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# (54) FUZING SYSTEM FOR A SUBMARINE SIGNAL FLARE

ZÜNDSYSTEM FÜR UBOOTSIGNALFACKEL

SYSTÈME DE MISE À FEU POUR FUSÉE DE SIGNALISATION SOUS-MARINE

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## Description

### TECHNICAL FIELD

**[0001]** The present invention relates to a fuzing system for a signal flare for use on a submarine vessel, said system comprising an ignition system that is operationally connected to a signalling substance in such a way that said signalling substance can be ignited by activating said ignition system. The invention also relates to a signal flare comprising a fuzing system.

### BACKGROUND ART

**[0002]** The level of safety required for equipment used on submarine vessels is generally very high, due to the environment inside the vessel and the risks connected with accidents in such an enclosed space located under water. If an emergency should arise, it is essential to be able to emit a distress signal to enable assistance from the surroundings, and for this purpose, signal flares are generally used.

**[0003]** Such signal flares must be constructed and used following many and very strict safety precautions to on the one hand guarantee that the signal flares when launched will perform as desired and on the other hand to prevent an accidental ignition of the signal flare during handling and transportation, e.g. inside the submarine vessel. For instance, a signal flare should not get affected e.g. in case it is dropped to the ground or subjected to other external forces e.g. during transportation and the like since that would lead to a serious security risk.

**[0004]** There are many known drawbacks among signal flares generally known in the art. One way of activating the ignition system of a flare is to have a break screw that during launch will be broken and thus start the ignition. Such a system can, however, present dangers both when handling and possibly dropping the flare inside the submarine and when a launch has been badly performed so that the flare remains stuck in an ignition tube. In such a case a plundering to bring the flare back onboard is desired, but if there is a risk that the ignition chain of the flare has been activated, such a manoeuvre can possibly result in an ignition inside the submarine, resulting in a possibly life-threatening situation for the crew.

**[0005]** Another problem is to choose a signal flare that is adapted to the water depth where the submarine is currently located, so that the ignition is delayed sufficiently for the flare to reach a desired water depth before the signalling substance is ignited but at the same time occurs before the flare has reached the water surface and possibly been placed in an undesirable position where the signalling substance cannot be activated in a desired way. One solution to this problem is to have a series of signal flares labelled with the depth where they can be used and having an operator select the flare that is suitable in a specific situation. One risk, of course, is that an operator in a stressful situation when an emergency has arisen may select an unsuitable flare, or that the flares best suited to the present depth have all been used so that an unsuitable flare must be used if any distress signal is to be emitted.

**[0006]** In US 5044281 there is described a submarine flare with a hydrostatic valve means arranged to open when the flare is near or at the surface whereupon a flare composition is released into the air. In order to safeguard a correct position of the flare inclination means prevents ignition unless the flare is within a predetermined range of vertical attitude. The system has a time delay means which ensures that ignition is initiated when the flare has cleared the water surface. This system is complicated and very unreliable, which is obviously unacceptable in situations where a proper function is essential for survival.

**[0007]** Another system is disclosed in US 3048111 relating to an arming and firing mechanism for pyrotechnic signals, according to the preamble of claim 1, where arming and firing means are operable in response to the predetermined sequence of hydraulic pressure conditions to which the signal is subjected after being launched. However, the system in US 3048111 is associated with a number of weaknesses which taken together results in that the system essentially lacks fail-safe mechanisms which obviously poses a problem in the strict conditions in a submarine.

**[0008]** The need for a signal flare that meets higher safety requirements while at the same time performing better and more accurately and eliminating the risk of an operator making a mistake in selecting or handling a flare while at the same time allowing for a safe plundering is therefore apparent.

### DISCLOSURE OF THE INVENTION

**[0009]** The object of the present invention is to solve or at least to minimise the problems mentioned above. This is achieved through a fuzing system according to claim 1. Thereby, an activation of the signal flare at a desired water depth can be achieved, regardless of the depth where the signal flare was launched from the submarine vessel.

**[0010]** Thanks to the construction, the need for a crew member to choose from a number of different signal flares for use at different depths can be eliminated, thereby also eliminating the risk of choosing an unsuitable signal flare and thus igniting too early or too late, preventing a signal in the form of light or smoke to be emitted.

**[0011]** Thanks to the use of a safety system with a rotatable tube sensor, a premature activation of the fuzing system before the signal flare has left the submarine vessel can also be prevented, allowing for plundering if a situation should arise where it is desired to abort a launch of the signal flare and return it to the inside of the submarine vessel. Thanks to this system, along with the additional safety systems used with the invention, an accidental activation of the fuzing system due to handling of

the signal flare by a human operator can also be prevented.

**[0012]** The compact construction of the fuzing system with casings or bodies surrounding its components also enables a construction of a signal flare without its commonly used casing that would ordinarily surround the fuzing system as well as the signal components. Thereby, a construction with multiple signals placed tightly together and connected to the same fuzing system and still fitting into regular sizes of launch tubes commonly used on submarine vessels is enabled.

**[0013]** Many other advantages of the present invention can be seen in the appended detailed description below.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0014]** The invention will now be described in more detail with reference to the appended drawings, wherein:

Fig. 1a shows a perspective view of a signal flare comprising a fuzing system according to a preferred embodiment of the present invention,

Fig. 1b shows a perspective view of a partly cut off signal flare comprising a fuzing system according to a preferred embodiment of the present invention,

Fig. 2 shows a perspective view of a fuzing system according to the invention,

Fig. 3a shows a perspective view of the fuzing system of Fig. 2 before launch,

Fig. 3b shows a perspective view of the fuzing system of Fig. 2 during launch,

Fig. 4a shows a perspective view of the fuzing system of Fig. 2 seen from a bottom end before launch,

Fig. 4b shows a perspective view of the fuzing system of Fig. 2 seen from a bottom end after launch,

Fig. 5a-f shows a perspective view of the fuzing system of Fig. 2 seen from a top end,

Fig. 6a shows a perspective view of the fuzing system of Fig. 2 before activation of a hydrostatic device,

Fig. 6b shows a perspective view of the fuzing system of Fig. 2 after activation of a hydrostatic device,

Fig. 6c shows a perspective view of the fuzing system of Fig. 2 at ignition.

## DETAILED DESCRIPTION OF THE INVENTION

**[0015]** In Fig. 1a-b, a flare with a cartridge 1 can be seen, encasing a fuzing system 2, according to a preferred embodiment of the invention, placed at a lower end 14 of the cartridge 1, a central tube 12 and a space 13, where at least one signal flare (not shown) can be contained, located towards an upper end 15. At the upper end 15, a nose plug 16 seals the cartridge 1, and at the lower end 14, an ejection bracket 3 is mounted. In a preferred embodiment said cartridge 1 comprises a standard design with dimensions that fit into standard launching tubes, i.e. no adaptations are required in order to use the signal flare according to the invention. All its inventive features and safety mechanisms are accomplished by means of a signal flare having the dimensions of a standard type cartridge 1.

**[0016]** The design of the cartridge 1 comprising in a lower end 14 a fuzing system 2 and inner spaces 13 elongating at the middle and upper portion of said cartridge 1 will lead to that the location of the centre of mass will contribute to the cartridge keeping a proper position during its trajectory through a body of water, i.e. with its nose portion 16 directed upwards and the lower end 14 directed downwards.

**[0017]** As can be seen in Fig. 2, the fuzing system 2 comprises a first body 21 housing an ignition system 5 and a second body 22, separated from said first body 21 by a plurality of spacers 23. Among these spacers 23, a central piston 4, a piston 7 called a "tube sensor" , a hydrostatic piston 6 and a ball locker 43 are mounted and arranged to interact in a manner that will be described below for launching, activation of safety systems and initiation of ignition, among other things.

**[0018]** Fig. 3a-b, Fig. 5a-b and Fig. 6a-c show the fuzing system 2 with the bodies 21, 22 separated by spacers 23, and with the central piston 4 and the hydrostatic piston 6. A central ignition spring 44 and an inner ignition ring member 45 are arranged around the central piston 4 inside a central casing 12, and a hydrostatic spring 61 is arranged so that it is abutting the hydrostatic piston 6.

**[0019]** A ball locker 43 with balls 49 locks the inner ignition ring member 45 to prevent its movement in relation to the ball locker 43 until the moment of initiation of ignition. Furthermore, a locking ring 62 is arranged to lock inner locking balls 49 (see e.g. Fig. 3a) which are located inside matching holes in the inner ignition ring member 45. In Fig. 4a-b, the flare can be seen from the lower end 14 with the second body 22 and with the rotatable tube sensor 7 extending through the second body 22 and ending in a latch mechanism 71 in the form of a sensor arm that extends along a lower surface of the second body 22. The tube sensor 7 is arranged to be rotatable around its longitudinal axis and is spring biased to rotate in a predetermined direction corresponding to said sensor arm being turned outwardly from said second

body 22 at an angle, as seen in Fig. 4b. Before launch, the sensor arm 71 is held in place by the ejection bracket 3 and as long as the signal flare remains inside the launch tube, the sensor arm 71 remains in the non-operable position shown in Fig. 4a. As soon as the signal flare has left the launch tube and been ejected into the water, the sensor arm 71 is free to rotate to the position shown by Fig. 4b, protruding from the second body 22 at an angle.

