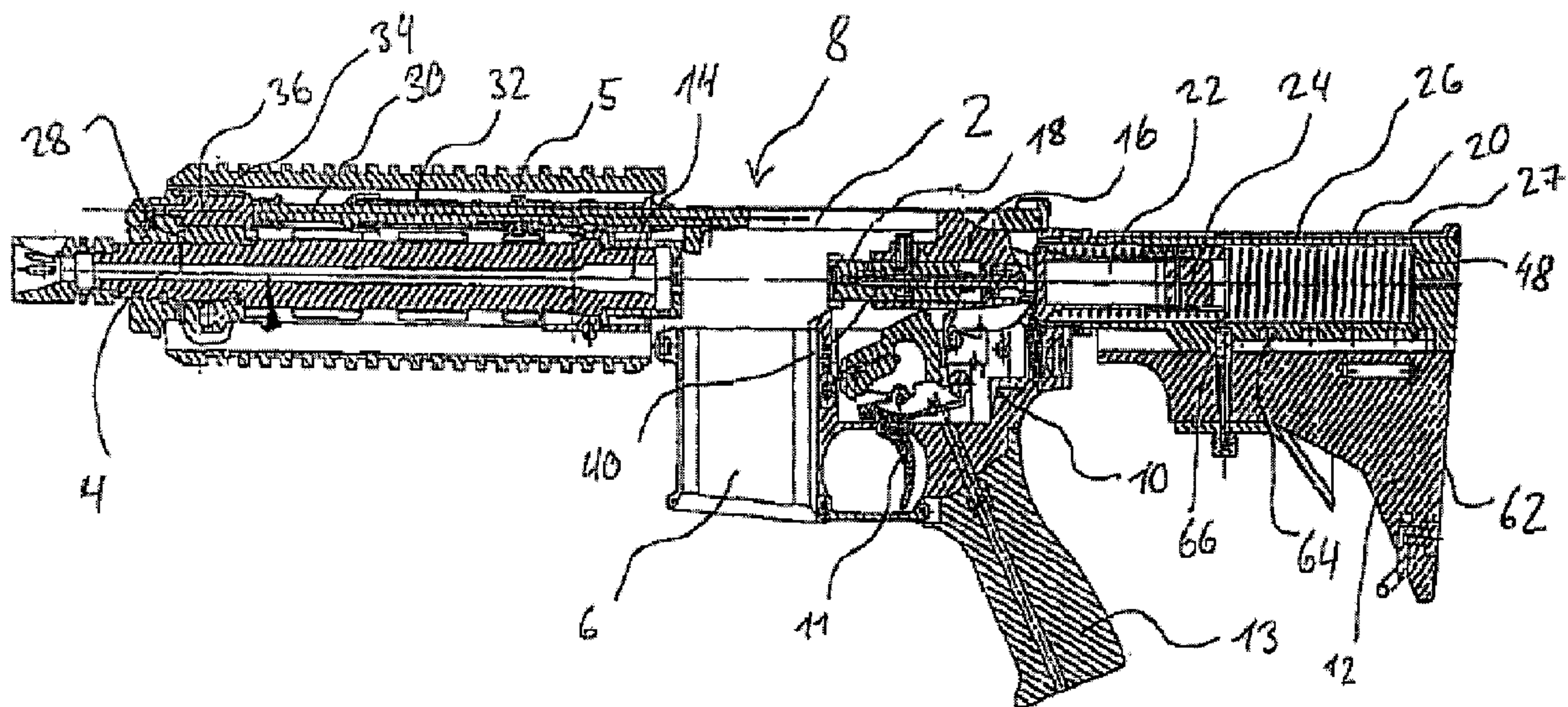




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(57) Abrégé/Abstract:

The invention relates to a weapon locking system (8) with at least one functional cavity (50, 52, 54, 56, 58, 60) and at least one fluid access opening (50, 52, 54, 56, 58, 60) connecting the functional void (38, 48) with the surroundings so that any fluid entering the functional void (38, 48) and negatively affecting the function of the locking system (8) can quickly and easily be conducted out through the fluid access opening(s) (50, 52, 54, 56, 58, 60).



ABSTRACT

The invention relates to a weapon locking system (8) with at least one functional cavity (50, 52, 54, 56, 58, 60) and at least one fluid access opening (50, 52, 54, 56, 58, 60) connecting the functional void (38, 48) with the surroundings so that any fluid entering the functional void (38, 48) and negatively affecting the function of the locking system (8) can quickly and easily be conducted out through the fluid access opening(s) (50, 52, 54, 56, 58, 60).

Weapon Locking System

The invention concerns a weapon locking system, i.e., a locking system for firearms.

Such systems usually serve the purpose of locking a firearm having a locking mechanism for firing, thereafter releasing the locking mechanism again and reloading with a loading mechanism in order to be able to fire again.

Subsequently listed position descriptions, such as, "front," "rear", "lateral," etc., refer to a weapon in normal, horizontal shooting position, whereas the shooting direction points forward.

Locking systems having different loading mechanisms as seen, for example, in gas pressure loaders or recoil-operated weapons are known. Such systems serve the purpose of automatically loading or reloading an automatic or semi-automatic weapon. However, they can also be operated manually. Incidentally, even repeating systems are known that can be manually loaded or reloaded or that have a locking mechanism which can be opened or closed.

Generally speaking, gas pressure loaders are self-loading firearms in which the lock is secured. If a shot is fired, some of the propellant gas is discharged by withdrawing one or several units of gas from the pipe and supplied to a self-loading mechanism. The energy of this highly pressurized propellant gas releases and opens the lock and initiates the reloading process.

Gas pressure loaders have the advantage that the locking mechanism of the lock is safe and structurally easy to maintain until the bullet has left the gun barrel. The propellant gas has an effect on the self-loading mechanism only if the bullet has passed gas

discharge. In addition, the amount of propellant gas discharged, for example, via a valve, can be affected in such a way that it changes the cadence of the weapon, or the weapon can be adapted to different types of munitions or munitions assembly.

