

Weapons platform and method for operating a weapons  
platform

The invention relates to a weapons platform comprising  
5 an undercarriage on which a weapon can be arranged,  
wherein the undercarriage can be supported with respect  
to the ground by means of a hydraulic supporting device  
for absorbing firing reaction forces. The invention  
further relates to a military vehicle comprising such a  
10 weapons platform and to a method for operating such a  
weapons platform.

Such weapons platforms are customarily used in the  
military field and comprise an undercarriage on which  
15 there is arranged a weapon, for example an artillery  
gun, a howitzer or a rocket launcher, which can be  
directed in terms of azimuth and elevation. To protect  
military facilities such as field camps, for example,  
use is generally made of stationary weapons platforms  
20 which remain permanently at their operational site.  
Also known are weapons platforms which are designed to  
be mobile insofar as they can be moved from one  
operational site to the next, for example on board a  
carrier vehicle. Such mobile weapons platforms can  
25 often also be used directly from the carrier vehicle,  
i.e. without removing the weapons platform from the  
carrier vehicle.

Since the triggering of the weapon gives rise to  
30 considerable firing reaction forces which can cause the  
weapons platform and possibly the carrier vehicle to  
vibrate or even to move, such weapons platforms must be  
supported with respect to the ground by means of  
suitable supporting devices. To support such weapons  
35 platforms, hydraulic supporting devices which are used  
in various design forms have proved themselves.

Thus, on the one hand, supporting devices having hydraulically extendable telescopic supports are known which are lowered into a supporting position and in the process raise the weapons platform and possibly the carrier vehicle from the ground. However, these are associated with the disadvantage that all the forces which are to be channeled into the ground must be absorbed by the hydraulic telescopic supports.

10 In the military operational field, on account of the high firing reaction forces which occur, use is often made of hydraulic supporting devices which have rigid supports which are pivoted to and fro between a transport position and a supporting position by means of a hydraulic cylinder. The weapons platform or the vehicle is propped up by means of the pivotable supports before firing a shot. The rigid supports make it possible to absorb the dynamic forces occurring during the firing operation and to channel them into the ground.

It is required in the aforementioned hydraulic supporting devices that the hydraulic telescopic support or the hydraulic cylinder holding the rigid support also behaves rigidly such that deflections of the weapons platform are avoided when firing a shot, a situation which, in the case of the high firing reaction forces which occur briefly, requires a correspondingly high pressure of the hydraulic fluid in the telescopic support or in the hydraulic cylinder and a large-dimensioned hydraulic system with a corresponding energy supply. The resulting high weight for the supporting system is particularly disadvantageous for mobile weapons platforms.

35 Against this background, the object of the invention is to reduce the supporting complexity for supporting the weapons platform or the vehicle.

In the case of a weapons platform of the type mentioned at the outset, the object is achieved by an energy accumulator hydraulically coupled to the supporting  
5 device and intended for accumulating the energy absorbed by the supporting device.

By virtue of the energy accumulator hydraulically coupled to the supporting device, a rigid behavior of  
10 the hydraulic supporting device during the occurrence of the firing reaction forces is unnecessary. Rather, the hydraulic supporting device is able to yield as a result of the firing reaction forces, with the hydraulic pressure increasing in the supporting device.  
15 The hydraulic energy arising as a consequence of the pressure increase can be briefly accumulated in the energy accumulator and then be used to return the hydraulic supporting device to its initial position. The hydraulic supporting device and the energy  
20 accumulator together behave in the manner of a hydraulic spring. In this respect, the weapons platform can be returned by means of the firing reaction energy absorbed in the hydraulic supporting device. It is therefore not required to enforce a rigid behavior of  
25 the hydraulic supporting device since additional hydraulic energy is provided by a hydraulic pump. Therefore, the energy requirement for supporting the weapons platform is reduced.

30 According to an advantageous embodiment, the hydraulic supporting device is flow-connected to the energy accumulator, with the result that a fluid flow can be conveyed from the hydraulic supporting device to the energy accumulator and, conversely, from the energy  
35 accumulator to the hydraulic supporting device. The fluid flow allows hydraulic energy to be introduced into the energy accumulator and to be supplied from the

energy accumulator to the supporting device to return the undercarriage.

Furthermore, it is advantageous if the supporting  
5 device comprises at least one hydraulic element  
connected to the energy accumulator and intended for  
absorbing the firing reaction forces. Moreover, the  
hydraulic element allows the movement of the  
undercarriage that is caused by the firing reaction  
10 forces to be damped. The hydraulic element can absorb  
the firing reaction forces and transmit them to the  
energy accumulator. The hydraulic energy absorbed by  
the hydraulic element can be supplied to the hydraulic  
energy accumulator for temporary accumulation.