**[0020]** Fig. 4a shows the fuzing system before the cartridge 1 is positioned into the launching tube, said tube sensor 7 being in an inoperable position and the latch mechanism 71 is held inwardly by retaining means comprised by the ejection bracket 3, and Fig. 4b shows the fuzing system after launch and after that the cartridge has been ejected out from the launching tube, wherein the tube sensor 7 is in an operable position. In an operable position the tube sensor 7 has armed the signal markers and ignition of the ignition system is enabled. However, in order for the system to be fully armed additional safety mechanisms must also be unlocked, i.e. only turning the tube sensor 7 will not fully arm the fuzing system. This means an unsuccessful launch (e.g. if the cartridge gets stuck inside the launch tube) can be interrupted thus eliminating the risk that the system is accidentally ignited: by turning back the latch mechanism 71 to the non-operable position seen in Fig. 4a ignition is prevented and thanks to the additional safety mechanisms there is no risk that the system will fire off during recovery of the cartridge and turning back of the latch mechanism 71. Also, said tube sensor design where a latch mechanism 71 is arranged to pivot in a horizontal direction (in relation to the length of the cartridge) leads to a flare having dimensions which are compatible with conventional launching tubes, i.e. the presence of the latch mechanism 71 per se does not lead to any need for any specially arranged launching tubes which is advantageous from a users perspective.

**[0021]** As long as the flare is in a non-operable position, for instance during storage or when transported, the latch mechanism 71 is arranged to cooperate with retaining means for keeping the tube sensor member 7 in an inoperable position, as shown in Fig. 4a. This is accomplished in that the latch mechanism 71, when the flare is mounted onto a bracket member 3 (see Fig. 2), will be retained inwardly by means of being located within a matching groove (not shown) in the bracket member 3 whereby said arm 71 is prevented from moving and thus also keeps the tube sensor member 7 in an inoperable position. The bracket member 3 is firmly fastened onto the lower end 14 of the second body 22, for instance by means of thumbscrews 33 safely keeping the bracket 3 in place. This means that as long as the bracket 3 is in place said sensor member 7 is completely shielded by it, and is thus protected from any sudden impacts, e.g. due to rough handling or dropping, and accidental arming/firing of the fuzing system is prevented.

**[0022]** In Fig. 4b is seen a situation where the retaining means (i.e. the bracket 3) has been removed allowing the latch mechanism 71 to flip outwards in the direction of the biasing force acting on the tube sensor 7, meaning that said tube sensor 7 has been rotated into an operable position whereat ignition of the ignition system is enabled, as will later be described in more detail.

**[0023]** Figs. 5a - f, are depicting components located at the uppermost side of the first body 21. It is to be understood that the following description of the function and safety aspects of the system are to be seen as merely illustrative for describing the technical function of the invention, and are thus not to be seen as limited to the exact outline of the appended figures.

**[0024]** As seen in Fig. 5a. a cone shaped portion 40 of the central piston 4 protrudes upwardly from a bore passing through the first body 21. In this position the system is in a non-operable state. A safety unit 9 is arranged in connection to the first body 21 and at least one spring member 94 is arranged between the upper surface of the first body 21 and the underside of the safety unit 9. The safety unit 9 is arranged with a first and a second retaining member 92, 93 arranged to lock the safety unit 9 in an unarmed position when the flare is in non-operable state. Said retaining members 92, 93 are arranged to release the safety unit 9 upon launch of the flare, whereupon said spring member 94 pushes the safety unit 9 upwards into an armed position, as will later be described in more detail.

**[0025]** In a state where said flare is in a non-operable position, right before the cartridge is to be introduced into the launching tube, the flare is prevented from being armed by means of several interconnected safety locking aspects. A first and second safety aspect is that of said safety bracket 3 being locked to the cartridge in two ways: firstly by means of the fastening means (thumbscrews) and secondly via a break screw 31. Said safety bracket 3 safeguards that said tube sensor 7 is kept in an inactive position. A third safety aspect is provided by the central piston 4. As long as said central piston 4 has not moved downwards said safety unit 9 is retained in a non-armed position. Another, fourth safety aspect is that said tube sensor 7 prevents the system from becoming activated as long as it is kept in a non-rotated position. As will later be described in more detail, as long as the tube sensor 7 is in a non-rotated position it locks the hydrostatic piston 6 preventing it from moving in a longitudinal direction. Furthermore, as long as the tube sensor 7 is kept in a non-rotated position the ignition chain at the upper side of the first body 21 is broken due to that the safety unit 9 is prevented from moving to an armed position. The function of the fuzing system 2 will now be described in detail with reference to the Figures.

**[0026]** When a situation arises that causes a desire to emit a distress signal from a submarine vessel, a signal flare is placed into a launch tube for launch into surrounding water. Before placement inside said launch tube, a first safety lock in the form of at least one thumbscrew 33 (see Fig. 1a), that serves to firmly secure the ejection bracket 3 to the second body 22 to prevent an accidental

breaking of a break screw 31, is removed. The ejection bracket 3 is still retained onto the second body 22 by means of said break screw 31 being connected to the central piston 4. The central piston 4 is protruding through the second body 22 via an opening in the second body 22.

**[0027]** Once the signal flare is in place within the launch tube and a first opening from said launch tube into an interior of the submarine vessel is closed, a second opening from said launch tube to a surrounding of the submarine vessel is opened and water fills the launch tube. When water gets into contact with the signal flare, a hydrostatic opening 63 allows the water to penetrate into the hydrostatic chamber 64 located at the lower end of the hydrostatic piston 6 whereupon the piston 6 becomes subjected to the water pressure at the depth where the submarine vessel is currently placed. In this position the water pressure inside the hydrostatic chamber 64 will push against the underside of the piston 6. In this stage the hydrostatic piston 6 is locked (i.e. is fixed into place) by a locking mechanism connected to said tube sensor 7. As long as the tube sensor 7 is in a non-rotated position the hydrostatic piston 6 is locked in position, whereas at the same moment as the tube sensor 7 rotates the hydrostatic piston 6 is free to move in a longitudinal direction. When free to move, said hydrostatic piston 6 will be affected in one end by a prebiased spring 61 and in another end by the water pressure inside the chamber 64, meaning that the position of the hydrostatic piston 6 is determined on one hand by the force exerted by said spring 61 and on the other hand by the water pressure. Preferably, the hydrostatic spring 61 is preloaded (i.e. held in a compressed position) already before launch by means of being somewhat compressed by the hydrostatic piston 6 which in its turn is held in place by said tube sensor 7.

**[0028]** In Fig. 3a there is depicted a fuzing system 2 before launch. Here the flare may or may not have been positioned inside a launch tube. The ejection bracket 3 is connected to the central piston 4 via the break screw 31 and the tube sensor 7 is retained in an inoperable position by means of said latch mechanism 71 being held inwardly within a matching groove of said ejection bracket 3. The central piston 4 is movable in a longitudinal direction, but until launch it is kept in place in a non-operable position by said central spring member 44. The spring member 44 is positioned so that it extends between the ring member 45 and a spring support unit 42 (shown in Fig. 3a). The spring support unit 42 is integrated with said central piston 4 and is movable inside and in relation to the central tube 12. Upon launching of the signal flare the cartridge 1 is subjected to a sudden, upwardly directed ejection force. As is commonly known, said ejection bracket 3 has a diameter larger than the launching tube and will therefore not be able to follow the flare as it is launched via the launching tube. Since the central piston 4 is attached to the break screw 31 and is movable in its longitudinal direction, the central piston 4 will initially be retained by the break screw 31 and will thus get pushed in a downward direction in relation to the other components of the flare. The downward movement of the central piston 4 leads to that the ignition spring 44 is compressed between the spring support unit 42 of the movable central piston 4 and the fixed, inner ignition ring member 45, as also seen in Fig. 3b. This means the ignition spring 44 is activated only upon launching the flare: up until the firing moment the ignition spring is inactive and cannot initiate firing which is an advantage from a safety aspect since careless handling of the cartridge when carrying or transporting it may not lead to accidental ignition since no ignition is possible due to the inactive ignition spring 44.