Power transmission from the propellant gas to the lock can be performed in different ways. In most systems, after leaving gas discharge, the propellant gases are directed to a gas piston which, on its part, transmits by means of a gas rod the gas pressure to the lock, more precisely, to a breechblock carrier, for example, in the well-known G 36. Gas piston, gas rod and breechblock carrier can consist of several components or can be combined in a single component. Such gas pressure loaders are classified in long stroke and short stroke systems. In the case of a long stroke system, the gas piston covers during loading the same distance as the breechblock carrier. In the case of a short stroke system, the distance of the gas piston is shorter than that of the breechblock carrier.

However, other gas pressure loading systems direct the propellant gases through a gas pipe into the interior of the weapon. Also in these cases, the propellant gas is initially discharged via a gas discharge at the pipe. However, thereafter it is directed via a pipe system to the lock, more precisely, to the breechblock carrier. There it immediately affects the breechblock carrier which is powered by the direct propellant gas jet. Such a system is used, for example, with the U.S. Armed Forces standard rifle M16 and the M4 carbine.

The omission of gas piston and gas rods results in considerable reduction of weight. However, the propellant gas directed directly into the interior of the weapon often settles as residual gas and powder residue. This can result in malfunction if such a system is not cleaned frequently. For this reason, the M16 became somewhat adequately reliable only

after long periods of development work and a considerable improvement of the propellants.

The majority of recoil-operated weapons, on the other hand, have non-secured locking systems. They receive the energy for ejecting a bullet casing and for repeated reloading directly from the recoil energy of a shot. This recoil energy has a direct effect on the front side of the breechblock. The breechblock moves the entire breech back to the extent that the empty bullet casing is ejected and the weapon is reloaded, as is the case, for example, with an unsecured blowback system or with a semi-rigid roller lock. Examples in this regard are the HK G3, the Israeli Uzi or the submachine gun MP40 of the German Armed Forces.

Generally, firearms, gas pressure loaders, recoil-operated weapons and even manual repeating systems have the disadvantage of not being functionally reliable, in most cases not functioning at all, if they are used after coming out of a fluid, for example, emerging from the sea or after having been immersed or left sitting in fluid. The fluid, especially water, penetrates the interior of the weapon, particularly the weapon locking system. In the case of gas pressure loaders without gas piston, the fluid penetrates the gas pipes of the gas pressure loading system. For example, because of the lacking gas piston, the gas pressure loading system of the M16 described above, or of the colt M4 carbine are filling with water. These weapons have to be completely taken apart and cleaned in order to restore their functional capability and reliability.

If fluid penetrates the interior of a weapon, for example, the locking system, it can prevent a cartridge from being fired. The movable elements required for firing a cartridge, for example, the firing pin, can be decelerated by the fluid to such an extent that, for example, the energy with which the firing pin impacts the cap is insufficient for firing a shot.

The problem of fluids penetrating weapons is known in prior art. For instance, it is discussed in US 4 100 855 A, US 3 300 888 A and US 3 553 876.

The invention is based on the objective of making a weapon locking system or a weapon equipped with such locking system robust against possible malfunction, especially malfunctions resulting from possible immersion in water or any other fluid.

This objective is achieved by the present invention, which provides a weapon locking system having a breechblock carrier and at least one fluid access opening, as well as a lock spring mechanism featuring a lock spring piston, wherein the breechblock carrier and the lock spring piston are designed to interact in such a way that, during the retracting travel of the breechblock carrier, the lock spring piston eliminates fluid from the at least one fluid access opening. The present invention also relates to a weapon having such a locking system. Accordingly, the invention-based weapon locking system features at least one fluid access opening connecting a functional cavity, in particular a functional hollow space, with the surrounding area. As a result, fluid penetrating the functional cavity and affecting that function of the locking system can be easily and quickly discharged to the outside via the fluid access opening(s). Consequently, the functional capability of the movable mechanical elements as well as the functional reliability of the locking system, or a weapon equipped with such locking system, continue to be guaranteed if fluid has penetrated the interior of the locking system or the weapon.

An invention-based locking system can basically be used in any kind of weapon, ranging from handguns to weapons mounted stationary to a gun carriage, such as, automatic, semi-automatic, small caliber and large caliber weapons, for example, assault rifles, machine guns, submachine guns, weapons having repeating firing systems, automatic cannons or grenade launchers, regardless of whether they are gas pressure loaders, recoil-operated weapons, manually operated weapons having repeating firing systems or weapons having other locking or loading systems.

Usually, because of the disadvantages and dangers mentioned, it would be completely absurd to use a weapon emerging from water. An invention-based locking system is directly or at least very shortly after a person handling a weapon emerges from the water (for example, a combat diver or combat swimmer, a member of a landing force or even a special unit) functional as well as functionally reliable, enabling the person to fire a shot if his weapon is equipped with said locking system.

Using at least one fluid access opening allows water or fluid to be specifically channeled in such a way that, after the weapon has been immersed in water, fluid that has penetrated the weapon can quickly be drained and possible fluid residues can be eliminated from the interior of the locking system or the weapon in case of firing and reloading. Several fluid access openings, especially their skilled arrangement and the resulting interaction make the invention-based locking system especially robust against functional interferences due to water penetration.

Basically, the at least one fluid access opening can be designed and arranged in any way as long as it is guaranteed that fluid is discharged from the weapon. The fluid access opening can be designed round, oval, looped, angular, especially rectangular or triangular, or in any other design. It is also possible to insert in the fluid access opening an element, for example a pipe, a case or any other element having an appropriate form and consisting of appropriate materials, for example, metal, plastics or the like. The element can be tightly connected with the fluid access opening; it can be, for example, fused, glued, riveted, jammed or pressed. Alternatively, it can also be detachably connected with the fluid access opening. A fluid access opening can be integrated in a weapon locking system in any possible way, for example, by drilling or milling a hole or making recesses, or by removing or eliminating pieces during the production process, the extrusion process or thereafter.

