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(54) **A machine tool with a reciprocating tool carrier**

(57) A tool such as a press with a reciprocating tool carrier 1.1 has a drive 2,3 mounted on the carrier and arranged to operate the toggle-lever pairs 9 mounted between the tool carrier and the machine frame 11. The drive 2, 3 is arranged symmetrically between the toggle-lever pairs, and is connected to each pair by a link 10. The drive may be a crank drive or a hydraulic jack in which either the cylinder or the piston is fixed relative to the carrier 1.1.

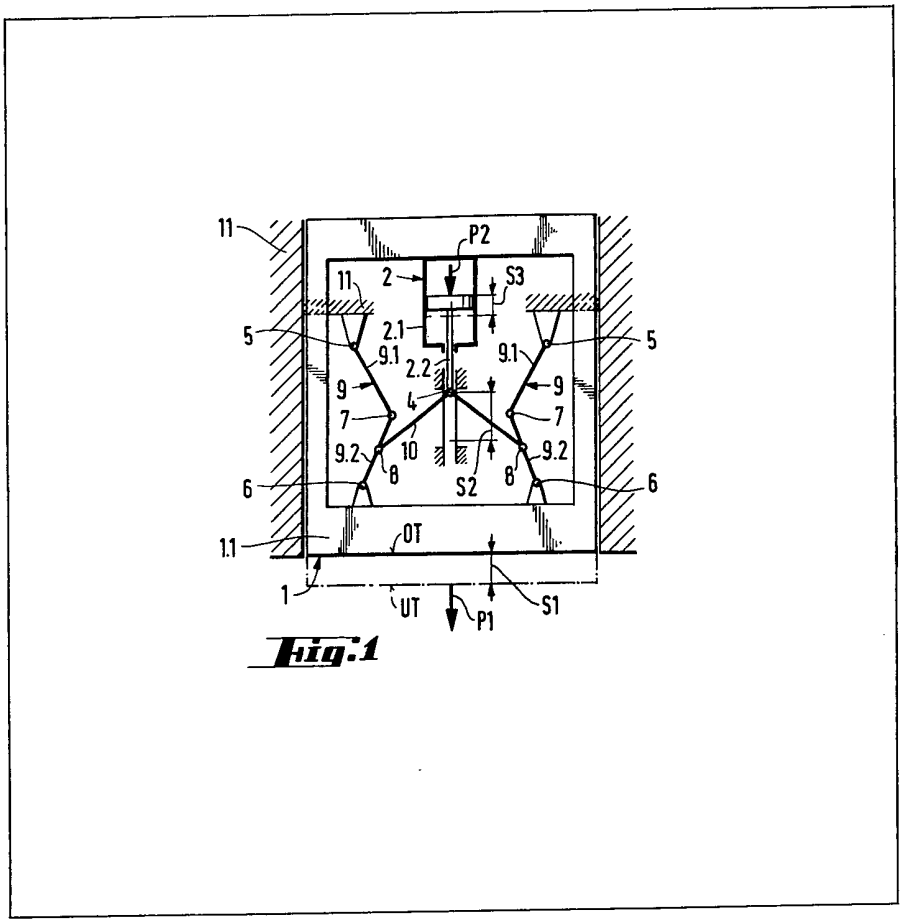

Fig.1

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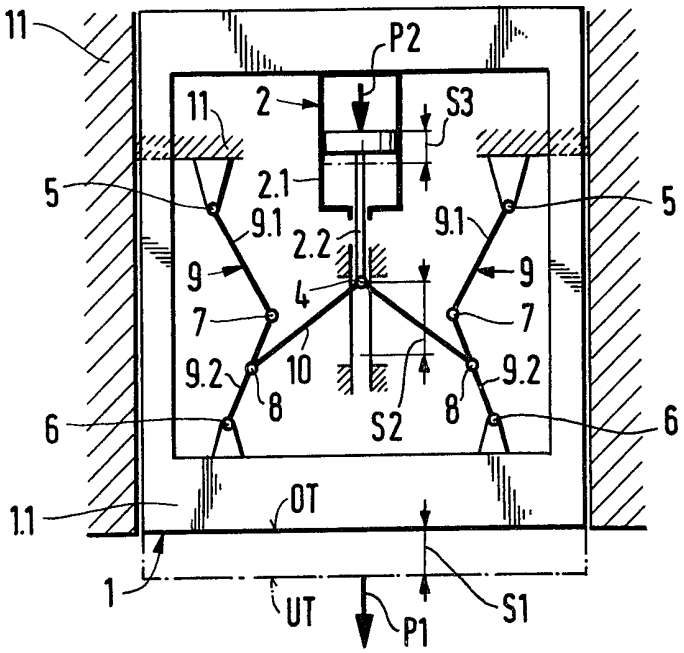
11
P2
11
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S3
5
2.1
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4
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9.2
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S2
6
1.1
OT
1
UT
P1
S1