**[0029]** Moreover, the central piston 4 is arranged to get locked once it reaches a lowermost position (as in Fig. 3b) by means of a locking member 47 located at the lower end of the central piston 4, locking the central piston 4 in relation to the lower surface of the second body 22. Preferably, once the central piston 4 has been moved enough downwards through the central opening in the second body 22 the locking member 47 is mechanically activated so that the central piston 4 is locked in a position where said ignition spring 44 has been compressed. The locking member 47 preferably comprises a spring biased latch member 47 which may be manually unlocked, meaning that in case a plundering to bring the launched flare back onboard is desired, the latch member 47 may be easily unlocked releasing the central piston 4 which may thus move upwards to its initial position, whereby also the ignition spring 44 is decompressed and ignition disabled. An accidental ignition inside the submarine may hereby be avoided.

**[0030]** Said central piston 4 is provided with an annular flange 46 which has a diameter larger than the diameter of the central opening in the second body 22. At launch, the central piston 4 will be drawn in a relative downward direction until the flange 46 is stopped by the surface around the central opening in the second body 22. At this point the break screw 31 is arranged to break so that the flare is released from the ejection bracket 3 and is allowed to continue through the launching tube. The break screw 31 and central piston 4 thus form a second safety lock. The downward movement of the central piston 4 leads to opening of a third safety lock at the upper side of the first body 21, as will be described in more detail in connection to Fig. 5a - b.

**[0031]** Disconnection of the ejection bracket 3 from the central piston 4 will lead to that the latch mechanism 71 is released from the retaining groove. However, the latch mechanism 71 will still be held in an inward position by the side walls of the launch tube as long as the cartridge 1 is located within the launch tube inhibiting activation of the system 2. Also, the ball locker 43 keeps the inner ignition ring member 45 fixed in relation to the central piston 4.

**[0032]** When the flare has been released from the launching tube and ejected into the water the latch 71 is free to move outwards in the direction of the biasing force as a consequence of a biasing spring forcing the tube

sensor piston 7 to rotate into an operable position. Thanks to this rotation, a fourth safety lock has been removed, as will be described below in connection to Fig. 5c - d. Since the position of the sensor arm 71 shown by Fig. 4b would be easily detectable when manually handling a signal flare, the unlikely event that both the first and second safety locks have been removed without anyone noticing it, i.e. that the thumbscrews have been removed and the break screw 31 broken, would easily be discovered. Thus, a situation where the tube sensor 7 would be able to rotate to unlock the fourth safety lock would be instantly noticed simply by looking at the signal flare, and anyone discovering such a situation could thereby easily prevent a possible accident inside the submarine vessel where the flare could be ignited prematurely by simply keeping the tube sensor 7 from rotating or, in case it has already rotated, move it back to a non-operable position.

**[0033]** The unlocking of the third and fourth safety locks caused by movement of the central piston 4 and rotation of the tube sensor 7 respectively will now be described, with reference to Fig. 5a - f.

**[0034]** In Fig. 5a - b there is seen the upper side of a first body 21 of a preferred embodiment according to the invention. The upper cone shaped end 40 of the central piston 4 is positioned so that it protrudes up from a bore through the first body 21. Fig. 5a shows a flare before launch, where said safety unit 9 is locked in an unarmed position. For comparison, Fig. 5f shows a flare after launch, where said safety unit 9 has been unlocked and has moved to an armed position where ignition of the ignition system 5 is enabled.

**[0035]** When the safety unit 9 is in an unarmed position the ignition chain 5 is broken, *i.e.* even if the ignition thread 8 would light the fuse 5 (as will be explained later) the lightening would be interrupted in case the safety unit 9 is in an unarmed position, and thereby there is no risk that the explosives of the flare composition would fire off e.g. in case of an external fire outbreak. This is achieved in that part of the blasting safety fuse of the ignition system 5 is arranged within the safety unit 9. Thus by separating the safety unit 9 from the rest of the ignition system until the moment when projection of the flare composition is to be enabled a safer fuzing system 2 is attained. When the safety unit 9 is brought into an armed position as seen in Fig. 5f, the previously separated ignition system units 5, 5' are connected via said safety unit 9, and via the fuse contained therein, so that the ignition chain 5 is closed and firing of the signal flare is enabled.

**[0036]** The function of the safety unit 9 is now to be described referring to Figs. 5a - f.

**[0037]** Before launch the central piston 4 protrudes up from the first body 21 to such an extent that its thickest base is exposed above the opening from which it protrudes. Abutting the base of the conical portion 40 there is a first retention pin 92 which in one end rests against the surface of said central piston 4, and in the other end is arranged to partly be introduced into a drill hole in the safety unit 9. As long as the central piston 4 is kept in a fully upward position, by means of the central spring 44, the retention pin 92 will lock said safety unit 9, keeping it in an unarmed position, as shown in Fig. 5a. However, when the central piston 4 is pushed downwards as a consequence of launching operation a major portion of the conical end 40 will move downwards into the bore hole, which is shown in Fig. 5b. This will lead to that the retention pin 92 is free to move out of the drill hole in the safety unit 9, for instance by means of a spring member pushing it out from the drill hole, and the third safety lock is hereby unlocked.

**[0038]** The safety unit 9 is also kept in an unarmed position by means of a second retention pin 93, representing a fourth safety lock, illustrated in Fig. 5c - d. The fourth safety lock is released by means of rotation of the tube sensor piston 7. In Fig. 5c there is seen a situation where the tube sensor 7 end portion is protruding upwardly from the surface of the first body 21. Said second retaining pin 93 abuts the tube sensor 7 in one end and is introduced into a drill hole in the safety unit 9 in its other end. In Fig. 5d there is seen a situation where rotation of the tube sensor 7 has occurred leading to that an opening 72 is exposed and becomes aligned with the retention pin 93 allowing it to move out from the drill hole in the safety unit 9 into the opening 72, for instance by means of a spring member pushing it out from the drill hole, thereby releasing the safety unit 9. The fourth safety lock is hereby unlocked.

**[0039]** Thus, thanks to the fuzing system of the invention, moving of the safety unit 9 to an armed position requires the release of both retention pins 92, 93, i.e. both turning of the tube sensor 7 and a downward movement of the central piston 4. As an example, the outline of said third safety lock means that if the ignition chain is ignited without the central piston 4 having moved enough downwards, the top portion 40 of the central piston 4 will stop the first retaining pin 92 from moving out from the drilled hole in the safety unit 9 and keeping the safety unit 9 in a position where it will interrupt the ignition chain. In a similar manner, the outline of said fourth safety lock will lead to that if the ignition chain is ignited without that the tube sensor 7 having rotated, the second retaining means 93 will not be able to release the safety unit 9 and the ignition chain will be interrupted.

**[0040]** Fig. 5e shows a situation where the safety unit 9 is kept in a lower, unarmed position by means of said first 92 and second 93 retaining members. When both the third and the fourth safety locks have been unlocked (i.e. the first and the second retaining pins 92, 93 have been pushed out of their corresponding drilled holes in the safety unit 9) the safety unit 9 is pushed upwards by said spring member 94 to an armed position as shown in Fig. 5f wherein the ignition chain is closed. This leads to that ignition of the smoke signal is now possible.

**[0041]** Rotation of the tube sensor piston 7 also leads to that the hydrostatic sensor 6 is released so that it becomes movable in its longitudinal direction. According to

one embodiment of the invention the hydrostatic piston 6 may be unlocked by means of a hydrostatic retaining pin (not shown) in a manner similar to that of locking/unlocking the safety unit 9. For instance a safety pin may be arranged which partly is introduced into a drilled hole in the hydrostatic piston 6, and which in the other end is locked against the surface of the tube sensor piston 7. Rotation of the tube sensor 7 (i.e. unlocking of the fourth safety lock) may lead to exposure of an opening in the tube sensor 7 allowing the hydrostatic retaining pin to exit the drilled hole in the hydrostatic piston 6 thereby releasing it.