Preferably, the fluid access opening has a round drill hole into which a pipe section is being inserted.

Such a construction can be produced cost-efficiently and allows for a quick discharge of fluid.

Preferably, the locking system comprises also at least one lockable lock and a lock spring mechanism. Furthermore, it preferably comprises at least two functional cavities, in particular functional hollow spaces. The lock can basically be formed integrally. However, preferably it comprises a breechblock carrier, a breechblock attached to it, whereas, preferably a functional cavity has also been arranged in the breechblock carrier. Preferably, this functional cavity is a firing pin channel which, in most cases, comprises a firing pin, a firing pin spring and a firing pin spring guide.

Preferably, the weapon locking system has several fluid access openings, preferably at least two fluid access openings, which are arranged in a front and a rear functional cavity, respectively, in particular, in a functional hollow space.

The front fluid access opening can extend laterally, angular or radially upwards or downwards or in any other way. Preferably, the front fluid access opening extends as a downward radial drilling in the breechblock carrier, perpendicular to the bore axis of the weapon underneath the firing pin end, and is arranged in such a way that it adjoins the breechblock and is located underneath the firing pin. This arrangement has the advantage that the firing pin can move freely and remains functional if fluid there is in this area. It guarantees that the fluid can be quickly drained, i.e., the release of the firing pin can easily eliminate the fluid from the firing pin channel. The firing pin can be actuated or released independently from the reloading mechanism, thereby guaranteeing that at least one shot is fired from a weapon equipped with such locking system.

Preferably, at least one rear fluid access opening is located directly in the wall of the lock spring guide tube and/or in the shaft and/or in the shoulder support. The rear fluid access openings can extend laterally, angular or radially upwards or downwards or in any other way. It is especially preferred if the weapon comprises in the rear area of the locking system at least two radial and three axial fluid access openings in the wall of the lock spring guide tube and/or in the shaft and/or in the shoulder support. It is especially preferred if the at least two fluid access openings are arranged and designed in such a way that they interact since this considerably increases fluid channeling.

It is especially preferred if in said locking system at least one fluid access opening is located in the breechblock carrier and at least five fluid access openings are located in the lock spring mechanism. As a result, the functional capability of the firing pin and of other movable elements in one of the functional (hollow) spaces, as well as the recoil of the lock, are guaranteed. The lock can be actuated actively via manual reloading or passively via automatic reloading.

Moreover, the fluid access openings are preferably designed and arranged in such a way that fluid can also be discharged into the functional (hollow) spaces. For example, if fluid is eliminated from one fluid access opening, a gas can enter via another fluid access opening in order to exclude a pull on the firing pin or any other blockage of the firing pin or the lock spring piston. This also accelerates a discharge of the fluid.

Furthermore, the locking system comprises preferably a lock spring housing and a functional (hollow) space located in the housing. It is also possible to omit the lock spring housing. However, the housing makes it easier to guide the lock spring. Preferably, said functional (hollow) space includes a lock spring mechanism. Said lock spring mechanism comprises a lock spring piston, a lock spring, a lock spring guide tube and a lock spring piston buffer. Preferably, the fluid access openings are guided through the wall of the lock spring guide tube.

Moreover, the locking system preferably comprises a notch opening to adjust horizontally the shoulder support and a radially positioned fluid access opening. It is especially preferred if two fluid access openings are located in the notch openings.

Furthermore, it is especially preferred if the one fluid access opening is arranged and designed in such a way that, after the locking system has been immersed or left sitting in a fluid, or fluid has penetrated the functional (hollow) space in other ways, it guarantees that the fluid is discharged within the period of 1-3 seconds, permitting an especially quick use of the weapon.

Finally, according to the preceding explanations, it is possible to use such a weapon locking system in weapons such as, gas pressure loaders, recoil-operated weapons or even manual or other repeating systems. However, it is especially preferred in a gas pressure loader. In this regard, the use of a short stroke gas piston system having a short gas piston is especially preferred.

Such a gas pressure loader comprises an operating rod, a piston and a short cylinder. It is especially preferred if the piston is a short gas piston, the cylinder a short gas cylinder and the operating rod a gas discharge rod. Preferably, said gas discharge rod extends from a gas discharge to the breechblock carrier and interacts with the locking system in such a way that it propels the breechblock carrier. Consequently, by means of the lock spring piston, which is propelled by the breechblock carrier, fluid is eliminated from the at least one fluid access opening of the lock spring mechanism. In this system, the gas rod and the breechblock carrier can be interconnected or are not interconnected.

Finally, at least one compression ring adjoining the interior wall of the gas cylinder is preferably arranged at the gas piston. Said gas cylinder removes combustion residue which has accumulated there. In such a gas pressure loader, no propellant gas and respective accumulations of propellant gas are penetrating the interior of the weapon. This reduces the time required for cleaning and increases the reliability of the weapon.

A detailed description of the invention is provided by means of an embodiment and the schematic diagram enclosed. It is shown

Figure 1 a cross section view of a weapon having an invention-based locking system;

Figure 2 an enlarged cross section view of a section of the weapon shown in Figure 1, which shows the locking system;

Figure 3 an enlarged front section of the locking system shown in Figure 2;

Figure 4 an enlarged rear section of the locking system shown in Figure 2; and

Figure 5 a cross section top view from behind on the shoulder support of the weapon shown in Figure 1.

The description involves the embodiment of a weapon locking system in the form of a gas pressure loader arranged in an assault rifle, which, however, should not be viewed as restrictive. As has already been mentioned, the invention generally concerns the weapon locking system mentioned at the beginning, provided said weapon locking system features at least one functional cavity having at least one fluid access opening.

