

(43) Date of publication:
09.11.2022 Bulletin 2022/45

(51) International Patent Classification (IPC):
B27B 17/08 ^(2006.01)

(21) Application number: **22163229.2**

(52) Cooperative Patent Classification (CPC):
B27B 17/08

(22) Date of filing: **21.03.2022**

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
 GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
 PL PT RO RS SE SI SK SM TR**
 Designated Extension States:
BA ME
 Designated Validation States:
KH MA MD TN

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(30) Priority: **05.05.2021 SI 202100098**

(57) The invention relates to a cutting and splitting machine for cutting sawlogs and splitting same to chopped wood, comprising a chainsaw bar, a bi-directional hydraulic cylinder (1), the piston rod (1a) of which is connected to the chainsaw bar to perform the cutting and reciprocating stroke, a hydraulic motor (2) that drives the cutting chain of the chainsaw bar, a pump (3), a first hydraulic line (4) which hydraulically connects the pump (3) to the hydraulic motor (2) via a 4/2 way shut-off valve (7),

a second hydraulic line (5) which hydraulically connects the first hydraulic line (4) on the inlet side of the hydraulic motor to the hydraulic cylinder on the piston rod (1a) side, a third hydraulic line (6) which hydraulically connects the first hydraulic line (4) on the outlet side of the 4/2 way shut-off valve (7) via a reducing valve (8) to the hydraulic cylinder on the piston (1b) side, where the parameters are selected so that the forces on the piston from both the piston rod side and the piston side are equalized when the pressure on the hydraulic motor reaches the selected maximum value. The parameters are: d is diameter of the hydraulic cylinder piston rod (1a), D is diameter of the hydraulic cylinder piston (1b), p_{HMmax} is maximum pressure of the hydraulic motor (2) selected in a way to be lower than the maximum peak pressure of the hydraulic motor, preferably lower than the maximum intermittent pressure declared by the hydraulic motor manufacturer, and p_D is working pressure set using a reducing valve (8). The advantage of the cutting and splitting machine according to the invention over known machines is that the chainsaw bar feed speed is adapted to the current cutting operating conditions.

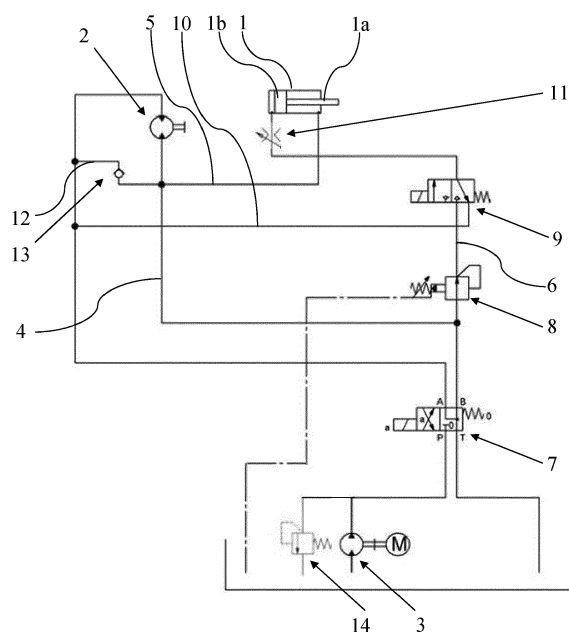


Figure 1

Description

Field of invention

[0001] The invention relates to a cutting and splitting machine for cutting sawlogs into individual pieces by means of a chainsaw bar and splitting sawlog pieces into chopped wood.