15 Although reference is made hereinbelow to at least one  
hydraulic element, the supporting device preferably  
comprises a plurality of hydraulic elements such that  
the weapons platform can be supported in a number of  
20 directions. The hydraulic elements can be arranged in a  
distributed manner on the weapons platform, in  
particular on at least two sides, at least three sides  
or on all sides of the weapons platform. The supporting  
device particularly preferably allows shooting in an  
25 azimuthal 270° range, in particular 360° range.

It has proved to be advantageous if the energy  
accumulated in the energy accumulator can be supplied  
to the hydraulic element in order to reset the  
30 undercarriage of the supporting device. For resetting  
purposes, hydraulic energy from the energy accumulator  
can be fed to the hydraulic element. When using a  
plurality of hydraulic elements, they can in each case  
be flow-connected to an energy accumulator. As an  
35 alternative, a plurality of hydraulic elements,  
preferably all hydraulic elements, can be coupled to a  
common energy accumulator.

It is particularly advantageous if the hydraulic element is formed as a hydraulic cylinder. Hydraulic cylinders both allow firing reaction forces to be absorbed and restoring forces to be delivered.

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According to a preferred embodiment of the invention, the supporting device comprises a plurality of supports which are articulated on the undercarriage in a pivotably movable manner and which can be pivoted by means of the hydraulic elements. The supports can be coupled to the hydraulic elements in such a way that they can be only pivoted and not moved in some other way. In this respect, the hydraulic elements can perform a number of functions: the hydraulic elements can pivot the supports to and fro, absorb and damp firing reaction forces and also return the weapons platform to its initial position.

The supports can be pivoted to and fro between an inoperative position, in which they are not in contact with the ground, and a supporting position, in which they are in contact with the ground.

Each support is preferably assigned at least one hydraulic element. The hydraulic element can extend between the undercarriage and the support.

The energy accumulator is preferably formed as a hydraulic accumulator. A hydraulic fluid can be accumulated under pressure in the hydraulic accumulator. Here, use can be made of a spring element. The hydraulic accumulator can be formed as a diaphragm accumulator, a bladder accumulator, a piston accumulator, a metal bellows accumulator or a spring accumulator. To increase the accumulator capacity, the energy accumulator can be formed as an accumulator battery which is composed of a plurality of energy accumulator units connected in parallel.

It is advantageous if the weapons platform comprises an initial energy generator for providing a basic energy content of the energy accumulator. The initial energy generator can be formed as a hydraulic pump. The pump can be connected to a tank from which the pump can suck in hydraulic fluid. The hydraulic fluid can be conveyed under pressure into the energy accumulator by means of the pump. The pivoting movement of the supports can be driven by means of the initial energy generator.

In the case of a military vehicle of the type mentioned at the outset, the provision of an above-described weapons platform contributes to achieving the object.

In the case of a method of the type mentioned at the outset, the object is achieved in that the energy released by the firing reaction forces is accumulated in an energy accumulator hydraulically coupled to the supporting device.

In the case of the military vehicle and the method, the same advantages as have already been described in conjunction with the weapons platform are obtained.

An advantageous embodiment of the method provides that, in order to return the undercarriage to its initial position, the accumulated energy is supplied to the supporting device, in particular to a hydraulic element of the supporting device. The accumulated hydraulic energy can be removed from the energy accumulator and supplied to the supporting device, in particular as a fluid flow.

In the case of the military vehicle and the method, the advantageous embodiments described in conjunction with the weapons platform can be used individually or in combination.

Further details and advantages will be explained hereinbelow with reference to an exemplary embodiment illustrated in the drawings, in which:

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figure 1 shows a perspective illustration of a military vehicle comprising a weapons platform, and

10 figure 2 shows a schematic illustration of the hydraulic supporting device of the weapons platform.

Figure 1 illustrates a military vehicle 1 which is  
15 constructed in the manner of a truck. In addition to a driver's cab 2, which can be of armored form, the vehicle comprises a mobile weapons platform 3. The weapons platform 3 can be formed as an interchangeable platform which is releasably connected to the vehicle  
20 1. A weapons platform 3 releasably arranged in such a way is associated with the advantage that the vehicle 1 can be equipped in a mission-specific manner with a suitable weapons platform 3. Moreover, it is possible for the weapons platform 3 to be moved, together with  
25 the vehicle 1, to an operational site, for example a field camp, and to be offloaded there so that the weapons platform 3 can be operated independently of the vehicle 1.

30 The weapons platform 3 shown in figure 1 has a weapon 4 which takes the form of an artillery gun. The weapon 4 has a weapon barrel 6 which is mounted in a turret 5 of the weapon 4 so as to be directable in terms of elevation. The turret 5 is received on an undercarriage  
35 7 of the weapons platform so as to be rotatable through 360°. Rotating the turret 5 allows the weapon barrel 6 to be directed in terms of azimuth.