Figure 1 shows the assault rifle. It comprises a housing 2, a barrel 4, a hand guard 5, a magazine shaft 6, a locking system 8, a trigger mechanism 10, a trigger 11 and a shaft 12. At the rear end of the barrel 4, a cartridge storage 14 is located which is locked by a lock 16, 18 which can be moved back and forth inside the housing 2. In the embodiment shown, the lock 16, 18 has two parts and is assembled of a breechblock carrier 16 and a breechblock 18 swiveling relative to the breechblock carrier.

In the rear section of the weapon, a first hollow space is located, subsequently depicted as functional hollow space 48, in which a lock spring mechanism has been arranged. By means of a lock spring 20, said lock spring mechanism loads the breechblock carrier 16 forward. The lock spring 20 runs in a lock spring guide tube 27 inside a lock spring housing 26. In the lock spring guide tube 27, a lock spring piston 22 is located which can be moved back and forth. At the end of said lock spring piston facing the shoulder support 62, a lock spring piston buffer 24 is located. Said lock spring piston buffer buffers a movement of the lock spring piston 22 against the rear bottom at

the end of the lock spring guide tube 27 located opposite of the locking system. Several notch openings 64 used to horizontally adjust the shoulder support 62 are located in the shoulder support 62. In order to retain the shoulder support 62 in the desired horizontal position, a pin 66 is drawn and then locked in a desired notch opening 64.

No further descriptions are provided for all other parts of the weapon, such as the trigger mechanism, etc., since they are adequately known to the expert. For a description of the detailed structure of such a gas pressure loader, reference is made, for example, to DE 196 15 181 by the applicant.

The gas pressure loader depicted comprises a gas cylinder 34 which is closed on its one end by a bottom and which encloses a gas chamber. Said gas chamber is connected with the frontal section of the barrel 4 via a gas channel, the so-called gas discharge 28. Inside the gas cylinder, a gas piston 36 is located which can be moved back and forth. A gas rod 30 is connected and attached to said gas piston. Said gas rod opens in known fashion the lock 16, 18, accelerating it backwards in order to open. At the same time, by means of a radial cam and a control bolt (both not shown), the breechblock 18 is screwed out of its position of being locked with the cartridge storage 14, releasing the locking nipples (not shown) and unlocking the breechblock 18. Because of mass inertia, the breechblock together with the breechblock carrier 16 moves backward against the spring pressure of the lock spring. At the same time, also the gas rod 30 is preloaded against the pressure of a gas rod spring 32 and pushed back into its starting position.

Figure 1 shows the weapon in a condition ready to fire, having the lock 16, 18 opened

and the trigger mechanism 10 retained in a position behind the magazine shaft 6. If a shot is released, the breechblock 18 and breechblock carrier 16 are moving forward, a cartridge is picked up from one of the magazines (not shown) contained in the magazine shaft 6, the cartridge is fed into the cartridge storage 14 and breechblock 18 and breechblock carrier 16 together with the cartridge storage 14 are locked, for example, by means of locking nipples. Inside the breechblock 18, a firing pin 40 having a hammer 46 at its rear end is movably guided along the bore axis of the weapon, inside a second functional hollow space 38, a so-called firing pin channel 38. The firing pin is partially surrounded by a firing pin channel cylinder 44 and is preloaded against the pressure of a firing pin spring 42. In order to release a shot, the firing pin is released via the trigger mechanism 10, if the locking system 8 is completely secured. The trigger mechanism 8 then strikes the hammer 46, for example, with a cock. Then the firing pin 28 strikes the cartridge bottom of a cartridge situated inside the cartridge storage 14 and fires it.

The lock 16, 18 remains secured until the bullet has left the barrel 4 and the gas pressure retained behind the bullet opens the lock 16, 18 via the gas discharge 28 and the gas rod 30. At the same time, the breechblock carrier 16 moves backward away from the barrel 4, the breechblock 18 extracts via a extractor (not shown) the empty bullet casing from the cartridge storage 14 and ejects the bullet from the lock 16, 18 via an ejection mechanism having an ejector (not shown). The further backward moving lock 16, 18 loads the lock spring 20 as well as the trigger mechanism 10. The lock spring piston buffer 24 buffers at the end of the release travel the remaining backward movement energy of the breechblock carrier 18 against the inner surfaces of the shoulder support 62. The trigger

mechanism then catches the lock 16, 18 in the rear position shown in Figure 1. In case of repeated trigger activation or continuous fire, the action described is repeated.

Figure 2 shows an enlarged cross section view of a section of the weapon shown in Figure 1, showing the locking system. It shows both functional hollow spaces 38, 48, the firing pin channel 38 and the lock spring mechanism 48. Several fluid access openings are arranged there. A first fluid access opening 50 connects the front functional hollow space 38 with the outside area. Five further fluid access openings 52, 54, 56, 58 and 60 (see Figure 5) connect the rear functional hollow space 48 with the outer area. Two of these, namely the fluid access openings 52 and 54 run radially from the functional cavity 48 into the notch openings 64. The three remaining fluid access openings 56-60 run axially from the functional cavity 48 backward, connecting the cavity 48 involving the lock spring mechanism by way of the shoulder support 62 to the outside. If the firing pin 40 is activated in order to release a shot, the firing pin is able to move freely, even though there is possibly fluid in the firing pin channel 38, or in the functional cavity 38 involving the firing pin. On the one hand, the fluid can drain passively via one or several fluid access openings, without the person handling the weapon becoming involved or without a specific weapon mechanism. On the other hand, the fluid can be eliminated actively from the locking system through the release of a shot and automatic or manual reloading or repeated loading of the trigger mechanism. To this end, the fluid runs from the frontal fluid access opening 50 into and through the magazine shaft 6, or into or through a magazine located in the magazine shaft, and is discharged downward. The fluid runs radially downward from the five rear fluid access openings 52, 54, 56, 58, 60 into or through the shaft 12 and/or axially backward into or through the shoulder support.

Figure 3 shows an enlarged frontal section of the locking system 8 shown in Figure 2, in which the frontal fluid access opening 50 is shown in detail.