Fig.1

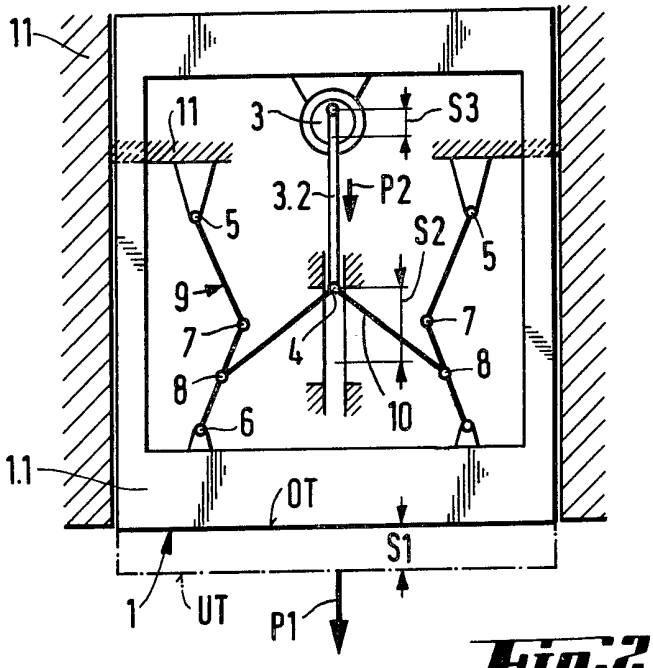
11
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Fig.2

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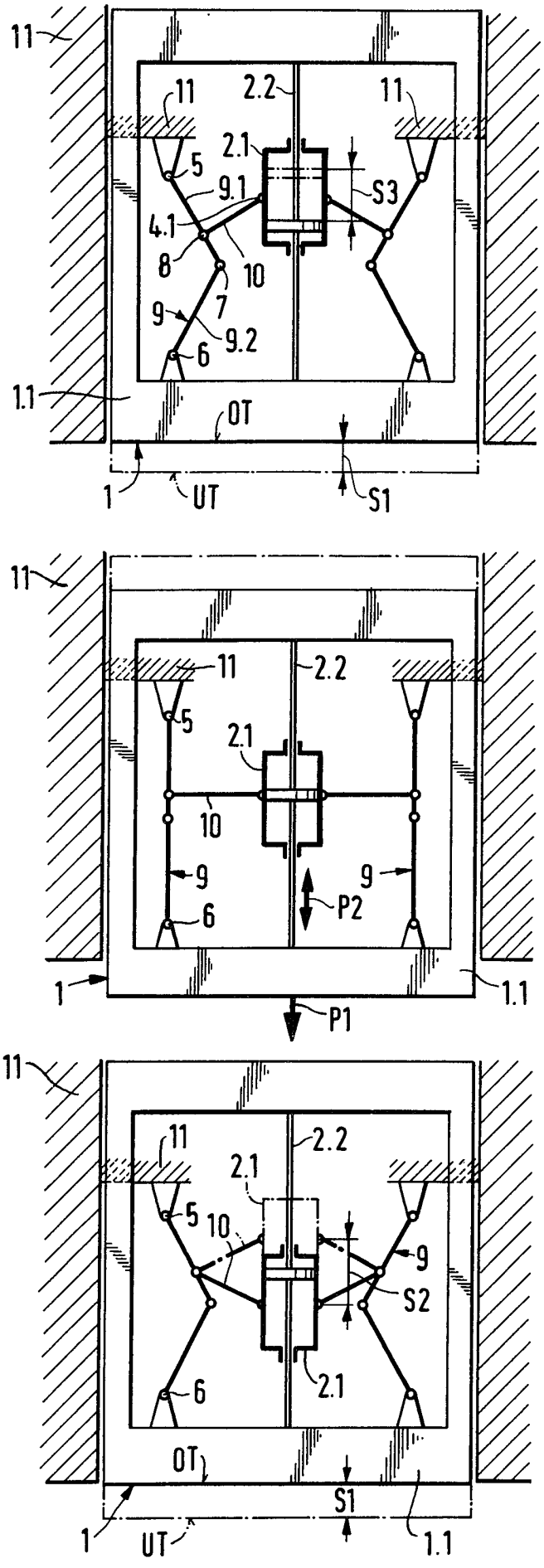
Fig.3



SPECIFICATION

A machine tool with a reciprocating tool carrier

The present invention relates to a machine tool, such as a press, having a reciprocating tool carrier which can be moved by means of two identical toggle-lever systems, with a driver supported between these, by action and reaction force.