**[0042]** As seen in Fig. 6a - c the hydrostatic piston 6 is arranged in one end with a hydrostatic spring device 61 exerting a predetermined force onto the piston 6, and in its other end being subjected to surrounding pressure which, in case the signal flare has been launched from a submarine into the water, corresponds to the surrounding water pressure acting on the hydrostatic piston via a hydrostatic opening 63 allowing the water to penetrate into a hydrostatic chamber 64 located at the lower end of the movable piston 6. The piston 6 seals against the walls of the chamber 64 with sealing means, such as O-rings, sealing the interior of the fuzing system 2 from ingress of water. At a predetermined pressure, preferably between 2-4 bar, more preferably between 2.5 - 3.5 bar, even more preferred at around 3 bar, the force from the hydrostatic spring 61 will overcome the pressure from surrounding water enough for pushing the piston 6 downwards into the chamber 64 to an activating position whereat it is arranged to cause initiation of ignition of the ignition system. This is accomplished as follows. When reaching a predetermined activating position below the water surface the hydrostatic piston 6 has been pushed downwards into the chamber 64 by means of the spring 61. The piston 6 is connected via a projecting arm 65 to a locking ring 62 which is positioned around the circumference of the central tube 12 which surrounds the central piston 4. The outer locking ring 62 is fixated onto the hydrostatic piston 6 but is movably positioned around the central tube 12 meaning the outer locking ring 62 will move together with the hydrostatic piston 6 as the signal flare ascends through the water and water pressure changes. The locking ring 62 is arranged to lock inner locking balls 49 (see e.g. Fig. 3a and Fig. 6a) which are located inside matching holes in the inner ignition ring member 45 and the central tube wall 12. Hereby the ignition ring member 45 around the central piston 4 is fixedly locked against the central tube 12. The ring member 45 further contributes to compressing the central spring 44 which is compressed between said ring member 45 and said spring support unit 42. At said predetermined water pressure the hydrostatic piston 6 has moved to a position whereat the outer locking ring 62 has moved below the holes containing the locking balls 49 thereby allowing opening of the ball locker 43 so that the balls 49 can fall out from the ignition ring member 45 and the central tube 12, shown in Fig. 6b. This hydrostatic activation liberates the ignition ring member 45, as is shown in Fig. 6c, and allows the central spring 44 to instantly push said ignition ring member 45 downwards. The ignition ring member 45 in its turn is connected to an ignition thread 8, and the downward motion leads to a sudden pull of said thread 8 which generates a friction so that an ignition in the ignition chain 5 is created. The ignition will eventually ignite a signal substance contained in the signal flare and allow for a signal in the form of light, smoke or the like, to be emitted.

**[0043]** Alternatively, the signal flare can be launched from the submarine vessel without the use of a launch tube, but simply by placing the signal flare in an area that can be opened into the surrounding water and allowing the signal flare to float up through the water towards a surface due to being arranged with a positive buoyancy. This type of launch would require manual activation of the system. Thereby, a distress signal can be emitted even if damages have occurred onboard the submarine vessel that affects operation of the launch tube, thus allowing for a distress signal to be sent even in these cases.

**[0044]** Thanks to the construction of the fuzing system 2 with sealed components surrounded by first and second bodies 21, 22, a signal flare can be made without a casing thus allowing for more signal units to be mounted together without using more space than a conventional flare with a casing would and thus giving a larger and more visible signal. Alternatively, a signal flare of a lower weight can be constructed, or with flotation elements, for instance in the form of a polyurethane foam, for achieving a faster rise through the water.

**[0045]** A fuzing system 2 according to the invention may be launched from any water depth, and even from the surface. Firing from the surface would lead to that the hydrostatic piston 6 will be activated immediately upon launch since the hydrostatic spring 61 does not need to overcome any surrounding water pressure, and thus ignition of the flare will be affected without delay.

**[0046]** The invention is not to be seen as limited by the embodiments described above, but can be varied within the scope of the appended claims, as will be readily understood by the person skilled in the art. For instance, the hydrostatic piston 6 may be replaced by any movable member 6 suitable for generating a movement as a result of change of surrounding pressure.

## Claims

1. A fuzing system (2) for a signal flare for use on a submarine vessel, said system comprising an ignition system that is operationally connected to a signalling substance in such a way that said signalling substance can be ignited by activating said ignition system, wherein a hydrostatic device is arranged to activate said ignition system at a predetermined surrounding pressure, and wherein said system comprises a movable central piston member (4) associ-

ated with the hydrostatic device, whereby said hydrostatic device comprises a movable member (6) which in one end is arranged with a hydrostatic spring device (61) exerting a predetermined force onto the movable member (6), and which movable member (6) in its other end is subjected to a pressure which equals the pressure surrounding said fuzing system (2),
**characterized in that** said spring device (61) is preloaded so that it upon launch of the fusing system (2) from a submarine immediately exerts a pushing force against the movable member (6) in a direction towards an activating position, wherein further the piston member (4) upon launch is arranged to be pushed downwards with respect to the launching direction, simultaneously compressing an ignition spring member (44) and locking the ignition spring member (44) in a compressed position until a point where said predetermined surrounding pressure leads to that the movable member (6) reaches an activating position, in which position said movable member (6) is arranged to cause release of the ignition spring member (44) thereby causing ignition of the ignition system.

**2.** A fuzing system according to claim 1, wherein said fuzing system (2) is arranged within an elongated cartridge (1), preferably at a lower end (14) of said cartridge (1).

**3.** A fuzing system according to claim 1, wherein the movable member (6), upon being pushed to an activating position by said spring device (61), is arranged to cause initiation of ignition of the ignition system.

**4.** A fuzing system according to claim 3, wherein said movable member (6) is a piston (6) which is movable in its longitudinal direction.

**5.** A fuzing system according to anyone of claims 2 - 4, comprising a locking arrangement inhibiting operation of the system (2) until the cartridge (1) is released from a firing tube within a submarine from which said cartridge (1) is to be launched.

**6.** A fuzing system according to claim 5, wherein said locking arrangement comprises a rotatable tube sensor member (7) associated with said movable member (6), which tube sensor member (7) may be rotatably positioned into an inoperable position in which the movable member (6) is prevented from moving and ignition of said ignition system disabled, and rotatably positioned into an operable position in which the movable member (6) is activated and movable and ignition of said ignition system is enabled.

**7.** A fuzing system according to claim 6, wherein said tube sensor member (7) comprises a latch mechanism (71) arranged to cooperate with retaining means for keeping the tube sensor member (7) in an inoperable position when said signal flare is in a non-operable/resting position.

**8.** A fuzing system according to claim 7, wherein said latch mechanism (71) is arranged to release said tube sensor member (7) when said cartridge (1) is launched from the submarine launching tube, whereupon said tube sensor member (7) is arranged to rotate from an inoperable position to an operable position enabling ignition of said ignition system.

**9.** A fuzing system according to anyone of claims 7 or 8, wherein said retaining means comprises a bracket member (3) arranged to be attached onto the cartridge (1) when the signal flare is in a non-operable position, and is arranged to be released from the cartridge (1) upon launching of the signal flare through the firing tube, which bracket member (3) further comprises a groove into which said latch member (71) can be located into a position where it keeps said tube sensor member (7) in an inoperable position.

**10.** A fuzing system according to anyone of claims 1 - 9, wherein said system (2) is water sealed.

**11.** A signal flare comprising a fuzing system according to any of the previous claims.

**Patentansprüche**

**1.** Zündvorrichtungssystem (2) für eine Signalfackel zur Verwendung auf einem Unterwasserfahrzeug, wobei das System ein Zündsystem umfasst, das mit einer Signalsubstanz auf eine Weise betriebsbereit verbunden ist, dass die Signalsubstanz durch Aktivieren des Zündsystems gezündet werden kann, wobei ein hydrostatisches Gerät eingerichtet ist, das Zündsystem bei einem vorbestimmten Umgebungsdruck zu aktivieren, und wobei das System ein bewegbares zentrales Kolbenelement (4) umfasst, das dem hydrostatischen Gerät zugeordnet ist, wobei das hydrostatische Gerät ein bewegbares Element (6) umfasst, welches in einem Ende mit einem hydrostatischen Federgerät (61) eingerichtet ist, das eine vorbestimmte Kraft auf das bewegbare Element (6) ausübt, und wobei das bewegbare Element (6) an seinem anderen Ende einem Druck ausgesetzt ist, welcher gleich dem Druck ist, der das Zündvorrichtungssystem (2) umgibt,
**dadurch gekennzeichnet, dass** das Federgerät (61) vorbelastet ist, so dass es nach Start des Zündvorrichtungssystems (2) von einem Unterseeboot sofort eine Drückkraft gegen das bewegbare Ele-

ment (6) in eine Richtung auf eine Aktivierungsposition zu ausübt, wobei weiterhin das Kolbenelement (4) nach Start eingerichtet ist, abwärts bezüglich der Startrichtung gedrückt zu werden, gleichzeitig ein Zündfederelement (44) zusammenzupressen und das Zündfederelement (44) in einer zusammengepressten Position zu sperren, bis zu einem Punkt, an dem der vorbestimmte Umgebungsdruck dazu führt, dass das bewegbare Element (6) eine Aktivierungsposition erreicht, wobei in dieser Position das bewegbare Element (6) eingerichtet ist, eine Freigabe des Zündfederelements (44) zu bewirken und dadurch eine Zündung des Zündsystems zu bewirken.

**2.** Zündvorrichtungssystem gemäß Anspruch 1,wobei das Zündvorrichtungssystem (2) innerhalb einer längsgestreckten Hülse (1) eingerichtet ist, vorzugsweise an einem niedrigeren Ende (14) der Hülse (1).

**3.** Zündvorrichtungssystem gemäß Anspruch 1, wobei das bewegbare Element (6), nachdem es durch das Federgerät (61) in eine Aktivierungsposition gedrückt wird, eingerichtet ist, eine Auslösung der Zündung des Zündsystems zu bewirken.