Figure 4 shows an enlarged rear section of the locking system shown in Figure 2, showing especially three of the rear fluid access openings 52 through 60, namely the radial fluid access openings 52 and 54 in the notch openings 64 and the axial fluid access opening 58.

Figure 5 shows a cross section top view from behind on the shoulder support 62 of the weapon shown in Figure 1. This view again clearly shows three of the rear fluid access openings 52 through 60, in this case the three axial fluid access openings 56, 58, 60. Fluid located in the functional cavity 48 involving the lock spring is actively eliminated or passively drained via the backward running lock spring piston 22, as well as via the three axially running fluid access openings 56, 58, 60.

Patent Claims

1. Weapon locking system (8) having a breechblock carrier (16) and at least one fluid access opening (50, 52, 54, 56, 58, 60), as well as a lock spring mechanism featuring a lock spring piston (22), wherein the breechblock carrier (16) and the lock spring piston (22) are designed to interact in such a way that, during the retracting travel of the breechblock carrier (16), the lock spring piston (22) eliminates fluid from the at least one fluid access opening (50, 52, 54, 56, 58, 60).
2. Weapon locking system (8) having at least one functional hollow space (50, 52, 54, 56, 58, 60) and at least one fluid access opening (50, 52, 54, 56, 58, 60) connecting the functional cavity (38, 48) with the surrounding area in such a way that fluid that has possibly penetrated the functional cavity (38, 48) and that has affected the function of the locking system (8) can be easily and quickly discharged to the outside via the fluid access opening(s) (50, 52, 54, 56, 58, 60).
3. Locking system (8) according to Claim 1 or 2 in which at least one fluid access opening (50, 52, 54, 56, 58, 60) is designed and arranged in such a way that through it fluid can be discharged even into the functional cavity (38, 48).
4. Locking system (8) according to any one of Claims 1-3 having at least two fluid access openings (50, 52, 54, 56, 58, 60).
5. Locking system (8) according to any one of Claims 1-4 in which the two fluid access openings (50, 52, 54, 56, 58, 60) interact.
6. Locking system (8) according to any one of Claims 1-5 having at least two functional cavities (38, 48).

7. Locking system (8) according to any one of Claims 1-6 having a breechblock carrier (16), a breechblock (18) arranged inside the breechblock carrier and a functional cavity (38) arranged inside the breechblock carrier (16).
8. Locking system (8) according to Claim 7 in which the functional cavity (38, 48) is a firing pin channel (44).
9. Locking system (8) according to Claim 8 in which the firing pin channel (38) comprises a firing pin (40), a firing pin spring (42) and a firing pin spring guide (44).
10. Locking system (8) according to any one of Claims 7-9 in which the fluid access opening (50, 52, 54, 56, 58, 60) has been designed as radial drilling in the breechblock carrier (16).
11. Locking system (8) according to any one of Claims 7-10 in which the fluid access opening (50, 52, 54, 56, 58, 60) has been arranged in such a way that it adjoins the breechblock (18) and is located beneath the firing pin (40).
12. Locking system (8) according to any one of Claims 1-11 having a lock spring housing (26) and a functional cavity (48) arranged in the lock spring housing.
13. Locking system (8) according to Claim 12 in which a lock spring mechanism is located in the functional cavity (48).
14. Locking system (8) according to Claim 13 in which the lock spring mechanism comprises a lock spring piston (22), a lock spring (20), a lock spring guide tube (27) and a lock spring piston buffer (24).
15. Locking system (8) according to Claim 14 in which a fluid access opening (50, 52, 54, 56, 58, 60) is guided through the wall of the lock spring guide tube (27).

16. Locking system (8) according to any one of Claims 12-15 in which the fluid access opening (50, 52, 54, 56, 58, 60) is located in the shaft (12) and/or in a shoulder support (62).
17. Locking system (8) according to Claim 16 in which the fluid access opening (50, 52, 54, 56, 58, 60) has been arranged axially and/or radially to the bore axis of the locking system (8).
18. Locking system (8) according to Claim 16 or 17 having at least one notch opening (62) for a horizontal adjustment of the shoulder support (62) and a fluid access opening (50, 52, 54, 56, 58, 60) that is radially arranged in said notch opening.
19. Locking system (8) according to any one of Claims 1-18 in which the at least one fluid access opening (50, 52, 54, 56, 58, 60) is arranged and designed in such a way that, after the locking system (8) has been immersed or left sitting in fluid or fluid has penetrated the functional hollow space (38, 48) in other ways, a fluid discharge within 1-3 second is guaranteed.
20. Locking system (8) according to any one of Claims 1-19 having at least one fluid access opening (50, 52, 54, 56, 58, 60) in the breechblock carrier (16) and at least five fluid access openings (50, 52, 54, 56, 58, 60) in the lock spring mechanism.
21. Weapon, especially a gas pressure loader, having a weapon locking system (8) according to any one of Claims 1-20.
22. Weapon according to Claim 21 in which the gas pressure loader comprises an actuation rod (30), a piston (36) and a short cylinder (34) according to any one of Claims 1-21.

23. Weapon according to Claim 21 or 22 in which the piston (36) is a short gas piston (36), the cylinder (34) is a short gas cylinder (34), and the actuation rod (30) is a gas discharge rod (30), which extends from a gas discharge (28) to the breechblock carrier (16) and interacts with the locking system (8) in such a way that it propels the breechblock carrier (16), whereby by means of the lock spring piston (22), which is propelled by the breechblock carrier (16), fluid is eliminated from the at least one fluid access opening of the lock spring mechanism.