Prior Art

[0002] The cutting and splitting machine has a section for cutting sawlogs into individual pieces and a section for splitting sawlog pieces into chopped wood. Cutting and splitting machines are known from prior art, where the sawlogs are cut into individual pieces by means of a chainsaw bar. In known cutting and splitting machines, the feed speed of the chainsaw bar is constant during the working stroke. When cutting sawlogs, the aim is to cut the sawlogs as quickly as possible. The cutting speed is conditioned by circumstances such as the type of wood, the temperature of the wood (frozen wood), knots in the wood, the state of cutting chain wear, as well as by circumstances on the side of the cutting chain drive, such as a change in the input speed of the tractor drive or a drop in the speed of the drive due to an increase in the load on the hydraulic motor driving the cutting chain. What seems to be the optimum feed speed of the chainsaw bar at a given moment may, under changed circumstances, lead to a stoppage of the cutting chain. With a lower chainsaw bar feed speed, the stoppage of the cutting chain can be avoided, but the cutting cycle is prolonged and the power of the drive hydraulic motor is not optimally utilized. The low feed speed of the chainsaw bar therefore means more energy and time consumption.

[0003] The prior art also includes a cutting and splitting machine with a hydraulic throttle, which can be used to manually adjust the chainsaw bar movement speed depending on the cutting conditions.

Technical problem

[0004] The technical problem is how to configure a cutting and splitting machine with a chainsaw bar, in which the chainsaw bar feed speed will automatically adapt to respective circumstances or cutting conditions.

Solution to the technical problem

[0005] The technical problem is solved by a cutting and splitting machine that comprises:

a chainsaw bar for cutting sawlogs into pieces,
a bi-directional hydraulic cylinder, the piston rod of which is connected to the chainsaw bar in such a way that it can perform the cutting and reciprocating stroke of the chainsaw bar,
a hydraulic motor that drives the cutting chain of the

chainsaw bar,

a pump,

a first hydraulic line which hydraulically connects the pump to the hydraulic motor via a 4/2 way shut-off valve,

a second hydraulic line which hydraulically connects the first hydraulic line on the inlet side of the hydraulic motor to the hydraulic cylinder on the piston rod side,
a third hydraulic line which hydraulically connects the first hydraulic line on the outlet side of the 4/2 way shut-off valve via a reducing valve to the hydraulic cylinder on the piston side,

where the parameters are chosen in such a way that

the relationship
$$p_D \times \frac{\pi D^2}{4} = p_{HMmax} \times \frac{\pi}{4} (D^2 - d^2)$$
 holds, wherein

d is diameter of the hydraulic cylinder piston rod,

D is diameter of the hydraulic cylinder piston,

p_{HMmax} is maximum pressure of the hydraulic motor selected in a way to be lower than the maximum peak pressure of the hydraulic motor, preferably lower than the maximum intermittent pressure declared by the hydraulic motor manufacturer; and

p_D is working pressure set using a reducing valve.

[0006] The pump ensures the flow of hydraulic fluid through the first hydraulic line when the 4/2 way shut-off valve is open and drives the hydraulic motor at maximum speed. The pump simultaneously supplies the third hydraulic line via the reducing valve which limits the pressure on the piston side of the hydraulic cylinder to the value of p_D . The piston of the hydraulic cylinder and consequently the chainsaw bar move at maximum speed. When the cutting chain of the chainsaw bar comes in contact with the sawlog to be cut, the pressure on the hydraulic motor starts to build up. Due to the connection of the hydraulic motor inlet side to the hydraulic cylinder on the piston rod side by means of the second hydraulic line, the pressure in the hydraulic cylinder on the piston rod side also increases and, as a consequence, the chainsaw bar movement speed decreases. If the pressure on the hydraulic motor (e.g. due to a knot in the wood) rises to the selected maximum pressure p_{HMmax} , the forces on the hydraulic cylinder piston from both the piston and piston rod sides are equalized and the chainsaw bar movement speed drops to zero. The resistance on the cutting chain is eventually reduced again, the pressure on the hydraulic motor and thus on the hydraulic cylinder on the piston rod side is lowered and the chainsaw rod starts to move again. In this way, the force of the chainsaw bar on the sawlog is automatically regulated as a function of the resistance on the cutting chain. The selected maximum pressure p_{HMmax} must be lower than the maximum peak pressure of the hydraulic motor, declared by the hydraulic motor manufacturer, to prevent

damage to the hydraulic motor. The selected maximum pressure p_{HMmax} may be in the range of pressures between the maximum peak pressure and the maximum intermittent pressure as specified by the hydraulic motor manufacturer, but this will have a negative impact on the lifetime of the hydraulic motor. It is therefore recommendable for the selected maximum pressure p_{HMmax} to be lower than the maximum intermittent pressure declared by the hydraulic motor manufacturer. On the other hand, a too large downward deviation of the selected maximum p_{HMmax} pressure from the maximum intermittent pressure of the hydraulic motor means a lower efficiency of the cutting and splitting machine and a longer cutting cycle.