**4.** Zündvorrichtungssystem gemäß Anspruch 3, wobei das bewegbare Element (6) ein Kolben (6) ist, welcher in seiner Längsrichtung bewegbar ist.

**5.** Zündvorrichtungssystem gemäß einem der Ansprüche 2 - 4, umfassend eine Sperranordnung, die einen Betrieb des Systems (2) verhindert bis die Hülse (1) aus einem Abschussrohr innerhalb eines Unterseeboots, von welchem die Hülse (1) gestartet werden soll, freigegeben wird.

**6.** Zündvorrichtungssystem gemäß Anspruch 5, wobei die Sperranordnung ein drehbares Rohrsensorelement (7) umfasst, das dem bewegbaren Element (6) zugeordnet ist, wobei das Rohrsensorelement (7) drehbar in einer nicht betriebsbereiten Position positioniert werden kann, in welcher das bewegbare Element (6) an einer Bewegung gehindert wird und eine Zündung des Zündsystems unterbunden ist, und drehbar in einer betriebsbereiten Position positioniert werden kann, in welcher das bewegbare Element (6) aktiviert und bewegbar ist und eine Zündung des Zündsystems ermöglicht ist.

**7.** Zündvorrichtungssystem gemäß Anspruch 6, wobei das Rohrsensorelement (7) einen Riegelmechanismus (71) umfasst, der eingerichtet ist, mit einem Rückhaltemittel zusammenzuwirken, um das Rohrsensorelement (7) in einer nicht betriebsbereiten Position zu halten, wenn sich die Signalfackel in einer nicht-betriebsfähigen/RuhePosition befindet.

**8.** Zündvorrichtungssystem gemäß Anspruch 7, wobei der Riegelmechanismus (71) eingerichtet ist, das Rohrsensorelement (7) freizugeben, wenn die Hülse (1) von dem Unterseeboot-Startrohr gestartet wird, woraufhin das Rohrsensorelement (7) eingerichtet ist, sich von einer nicht betriebsbereiten Position in eine betriebsbereite Position zu drehen, um die Zündung des Zündsystems zu ermöglichen.

**9.** Zündvorrichtungssystem gemäß einem der Ansprüche 7 oder 8, wobei das Rückhaltemittel ein Trägerelement (3) umfasst, das eingerichtet ist, an der Hülse (1) angebracht zu werden, wenn sich die Signalfackel in einer nicht-betriebsfähigen Position befindet, und eingerichtet ist, nach Starten der Signalfackel durch das Abschussrohr von der Hülse (1) freigegeben zu werden, wobei das Trägerelement (3) weiterhin eine Rille umfasst, in welcher sich das Riegelelement (71) in einer Position, in der es das Rohrsensorelement (7) in einer nichtbetriebsbereiten Position hält, befinden kann.

**10.** Zündvorrichtungssystem gemäß einem der Ansprüche 1 - 9, wobei das System (2) wasserdicht ist.

**11.** Signalfackel umfassend ein Zündvorrichtungssystem gemäß einem der vorstehenden Ansprüche.

**Revendications**

**1.** Un système de mise à feu (2) pour une fusée de signalisation destinée à être utilisée sur un navire sous-marin, ledit système comprenant un système de mise à feu qui est relié de manière opérationnelle à une substance de signalisation de telle sorte que ladite substance de signalisation peut être mise à feu en activant ledit système de mise à feu, dans lequel un dispositif hydrostatique est agencé de façon à activer ledit système de mise à feu à une pression environnante prédéterminée, et dans lequel ledit système comprend un organe mobile (4) formant piston central associé au dispositif hydrostatique, ledit dispositif hydrostatique comprenant un organe mobile (6) qui, à une extrémité, est agencé avec un dispositif à ressort hydrostatique (61) exerçant une force prédéterminée sur l'organe mobile (6), lequel organe mobile (6) à son autre extrémité est soumis à une pression égale à la pression environnant ledit système de mise à feu (2), **caractérisé en ce que** ledit dispositif à ressort (61) est pré-chargé de telle sorte que, lors du lancement du système de mise à feu (2) à partir d'un sous-marin, il exerce immédiatement une force de poussée contre l'organe mobile (6) dans une direction allant vers une position d'activation, l'organe formant piston (4), en outre, lors du lancement, étant agencé pour être poussé vers le bas par rapport à la direction de lancement, comprimant simultanément un élément à ressort (44) de

mise à feu et verrouillant l'élément à ressort (44) de mise à feu dans une position comprimée jusqu'à un point au niveau duquel ladite pression environnante prédéterminée aboutit à ce que l'organe mobile (6) atteigne une position d'activation, position dans laquelle ledit organe mobile (6) est agencé pour provoquer la libération de l'élément à ressort (44) de mise à feu, provoquant de ce fait la mise à feu du système de mise à feu.

**2.** Un système de mise à feu selon la revendication 1, dans lequel ledit système de mise à feu (2) est agencé dans une cartouche allongée (1), de préférence à une extrémité inférieure (14) de ladite cartouche (1).

**3.** Un système de mise à feu selon la revendication 1, dans lequel l'organe mobile (6), lorsqu'il est poussé jusqu'à une position d'activation par ledit dispositif à ressort (61), est agencé pour provoquer le début de la mise à feur du système de mise à feu.

**4.** Un système de mise à feu selon la revendication 3, dans lequel ledit organe mobile (6) est un piston (6) mobile dans sa direction longitudinale.

**5.** Un système de mise à feu selon l'une quelconque des revendications 2 à 4, comprenant un dispositif de verrouillage empêchant le fonctionnement du système (2) jusqu'à ce que la cartouche (1) soit libérée d'un tube de tir présent dans un sous-marin, à partir duquel ladite cartouche (1) est destinée à être lancée.

**6.** Un système de mise à feu selon la revendication 5, dans lequel ledit agencement de verrouillage comprend un organe rotatif (7) de détection de tube associé audit organe mobile (6), lequel organe de détection (7) de tube est apte à être positionné par rotation dans une position de non utilisation dans laquelle l'organe mobile (6) est empêché de se déplacer et la mise à feu dudit système de mise à feu est désactivée, et étant apte à être positionné par rotation dans une position d'utilisation dans laquelle l'organe mobile (6) est activé et mobile et la mise à feu dudit système de mise à feu est activée.

**7.** Un système de mise à feu selon la revendication 6, dans lequel ledit élément de détection (7) de tube comprend un mécanisme de verrouillage (71) agencé pour coopérer avec des moyens de retenue de façon à maintenir l'organe de détection (7) de tube dans une position de non utilisation lorsque ladite fusée de signalisation est dans une position de non utilisation / de repos.

**8.** Un système de mise à feu selon la revendication 7, dans lequel ledit mécanisme de verrouillage (71) est agencé pour libérer ledit organe de détection (7) de tube lorsque ladite cartouche (1) est lancée depuis le tube de lancement d'un sous-marin, après quoi ledit organe de détection (7) de tube est agencé pour tourner depuis une position de non utilisation vers une position d'utilisation permettant la mise à feu dudit système de mise à feu.

**9.** Un système de mise à feu selon l'une quelconque des revendications 7 ou 8, dans lequel ledit moyen de retenue comprend un élément de support (3) agencé pour être fixé sur la cartouche (1) lorsque la fusée de signalisation est dans une position de non utilisation, et est agencé pour être libéré de la cartouche (1) lors du lancement de la fusée de signalisation à travers le tube de lancement, lequel élément de support (3) comprend en outre une rainure dans laquelle ledit élément de verrouillage (71) est apte à être situé dans une position dans laquelle il maintient ledit organe de détection (7) de tube dans une position de non utilisation.

**10.** Un système de mise à feu selon l'une quelconque des revendications 1 à 9, dans lequel ledit système (2) est étanche à l'eau.

**11.** Une fusée de signalisation comprenant un système de mise à feu selon l'une quelconque des revendications précédentes.