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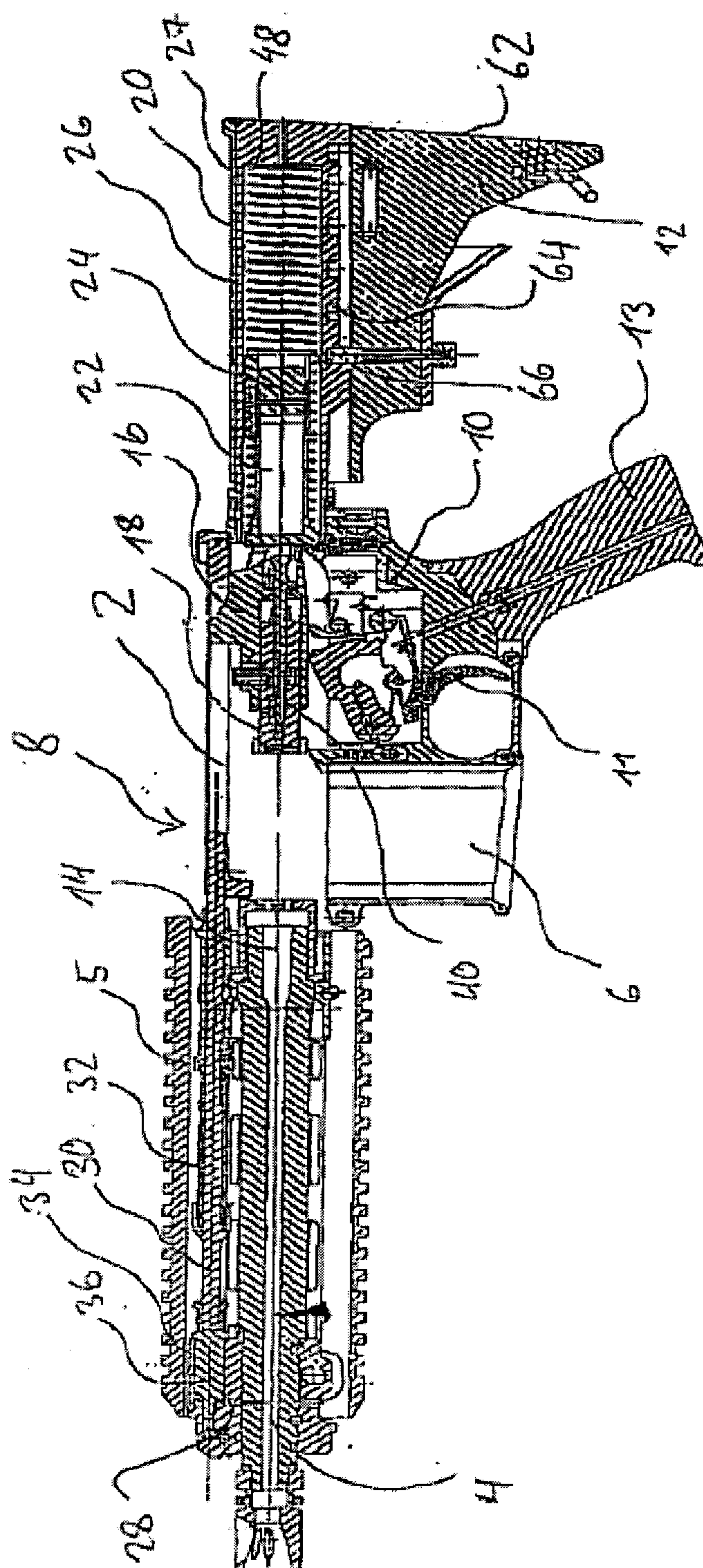