[0007] The advantage of the cutting and splitting machine according to the invention over known machines is that the chainsaw bar feed speed is adapted to the current cutting operating conditions, which consequently means an optimum sawlog cutting duty cycle without unnecessary disturbances and stoppages, and a good efficiency of the cutting and splitting machine.

Figure 1: Schematic diagram of the hydraulic system of a cutting and splitting machine in the off position

Figure 2: Schematic diagram of the hydraulic system of a cutting and splitting machine in the working position

[0008] The invention is described in more detail hereinbelow.

[0009] The technical problem is solved by a cutting and splitting machine that comprises:

a chainsaw bar for cutting sawlogs into pieces,
a bi-directional hydraulic cylinder 1, the piston rod 1a of which is connected to the chainsaw bar in such a way that it can perform the cutting and reciprocating stroke of the chainsaw bar,
a hydraulic motor 2 that drives the cutting chain of the chainsaw bar,
a pump 3,
a first hydraulic line 4 which hydraulically connects the pump 3 to the hydraulic motor 2 via a 4/2 way shut-off valve 7,
a second hydraulic line 5 which hydraulically connects the first hydraulic line 4 on the inlet side of the hydraulic motor to the hydraulic cylinder on the piston rod 1a side,
a third hydraulic line 6 which hydraulically connects the first hydraulic line 4 on the outlet side of the 4/2 way shut-off valve 7 via a reducing valve 8 to the hydraulic cylinder on the piston 1b side,

where the parameters are chosen in such a way that

the relationship
$$p_D \times \frac{\pi D^2}{4} =$$

$$p_{HMmax} \times \frac{\pi}{4} (D^2 - d^2) \quad \text{holds, wherein}$$

d is diameter of the hydraulic cylinder piston rod 1a, D is diameter of the hydraulic cylinder piston 1b, p_{HMmax} is maximum pressure of the hydraulic motor 2 selected in a way to be lower than the maximum peak pressure of the hydraulic motor, preferably lower than the maximum intermittent pressure declared by the hydraulic motor manufacturer; and p_D is working pressure set using a reducing valve 8.

[0010] The pump 3 ensures the flow of hydraulic fluid through the first hydraulic line 4 when the 4/2 way shut-off valve 7 is open and drives the hydraulic motor 2 at maximum speed. The pump simultaneously supplies the third hydraulic line 6 via the reducing valve 8 which limits the pressure on the piston 1b side of the hydraulic cylinder to the value of p_D . The piston rod of the hydraulic cylinder and consequently the chainsaw bar move at maximum speed. When the cutting chain of the chainsaw bar comes in contact with the sawlog to be cut, the pressure on the hydraulic motor 2 starts to build up. Due to the connection of the hydraulic motor inlet side to the hydraulic cylinder on the piston rod side by means of the second hydraulic line 5, the pressure in the hydraulic cylinder on the piston rod side also increases and, as a consequence, the chainsaw bar movement speed decreases. If the pressure on the hydraulic motor (e.g. due to a knot in the wood) rises to the selected maximum pressure p_{HMmax} , the forces on the hydraulic cylinder piston from both the piston and piston rod sides are equalized and the chainsaw bar movement speed drops to zero. The resistance on the cutting chain is eventually reduced again, the pressure on the hydraulic motor and thus on the hydraulic cylinder on the piston rod side is lowered and the chainsaw rod starts to move again. In this way, the force of the chainsaw bar on the sawlog is automatically regulated as a function of the resistance on the cutting chain.