Considerable firing reaction forces occur when a shot is fired by the artillery gun. The firing reaction forces of the artillery gun act in the manner of recoil forces in a direction F which is oriented counter to the firing direction G. The firing reaction forces are channeled via the turret 5 into the undercarriage 7 of the weapons platform 3. In order to be able to channel the firing reaction forces from the undercarriage 7 into the ground U, a hydraulic supporting device 8 is provided on the weapons platform 3. The hydraulic supporting device 8 comprises a plurality of supports 9 which act on the undercarriage 7. In the case of the vehicle 1 shown in figure 1, a respective support 9 is provided in the rear region of the undercarriage 7 and a respective support 9 is provided on the right-hand and left-hand side of the undercarriage 7 as viewed in the direction of travel.

As can further be seen from the illustration in figure 1, at least one hydraulic element 10, which is formed as a hydraulic cylinder, is arranged on each of the supports 9. The hydraulic elements 10 allow movements of the undercarriage 7 that are caused by the firing reaction forces to be damped. Here, the hydraulic elements 10 formed as hydraulic cylinders can absorb the firing reaction forces and convert them into hydraulic energy.

In the case of conventional hydraulic supporting devices, it is required to set the hydraulic pressure in the hydraulic cylinder 10 in such a way that said cylinder behaves rigidly during the occurrence of the firing reaction forces, this being associated with a high energy requirement for the hydraulic pump feeding the hydraulic cylinder. To reduce the required amount of energy, special measures have been taken in the case of the weapons platform 3 according to the invention. Thus, an energy accumulator 12 hydraulically coupled to

the supporting device 8 and intended for accumulating the energy absorbed by the supporting device 8 is provided. The pressure in the supporting device 8 that increases on account of the yielding of the hydraulic elements 10 can be transmitted via a fluid connection into the energy accumulator 12 and briefly temporarily accumulated there. The accumulated energy can be used to return the undercarriage 7 to its initial position. In this respect, the weapons platform 3 can be sprung back by means of the hydraulic energy obtained from the firing reaction forces. It is therefore not required to bring about a rigid behavior of the hydraulic elements 10 by the provision of additional energy. The energy requirement for supporting the weapons platform 3 is consequently reduced.

The coupling between the hydraulic supporting device 8 and energy accumulator 12 will be explained in more detail hereinbelow with reference to the schematic illustration in figure 2.

The hydraulic elements 10 of the hydraulic supporting device 8 that are formed as hydraulic cylinders are flow-connected to the energy accumulator 12 via hydraulic lines. The hydraulic lines thus allow a hydraulic fluid to be exchanged between the hydraulic elements 10 and the energy accumulator in both directions. When firing reaction forces are absorbed by the hydraulic elements 10, a fluid flow flows in the direction of the energy accumulator 12.

The energy accumulator 12 is formed as a hydraulic accumulator. The hydraulic pressure within the energy accumulator 12 increases as a result of the introduction of the hydraulic fluid. The hydraulic accumulator can optionally be formed as a diaphragm accumulator, a bladder accumulator, a piston accumulator, a metal bellows accumulator or a spring

accumulator. To increase the accumulator capacity, it is further possible to form the energy accumulator 12 as an accumulator battery which is composed of a plurality of energy accumulator units connected in parallel.

A valve 11, which is formed as a throttle valve, is arranged between the hydraulic elements 10 and the energy accumulator 12. The valve 11 is electronically controllable. The throttle valve 11 allows the fluid flow between the hydraulic elements 10 and the energy accumulator 12 to be set in terms of quantity. Thus, the damping behavior of the hydraulic elements 10 can be influenced by means of the valve 11.

In order to return the undercarriage 7 to its initial position, the hydraulic fluid can be supplied from the energy accumulator to the hydraulic elements 10.

The hydraulic elements 10 make it possible for the supports 9 to be pivoted from an upwardly pivoted inoperative position into the supporting position, shown in figure 1, in which the supports 9 rest on the ground U. The supports 9 can in each case be pivoted only about a pivot axis S by means of the hydraulic elements 10 and cannot be extended or moved in some other way.

In order to be able to move the supports 9 from the inoperative position into the supporting position, a hydraulic basic energy quantity which must be reserved in the energy accumulator 12 is required. To provide such a basic energy content, the energy accumulator 12 is flow-connected to an initial energy generator 14. The initial energy generator 14 is formed as a hydraulic pump which is fed from a tank 15 filled with hydraulic liquid. The initial energy generator 14 is dimensioned in such a way that the hydraulic pressure

generated by it allows the supports 9 to move and the overall travel weight of the military vehicle 1 can be borne by means of the supports 9. The energy is supplied by means of an energy supply unit which is  
5 carried along or by means of the vehicle energy supply.