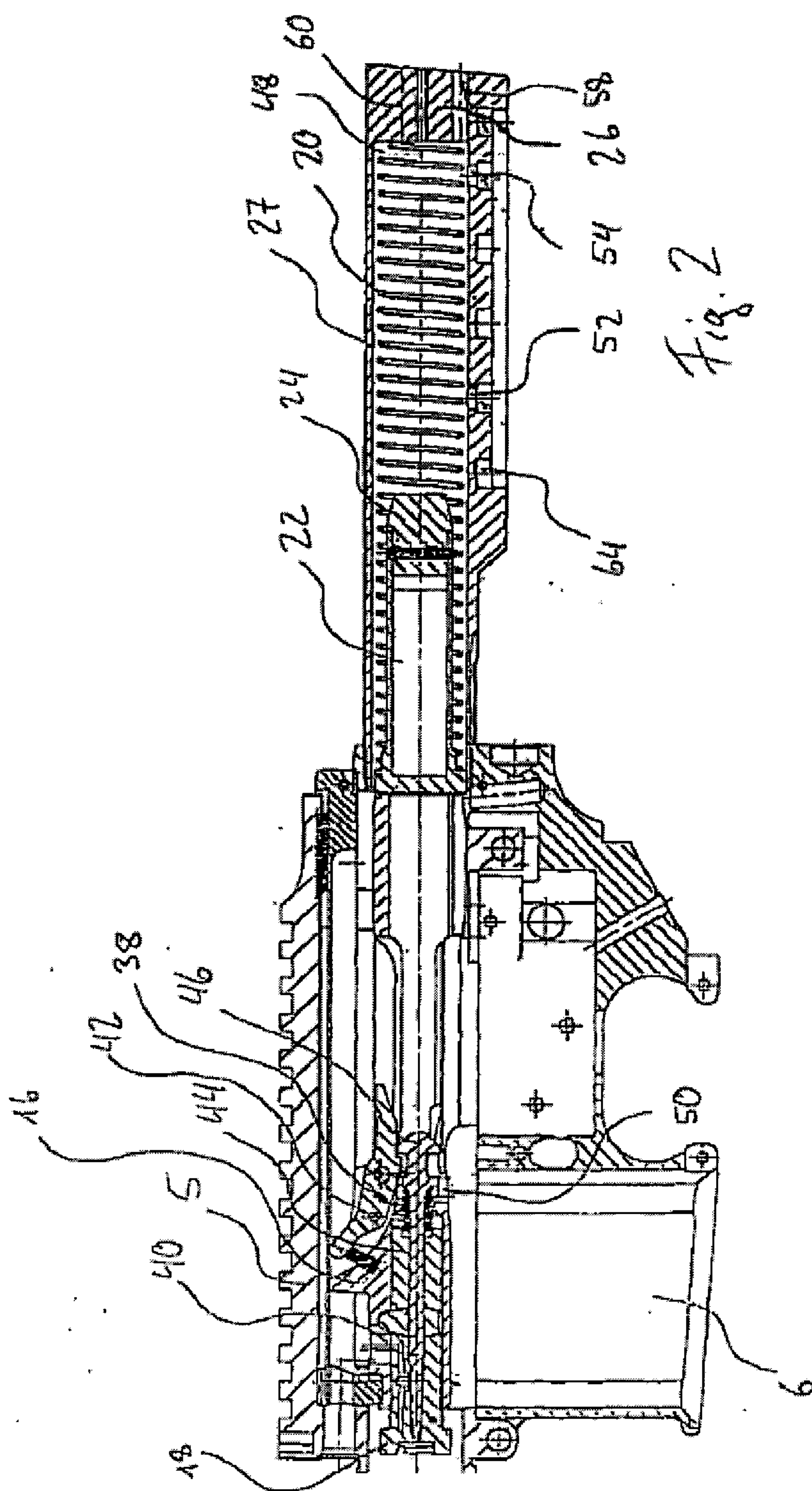
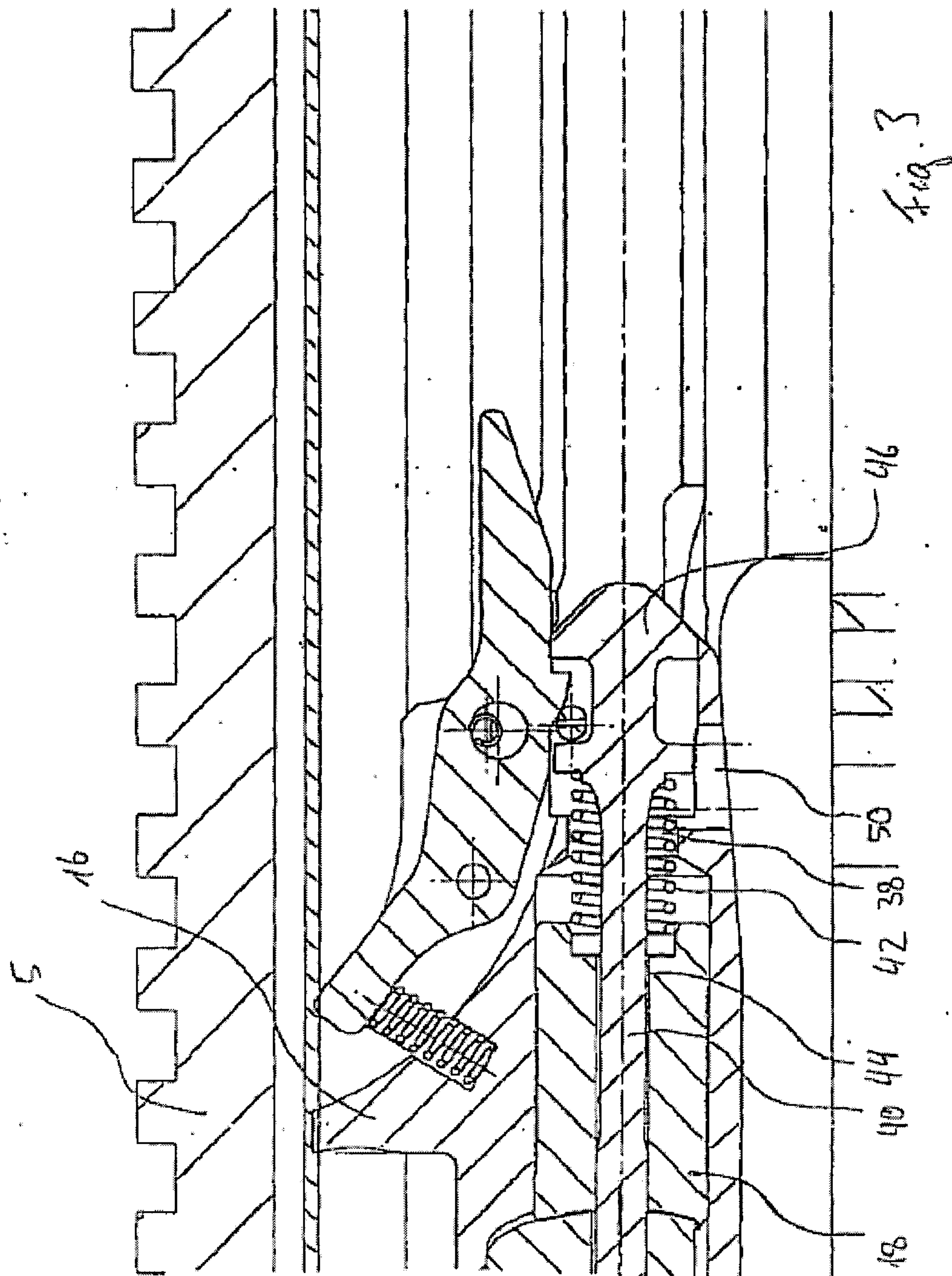