[0011] An embodiment with concrete parameters is described below. The selected hydraulic cylinder has a piston diameter of 35 mm and a piston rod diameter of 18 mm. If the pressure at the pressure reducing valve p_D is limited to 170 bar, the condition of equalization of the forces on both sides of the hydraulic cylinder piston will be met at p_{HMmax} 231 bar. A hydraulic motor the declared maximum peak pressure of which is higher than the p_{HMmax} value mentioned above is selected or a hydraulic motor the declared maximum intermittent pressure of which will be higher than said value is selected. For example, a hydraulic motor with a maximum peak pressure of 255 bar, a declared maximum intermittent pressure of 240 bar and a maximum continuous pressure of 215 bar can be selected.

[0012] The third hydraulic line 6 may be further equipped with a flow control valve 11, which can be used to limit the flow and thus the chainsaw bar movement

speed.

[0013] The third hydraulic line 6 may be further equipped with a 3/2 way valve 9 for the reciprocating motion of the chainsaw bar, said valve being connected to the first hydraulic line on the outlet side of the hydraulic motor by a fourth hydraulic line 10. When the cutting stroke of the chainsaw bar is complete, the 3/2 way valve 9 switches to the other position and releases the pressure in the hydraulic cylinder. The piston of the hydraulic cylinder then reverses the movement by means of a pre-stressed spring and the chainsaw bar is returned to its starting position. After switching the 3/2 way valve 9 again, the chainsaw bar is ready to perform the next cutting stroke.

[0014] The inlet and outlet sides of the first hydraulic line 4 may be further interconnected by a fifth hydraulic line 12 equipped with a non-return valve 13.

[0015] The third hydraulic line 6 may be further equipped with a safety valve 14.

Claims

1. A cutting and splitting machine comprising:

a chainsaw bar for cutting sawlogs into pieces, a bi-directional hydraulic cylinder (1), the piston rod (1a) of which is connected to the chainsaw bar in such a way that it can perform the cutting and reciprocating stroke of the chainsaw bar, a hydraulic motor (2) that drives the cutting chain of the chainsaw bar, a pump (3), a first hydraulic line (4) which hydraulically connects the pump (3) to the hydraulic motor (2) via a 4/2 way shut-off valve (7), a second hydraulic line (5) which hydraulically connects the first hydraulic line (4) on the inlet side of the hydraulic motor to the hydraulic cylinder on the piston rod (1a) side, a third hydraulic line (6) which hydraulically connects the first hydraulic line (4) on the outlet side of the 4/2 way shut-off valve (7) via a reducing valve (8) to the hydraulic cylinder on the piston (1b) side, where the parameters are chosen in such a way

that the relationship $p_D \times \frac{\pi D^2}{4} =$

$p_{HMmax} \times \frac{\pi}{4} (D^2 - d^2)$ holds, wherein

d is diameter of the hydraulic cylinder piston rod (1a),

D is diameter of the hydraulic cylinder piston (1b),

p_{HMmax} is maximum pressure of the hydraulic motor (2) selected in a way to be lower than the

maximum peak pressure of the hydraulic motor, preferably lower than the maximum intermittent pressure declared by the hydraulic motor manufacturer; and p_D is working pressure set using a reducing valve (8).

2. The machine according to claim 1, **characterized in that** the third hydraulic line (6) is equipped with a flow control valve (11).
3. The machine according to any of preceding claims, **characterized in that** the third hydraulic line (6) is equipped with a 3/2 way valve (9) for the reciprocating motion of the chainsaw bar, said valve being connected to the first hydraulic line on the outlet side of the hydraulic motor by a fourth hydraulic line (10).
4. The machine according to any of preceding claims, **characterized in that** the inlet and outlet sides of the first hydraulic line (4) are interconnected by a fifth hydraulic line (12) equipped with a non-return valve (13).
5. The machine according to any of preceding claims, **characterized in that** the third hydraulic line (6) is equipped with a safety valve (14).