German Offenlegungsschrift 2,755,962 discloses a press of this type, in which the drive is effected by a crank drive located in a closed toggle-lever system.

This system, which combines the advantages of a toggle-lever press with that of the crank drive in an almost ideal manner, is in particular suitable for automatic operation at high stroke frequency. However, particularly in conjunction with a high rate of operation, the asymmetrical arrangement of the hydraulic crank drive in one toggle-lever joint, as described in German Offenlegungsschrift 2,755,962, causes the guide on the ram side to undergo high stress which can, depending on the particular usage, lead to rapid wear.

The proposal to use a crank drive exclusively as the drive has also proved very restrictive, since this system is unsuitable for universal application.

This is particularly true for presses whose operation is subject to strict safety regulations, specifically with a view to precise braking and avoidance of over-run.

A crank drive can in general meet these conditions with adequate safety but not with complete safety, in spite of the relatively low energy build-up in the drive system of such mechanisms.

In spite of the above, the drive proposed in the Offenlegungsschrift referred to offers a series of significant advantages. Thus, in contrast to the conventional toggle-lever drives, the working shaft with its eccentric power take-off, and hence the counter-force, need not be accommodated by the machine stand and instead the relatively light drive is located within the system, so that the counter-force, or at least the essential part thereof, acts, by virtue of the closed nature of this system, on the ram or tool carrier, that is to say the machine stand can be designed to be of lighter construction.

According to the invention, there is provided a machine tool having a reciprocating tool carrier which can be moved by means of two buckling identical toggle-lever pairs, a drive supported between the toggle-lever pairs, on a frame which forms the tool carrier and is guided in the machine stand, the two toggle-lever pairs being arranged at a distance from one another in the free space of the frame construction, with their fixed joints hinged to the machine stand and with their joints which are movable in the stroke direction hinged to the frame, the pivot joints of the toggle-lever pairs facing one another and the toggle-lever pairs being connected to the drive by means of hingedly mounted intermediate members.

As a further development, it is proposed that the intermediate members which connect the drive and the toggle-lever pairs are - in the case where the cylinder member of the jack is fixed - pivotably mounted on the free end of the piston rod or on a guided central intermediate joint which is attached to the power take-off end of the connecting rod of the crank drive or - when using a fixed piston rod and a movable cylinder member - are pivotably mounted on two intermediate joints which are attached to the cylinder member in the same plane, axially parallel to the piston rod, and also pivotably mounted on the joints provided on the toggle-lever pairs.

The choice of the drive means is not confined to the use of a crank drive; instead it is also possible, in accordance with the intended use, to employ hydraulic jacks, in which case, furthermore, a decision can be made from case to case as to whether it should be the cylinder member or the piston rod which is fixed in the frame construction of the tool carrier.

An embodiment with a movable cylinder member on a fixed piston rod will be discussed in more detail later.

As a further development of the drive, it is proposed that the guide of the central intermediate joint or of the piston rod should be located centrally between the toggle-levers in the stroke direction of the tool carrier.

When using a cylinder member which is fixed in the frame construction, or using a crank drive, the stroke of the tool carrier between the top and bottom dead-centre points TDC and BDC is equal to the difference in the stroke travelled by the intermediate joint and the stroke travelled by the drive.

As already noted, when using a cylinder member which is movable on a piston rod which is fixed centrally and in the stroke direction of the tool carrier in the frame construction, the tool carrier is, in the upper and lower end position of this cylinder member, always in the TDC position, whilst in the middle setting of the cylinder member it is in the BDC position, so that for a complete stroke, starting from the upper or lower cylinder position, the TDC position is encountered twice, in each case with maximum pivoting of the toggle-levers, and the BDC position is encountered once, with maximum extension of the toggle-lever pairs.

This has the advantage that in the course of executing a complete stroke of the piston rod, the cylinder, on reaching the bottom dead-centre of the tool carrier, does not have to be braked and again accelerated away from this position, and that therefore the switching time for the change-over members which normally come into action in the BDC region is saved.

The invention will now be further described, by way of example, with reference to the accompanying schematic drawings, in which:

Figure 1 shows a first embodiment of the invention, with a jack drive;

Figure 2 shows a second embodiment, with a crank drive; and

Figures 3A, 3B and *3C* show various stages in the operation of a third embodiment, employing a jack drive.

In Figure 1, a cylinder member 2.1 of a jack 2 is fixedly located in a frame 1.1 of a tool carrier 1. The tool carrier 1 is slidably suspended in a machine

stand 11 and two joints 5 fixedly located on the machine stand 11, toggle-lever pairs 9 and joints 6 which are movable in the stroke direction. The individual toggle-lever 9.1 and 9.2 are in each case connected by toggle joints 7 to form a toggle-lever pair 9.