Fig. 1





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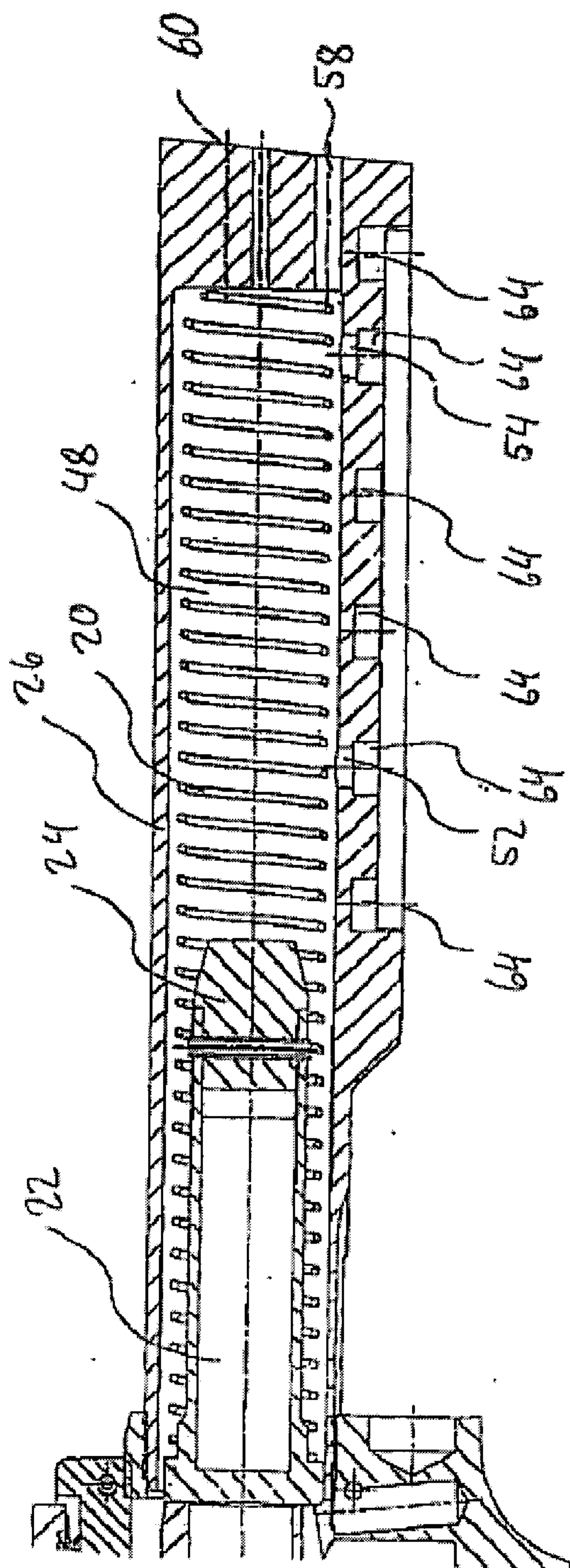


Fig. 4.

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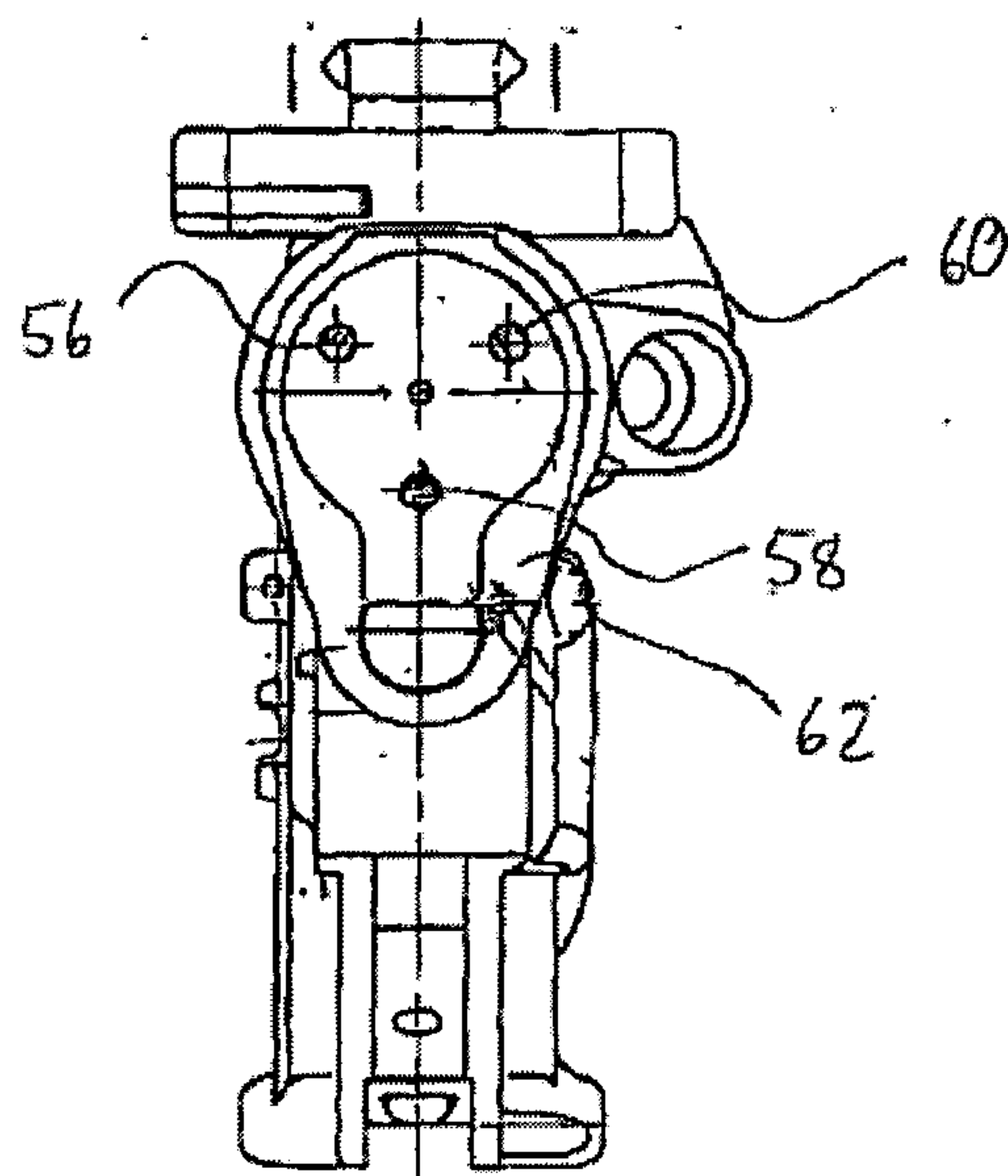


Fig. 5