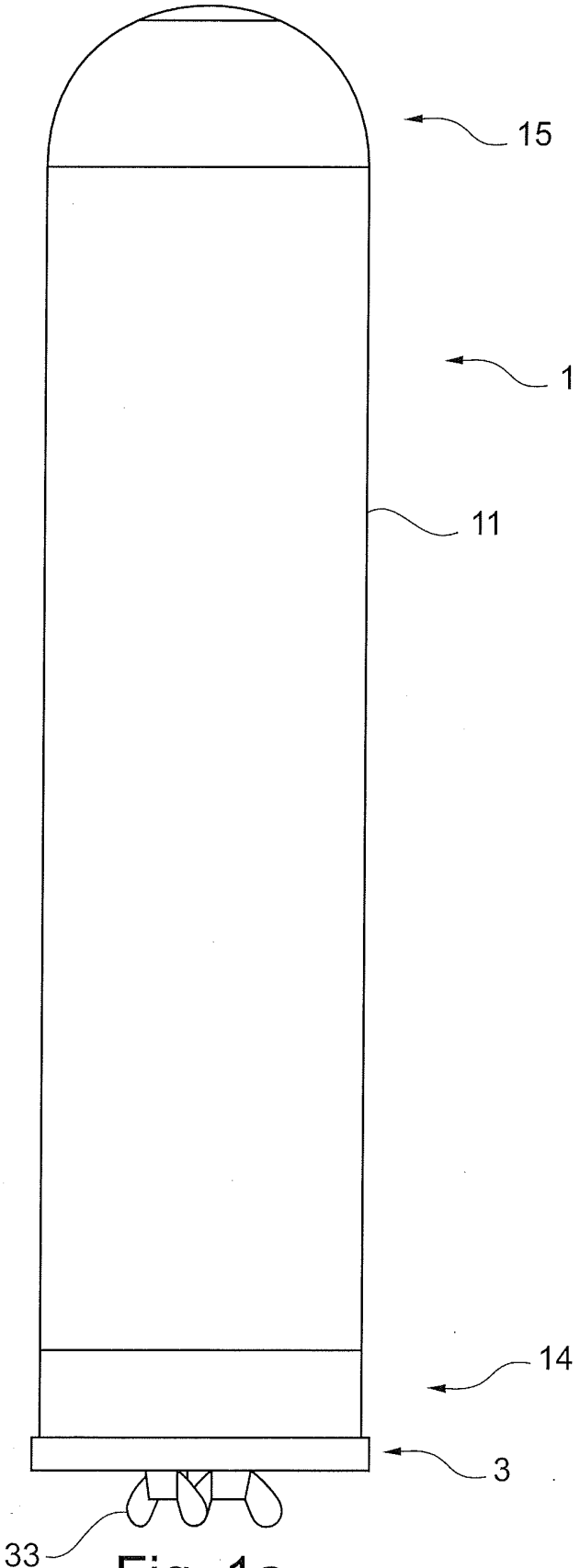


Fig. 1a

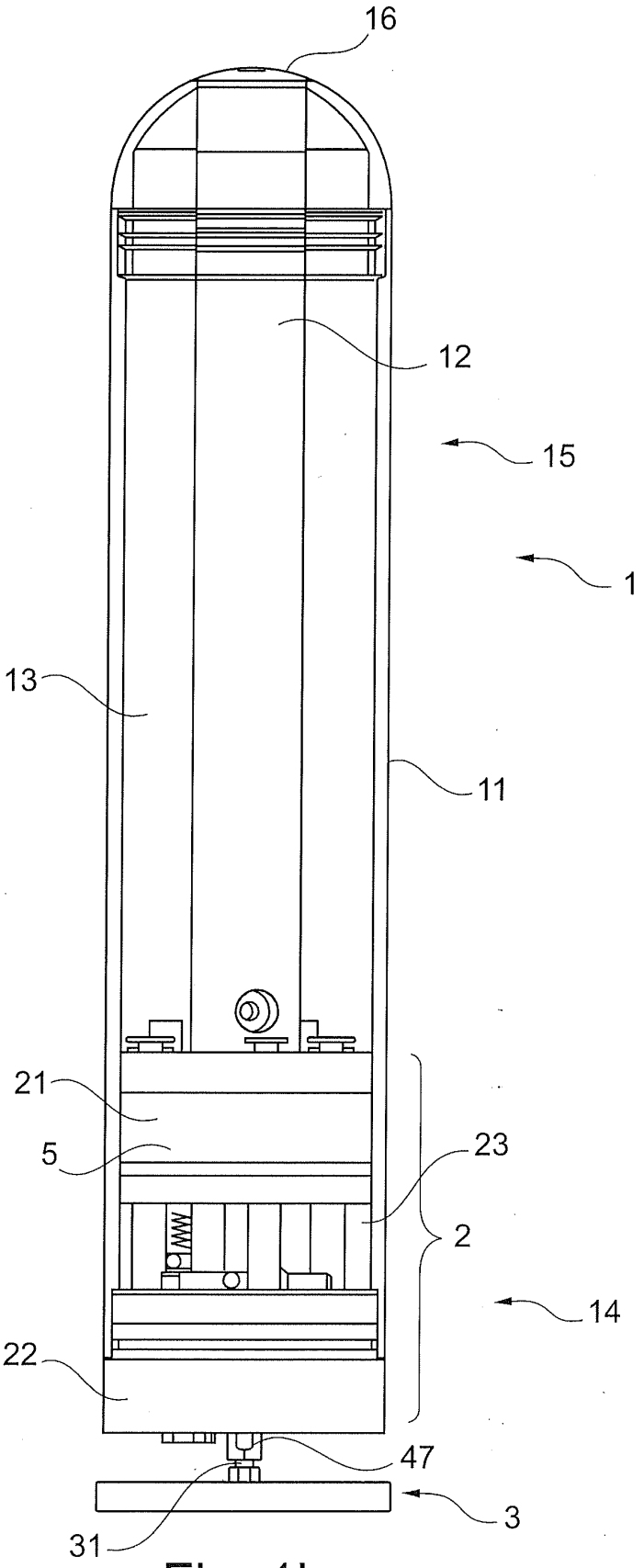


Fig. 1b

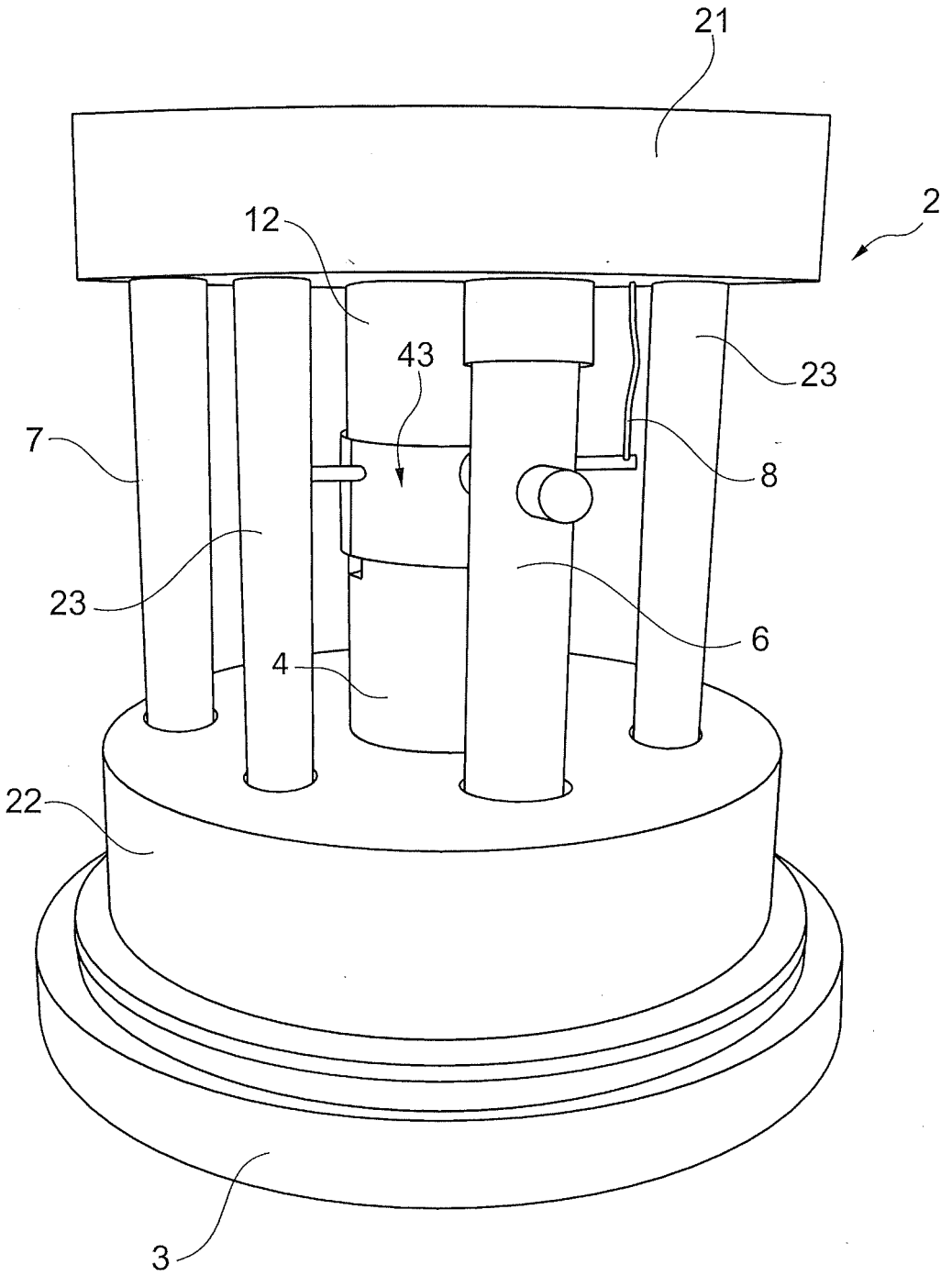


Fig. 2

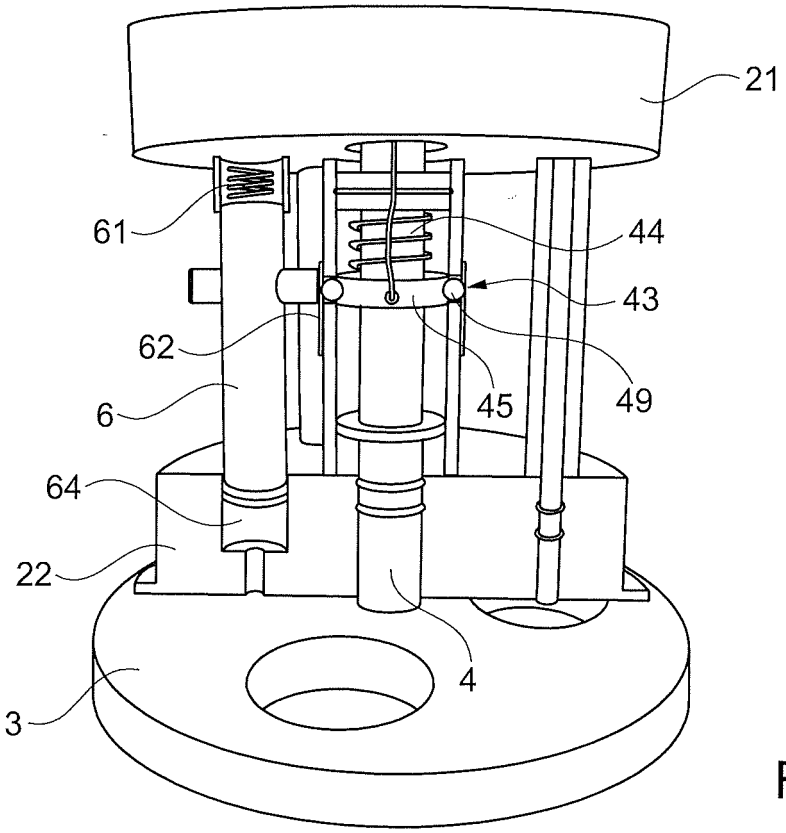