The drive is effected, starting from a movable piston rod 2.2, *via* a guided central intermediate joint 4 and two intermediate members 10 so as to act on the joints 8, present on the toggle-lever pairs 9, by means of which the toggle-lever pairs 9 can be extended and pivoted at the joints 7.

According to Figure 2, a crank drive 3, with a power take-off connecting rod 3.2, is fixedly located in the frame 1.1 of the tool carrier 1. The connecting rod 3.2 terminates in the guide central intermediate joint 4. The remaining construction is identical with the construction according to Figure 1.

For the embodiments according to Figure 1 and according to Figure 2, the stroke S1 of the tool carrier 1 from the top dead-centre (TDC) to the bottom dead-centre (BDC), is given by the equation S1 = S3 - S2 or S3 = S2 - S1, S3 being the stroke of the drive and S2 the stroke of the intermediate joint 4.

Example

In a press constructed in accordance with these principles, and having a nominal force, 20% before reaching the BDC, of P1 = 100 kN, and a stroke S1 of 60 mm, the force P2 = 20kN, the stroke S2 is 100 mm, and the stroke S3 is effectively 40 mm.

In the embodiment according to Figure 3, the piston rod 2.2 is fixedly located in the frame construction 1.1 of the tiool carrier 1, and more especially is located centrally relative to the system.

As may be seen from the individual positions A to C, the TDC position of the tool carrier 1 is achieved in both the upper and the lower position of the cylinder member 2.1, whilst in the middle position, that is to say with the toggle-lever pairs 9 extended, the BDC position of the tool carrier 1 is achieved. During a complete stroke starting from the upper or lower cylinder position, the TDC position is thus encountered twice and the BDC position once.

In the press described, the drive is arranged so as to avoid any stress on the tool guide applied transversely to the stroke direction of the tool carrier.

The construction of the press described firstly eliminates any possible stress on the tool carrier guide transversely to the stroke direction, and furthermore confines the movement of the drive means connected to the tool carrier solely to one direction, that is to say to the stroke direction, whilst in a prior art construction a movement of the crank drive both in the stroke direction and transversely to the stroke direction is possible, that is to say in the case of the press described, the hydraulic hoses through which the hydraulic fluid passes, and the hose connections, are subjected to substantially less stress.

Regardless of which embodiment is chosen, the advantages of a completely closed drive system are achieved to the full extent, so that only about 50% of the drive energy which the most modern of the prior art hydraulic presses require is needed.

CLAIMS

1. A machine tool having a reciprocating tool carrier which can be moved by means of two buckling identical toggle-lever pairs, a drive supported between the toggle-lever pairs, on a frame which forms the tool carrier and is guided in the machine stand, the two toggle-lever pairs being arranged at a distance from one another in the free space of the frame construction, with their fixed joints hinged to the machine stand and with their joints which are movable in the stroke direction hinged to the frame, the pivot joints of the toggle-lever pairs facing one another and the toggle-lever pairs being connected to the drive by means of hingedly mounted intermediate members.

2. A machine tool as claimed in claim 1, wherein the drive is a hydraulic jack.

3. A machine tool as claimed in claim 2, wherein the cylinder of the hydraulic jack is fixed to the frame.

4. A machine tool as claimed in claim 2, wherein the piston of the hydraulic jack is fixed to the frame.

5. A machine tool as claimed in claim 1, wherein the drive is a crank drive.

6. A machine tool as claimed in claim 3, wherein the intermediate members are pivotably mounted on the free end of the piston rod.

7. A machine tool as claimed in claim 5, wherein the intermediate members are pivotably mounted on a guided central intermediate joint which is attached to the power take-of end of a connecting rod of the crank drive.

8. A machine tool as claimed in claim 4, wherein the intermediate members are pivotably mounted on two intermediate joints which are attached to the cylinder member in the same plane, axially parallel to the piston rod, and also pivotably mounted on joints provided on the toggle-lever pairs.

9. A machine tool as claimed in claim 6, wherein the free end of the piston rod runs in a guide located centrally between the toggle-lever pairs in the stroke direction of the tool carrier.

10. A machine tool as claimed in claim 7, wherein the central intermediate joint runs in a guide located centrally between the toggle-lever pairs in the stroke direction of the tool carrier.

11. A machine tool as claimed in claim 9 or claim 10, wherein the stroke of the tool carrier between the two dead-centre points TDC and BDC is equal to the difference between the stroke of the piston rod or of the intermediate joint and the stroke of the drive.

12. A machine tool as claimed in claim 4, wherein the tool carrier, in the upper and lower end position of this cylinder, is in each case in the TDC position, whilst in the middle position it is in the BDC position.

13. A machine tool with a reciprocating tool carrier, substantially as herein described with reference to any one embodiment shown in the accompanying drawings.

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