A non-return valve 13 is arranged between the energy accumulator 12 and the initial energy generator 14 such that hydraulic liquid, in particular during firing,  
10 cannot pass from the energy accumulator 12 in the direction of the initial energy generator 14. Thus, the initial energy generator 14 can be hydraulically uncoupled from the supporting device 8 during firing.

15 According to the method according to the invention, the energy released by the firing reaction forces is converted into hydraulic energy by the hydraulic elements 10 and conveyed from the hydraulic elements 10 via the hydraulic lines into the energy accumulator 12  
20 hydraulically coupled to the hydraulic elements 10 and at least briefly accumulated in said accumulator. In a further step, the accumulated energy is removed from the energy accumulator in order to spring back the undercarriage 7 to its initial position. The energy is  
25 supplied to the hydraulic elements 10 of the supporting device 8. The fluid flow can be set by means of the valve 11 arranged between the energy accumulator 12 and the hydraulic element 10 and thus the time profile of the restoring force of the hydraulic element 10 can be  
30 influenced.

The vehicle 1 can have a known spring/damper system to provide suspension/damping during travel. In this context, the wheels of the vehicle 1 can be attached by  
35 means of a vehicle suspension. During firing, the wheels of the vehicle 1 can remain on the ground. The spring travel of the hydraulic supporting device 8 is smaller than the possible spring travel of the vehicle

suspension. It is thus ensured that the vehicle 1 and the vehicle suspension are not unduly loaded during firing.

5 The weapons platform 3 described above comprises an undercarriage 7 on which a weapon 4 can be arranged, wherein the undercarriage 7 can be supported with respect to the ground U by means of a hydraulic supporting device 8 for absorbing firing reaction  
10 forces. In order to accumulate the energy absorbed by the supporting device 8, the supporting device 8 is hydraulically coupled to an energy accumulator 12.

**Reference Signs:**

- 1 Military vehicle
- 2 Driver's cab
- 3 Weapons platform
- 4 Weapon
- 5 Turret
- 6 Weapon barrel
- 7 Undercarriage
- 8 Hydraulic supporting device
- 9 Support
- 10 Hydraulic element, hydraulic cylinder
- 11 Valve
- 12 Energy accumulator, hydraulic accumulator
- 13 Non-return valve
- 14 Initial energy generator, hydraulic pump
- 15 Tank

F, G Directions

S Pivot axis

U Ground

**Patent Claims:**

1. A weapons platform comprising an undercarriage (7)  
on which a weapon (4) can be arranged, wherein the  
undercarriage (7) can be supported with respect to  
5 the ground (U) by means of a hydraulic supporting  
device (8) for absorbing firing reaction forces,  
characterized by  
an energy accumulator (12) hydraulically coupled  
to the supporting device (8) and intended for  
10 accumulating the energy absorbed by the supporting  
device (8).
2. The weapons platform as claimed in claim 1,  
characterized in that the supporting device (8) is  
15 flow-connected to the energy accumulator (12).
3. The weapons platform as claimed in claim 1 or 2,  
characterized in that the supporting device (8)  
comprises at least one hydraulic element (10)  
20 connected to the energy accumulator (12) and  
intended for absorbing the firing reaction forces.
4. The weapons platform as claimed in claim 3,  
characterized in that the energy accumulated in  
25 the energy accumulator (12) can be supplied to the  
hydraulic element (10) in order to reset the  
undercarriage (7).
5. The weapons platform as claimed in claim 3 or 4,  
30 characterized in that the supporting device (8)  
comprises a plurality of supports (9) which are  
articulated on the undercarriage (7) in a  
pivotably movable manner and which can be pivoted  
by means of the hydraulic elements (10).

6. The weapons platform as claimed in one of the preceding claims, characterized in that the energy accumulator (12) is formed as a hydraulic accumulator.

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7. The weapons platform as claimed in one of the preceding claims, characterized by an initial energy generator (14) for providing a basic energy content of the energy accumulator (12).

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8. A military vehicle comprising a weapons platform (3) as claimed in one of the preceding claims.

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9. A method for operating a weapons platform (3) comprising an undercarriage (7) on which a weapon (4) can be arranged, wherein the undercarriage (7) can be supported with respect to the ground (U) by means of a hydraulic supporting device (8) for absorbing firing reaction forces, characterized

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in that the energy released by the firing reaction forces is accumulated in an energy accumulator (12) hydraulically coupled to the supporting device (8).

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10. The method as claimed in claim 9, characterized in that, in order to return the undercarriage (7) to its initial position, the accumulated energy is supplied to the supporting device (8), in particular to a hydraulic element (10) of the supporting device (8).

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