Fig. 3a

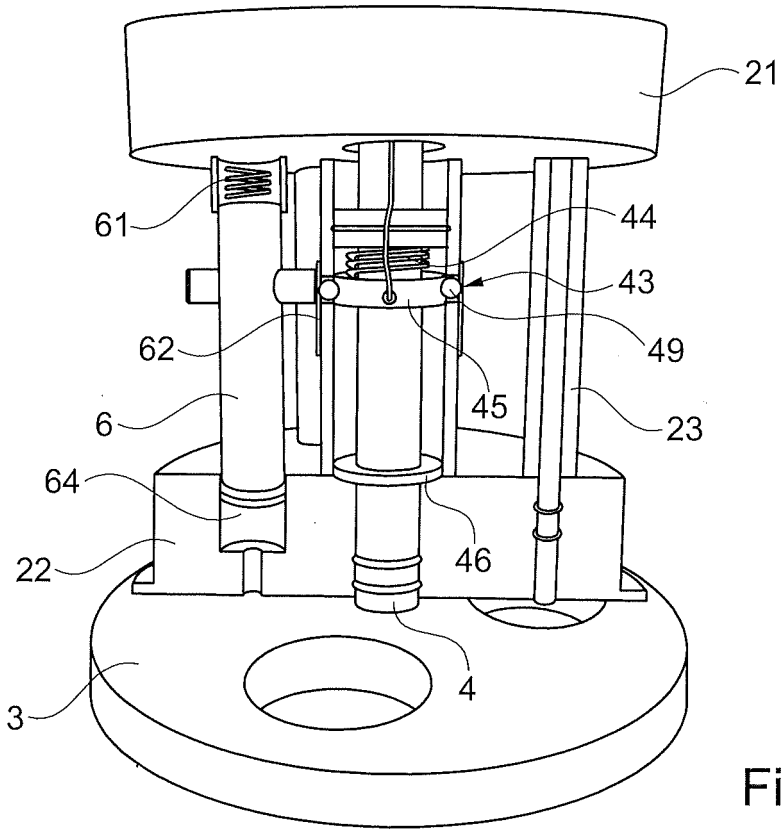


Fig. 3b

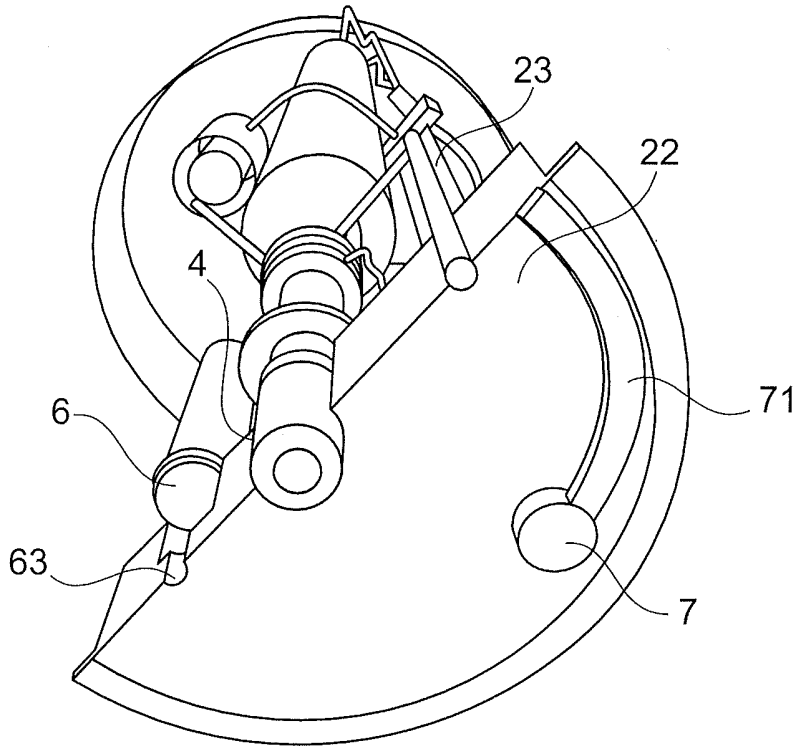


Fig. 4a

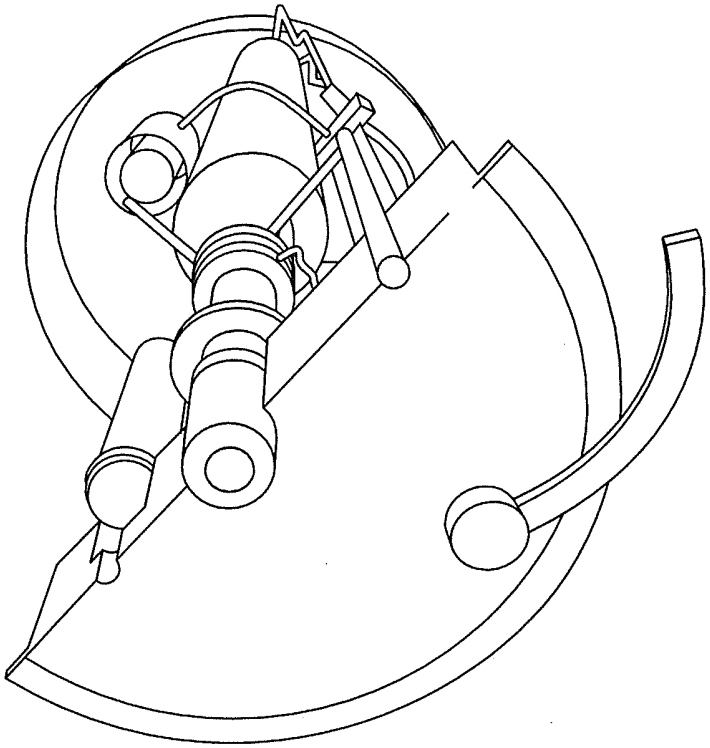

Fig. 4b

