders 2 and 3 are pressurised with hydraulic fluid via a common duct 21. Retraction cylinders and pistons (not shown) are connected to the appropriate forging pistons 4 and 5 or piston shanks 8 and 9 respectively.

For example, if hydraulic fluid is admitted into the cylinder 2, the forging piston 4 together with the coupling cylinders 14*a* and 14*b* will move forward. The coupling fluid is displaced from the coupling cylinders 14*a* and 14*b* and flows via ducts 20 to the coupling cylinder 11 of the opposite forging piston 5. Since the areas of the coupling pistons 14*a*′ and 14*b*′ on the one hand and of the coupling pistons 11′ on the other hand are identical, both forging pistons 4 and 5 are advanced by identical amounts.

At the same time, coupling fluid is displaced from the coupling cylinders 15*a* and 15*b* to the coupling cylinder 10 via ducts 19.

The hydraulic coupling is merely required to compensate for any force differences occurring for example due to different frictional forces on the forging pistons 4 and 5, the areas of the respective coupling pistons which co-operate with the two forging cylinders 2 and 3 or the forging pistons 4 and 5 being kept equal to one another.

In FIG. 2, the coupling cylinders 10, 14*a*, 14*b* and 11, 15*a*, 15*b* are stationary while the corresponding coupling pistons 10′, 14*a*′, 14*b*′ and 11′, 15*a*′ and 15*b*′ are fixed to the appropriate piston shanks.

FIG. 3 shows a further way of arranging the coupling cylinders and pistons. In this case, the coupling cylinders 10 and 14 or 11 and 15 respectively are disposed in one axis, namely the forging axis, the co-operating pistons 10′ and 15′ or 11′ and 14′ having identical piston areas. FIG. 4 shows a press which combines many of the features of the presses of FIGS. 1 and 2, and also shows the construction in more detail. In general, the references in FIG. 4 indicate parts corresponding to those with the same references in FIGS. 1 and 2, and the operation of the press is generally as in FIGS. 1 and 2. The coupling cylinder 10 (corresponding to that in FIG. 2) and the tie rods 16 have their axes in one horizontal plane while the coupling cylinders 14*a* and coupling pistons 14*a*′ (of which only one of each is shown) have their respective axes on either side of said plane. The forging cylinder 2 is secured to the frame members 1*a* and 1*b* by straps 1*a*′ and 1*b*′ which are tightened against the frame members by bolts (indicated by the dot-dash lines) screwed into the forging cylinder 2. The forging tools 6 (and 7, not shown in FIG. 4) are mounted on the respective forging pistons 4 (and 5, not shown in FIG. 4) as described in detail in our German Pat. Application No. P 22 25 528.3, filed on 26th May, 1972. The lower part of the cylinder 2 has two axially-spaced sliding seals 2*a*, which also provide guidance for the forging piston 4, the seals being retained by a retainer ring 2*b* and bolts (indicated by the dot-dash lines). The upper part of the forging cylinder 2 has a similar sealing arrangement, for the piston shank 8, and the coupling cylinders 10 and 14*a* also have similar sealing arrangements. The ducts 2*c*, 10*a* and 12*a* leading to the respective cylinders are shown; the further connecting ducts such as 19, 20 and 21 in FIGS. 1 and 2 are not shown, but are conventional.

In principle, the two-sided forging press arrangement of any of FIGS. 1 to 4 could be duplicated to provide a four-sided forging press as long as there was suitable coupling between the two sets of forging pistons.

We claim:

1. A horizontal hydraulic forging press comprising:
a press frame;
counter-acting first and second forging pistons, each said piston defining a step and having a rearwardly-extending shank;
forging tool holding means mounted on each of said forging pistons;
respective cylinders receiving said forging pistons, said steps being within respective said cylinders and said shanks projecting rearwardly out of respective said cylinders;
retraction means for retracting said forging pistons after a forging stroke;
at least two coupling piston-cylinder units connected to each said shank, at least one of said piston-cylinder units having a cylinder volume which increases with progressive motion of said shank in the forging direction and at least another one of said piston-cylinder units having a cylinder volume

which decreases with progressive motion of said shank in the forging direction; and

duct means intercommunicating the at least one coupling piston-cylinder unit which is connected to said first forging piston and has said increasing cylinder volume with the at least one coupling piston-cylinder unit which is connected to said second forging piston and has said decreasing cylinder volume, and also intercommunicating the at least one coupling piston-cylinder unit which is connected to said second forging piston and has said increasing cylinder volume with the at least one coupling piston-cylinder unit which is connected to said first forging piston and has said decreasing cylinder volume, whereby said coupling piston-cylinder units couple together the forging movements of said forging pistons.

2. A forging press as claimed in claim **1**, wherein said shank of each said forging piston has a central coupling cylinder of a said piston-cylinder unit, and two or more coupling cylinders of said piston-cylinder units which act in the opposite direction to said central coupling cylinder are equi-spaced around said shank, said central coupling cylinder and said coupling cylinders therearound having respective coupling pistons which are fixed to said press frame.

3. A forging press as claimed in claim **1**, wherein said shank of each said forging piston has a rear end having a central coupling piston of a said piston-cylinder unit, and two or more coupling pistons of said piston-cylinder units which act in the opposite direction to said central coupling piston are equi-spaced around said shank, said central coupling piston and said two or more coupling pistons therearound having respective coupling cylinders which are fixed to said press frame.

4. A forging press as claimed in claim **1**, wherein said shank of each said forging piston has a central coupling cylinder of a said piston-cylinder unit, and another coupling cylinder of another said piston-cylinder unit, which acts in the opposite direction to said central coupling cylinder, is disposed coaxially with and spaced to the rear of the rear end of said shank and is connected to said shank, said central and coaxial coupling cylinders having respective coupling pistons which are fixed to said press frame.

5. A forging press as claimed in claim **1**, wherein said shank of each said forging piston has a rear end having a central coupling piston of a said piston-cylinder unit, said central coupling piston having a respective coupling cylinder which is fixed to said press frame, and wherein two or more coupling cylinders of said piston-cylinder units which act in the opposite direction to said central coupling cylinder are equi-spaced around said shank, said two or more coupling cylinders having respective coupling pistons which are fixed to said press frame.

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