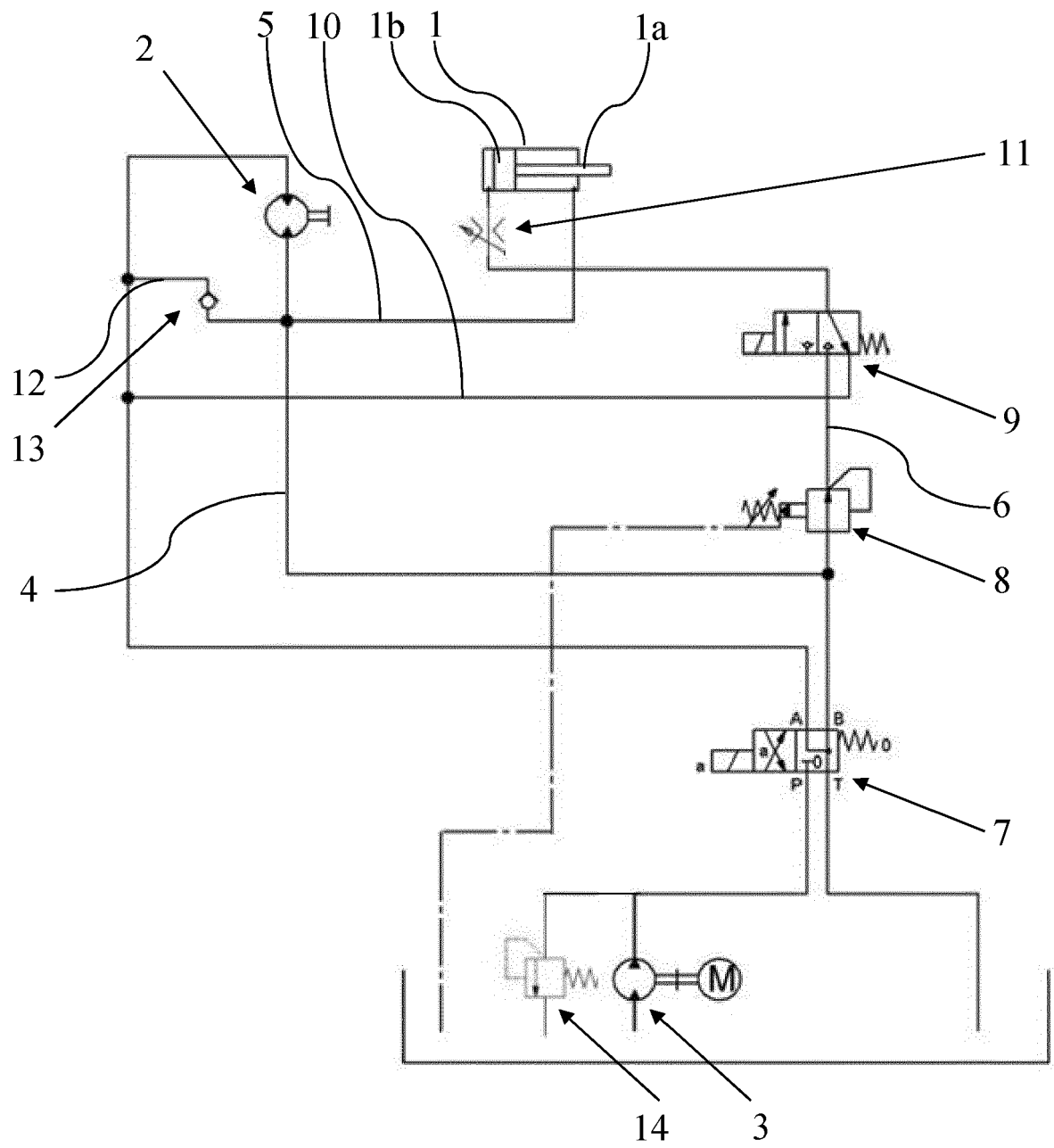


Figure 1

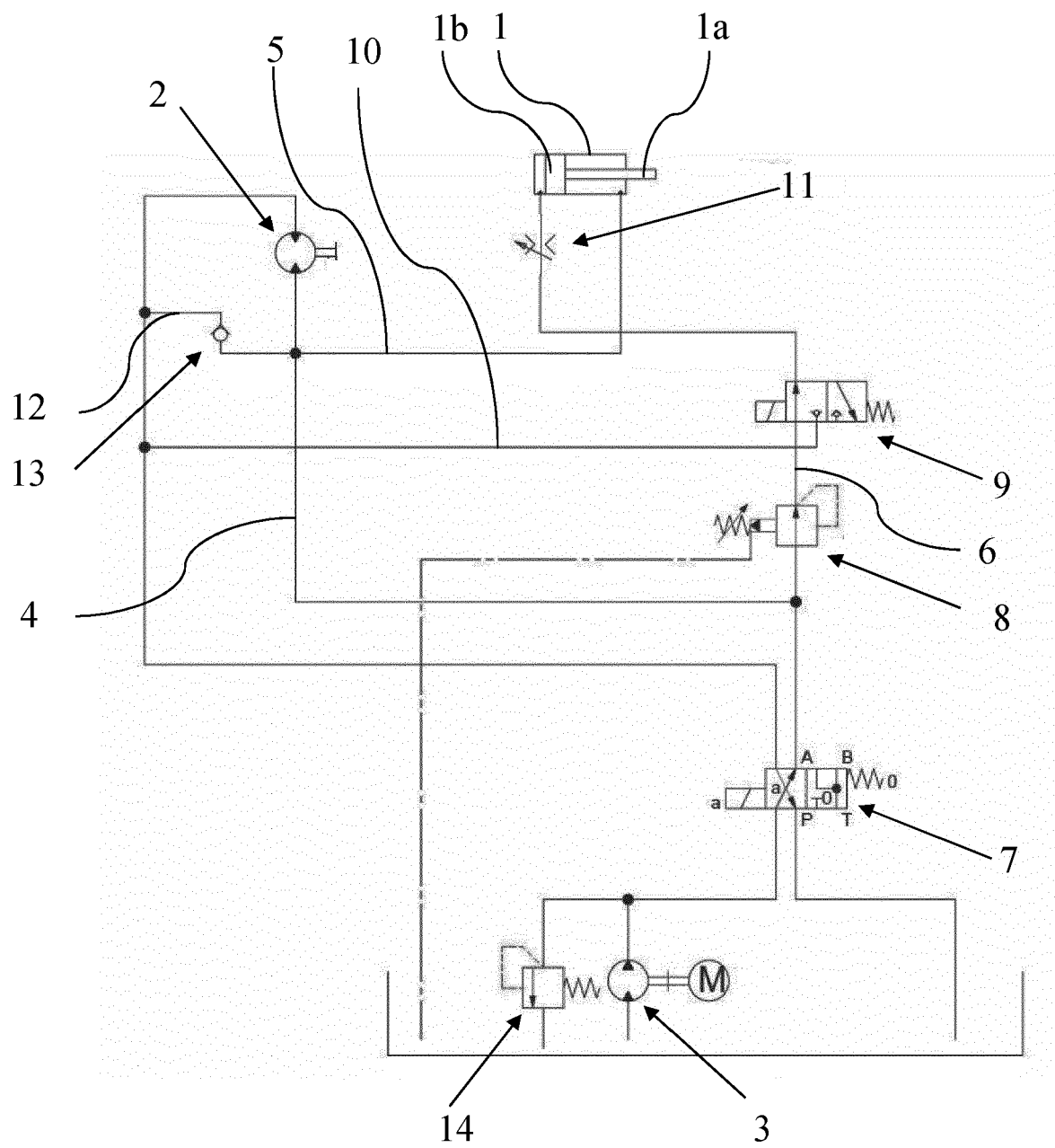


Figure 2



EUROPEAN SEARCH REPORT

Application Number

EP 22 16 3229

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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 7 September 2022	Examiner Chariot, David
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 O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 22 16 3229

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