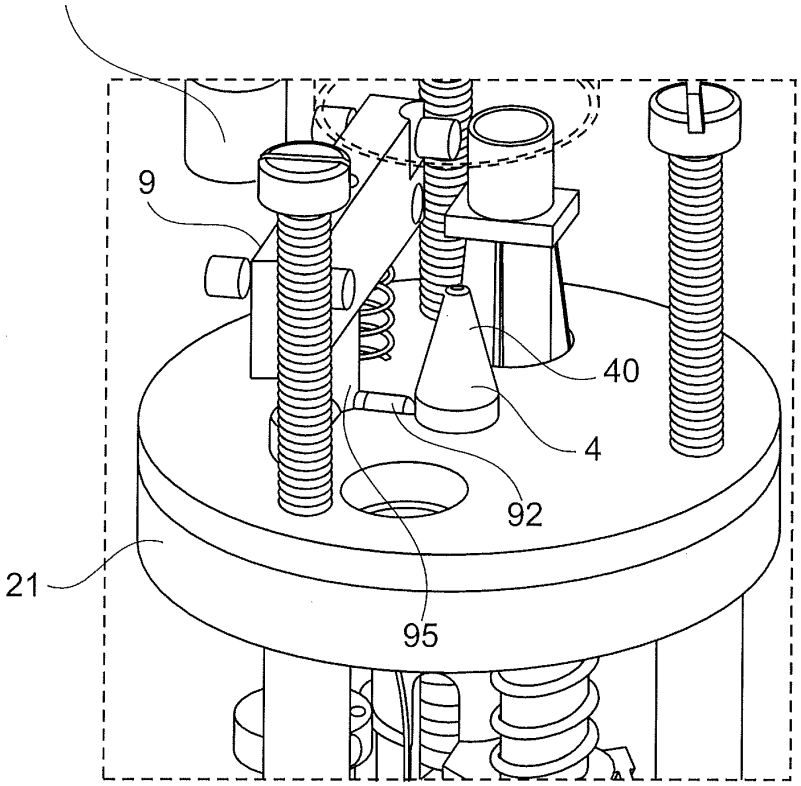


Fig. 5a

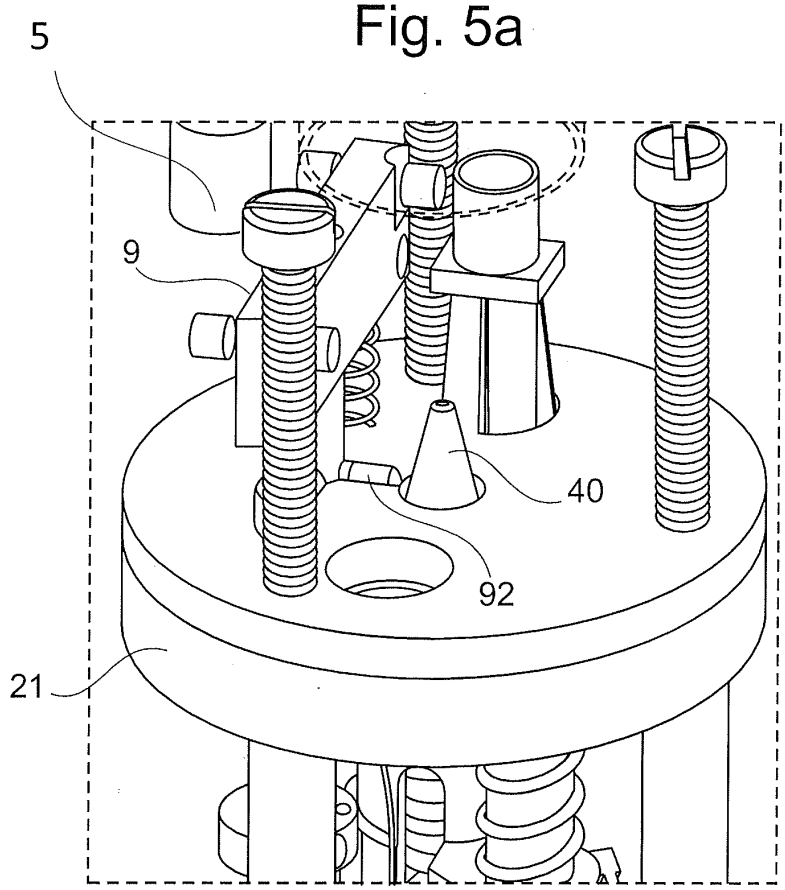


Fig. 5b

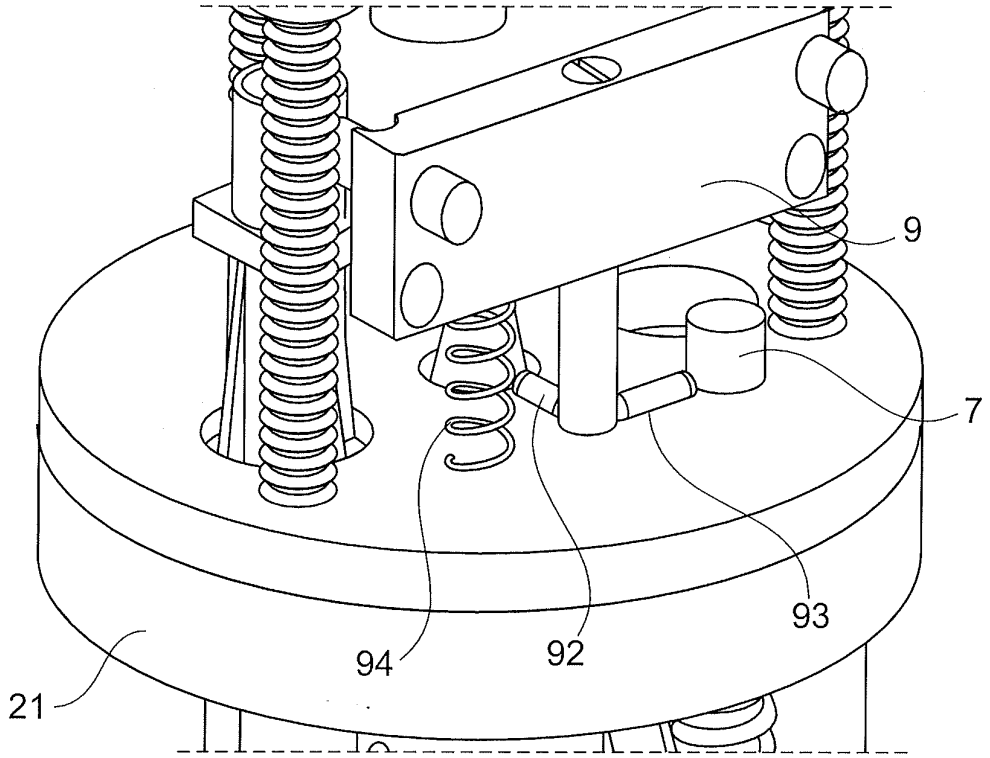


Fig. 5c

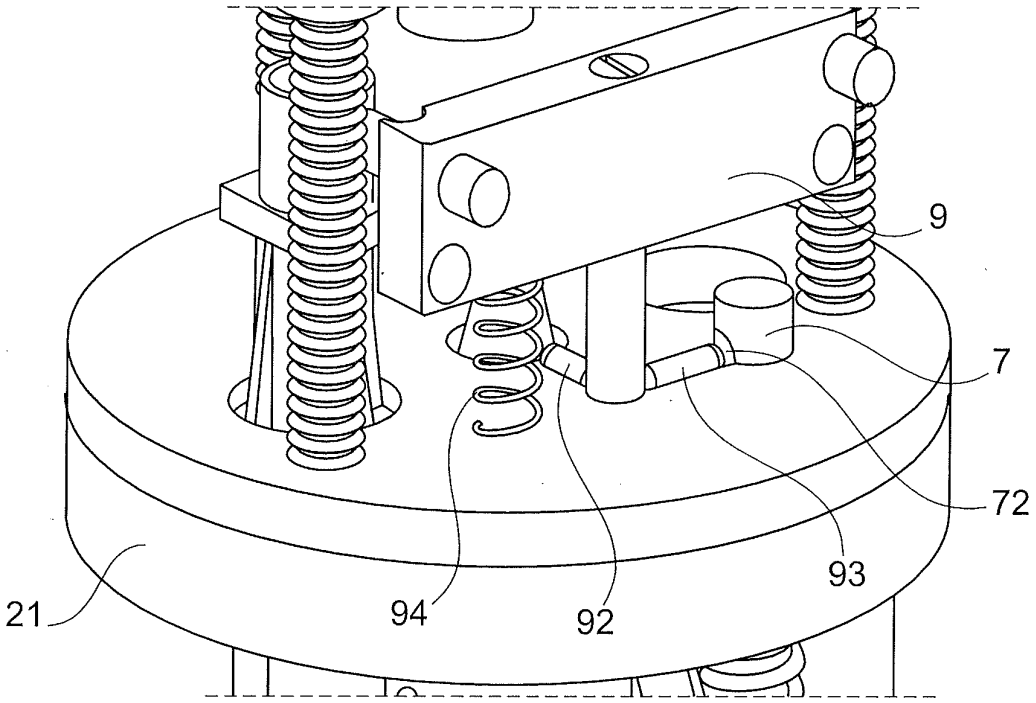


Fig. 5d

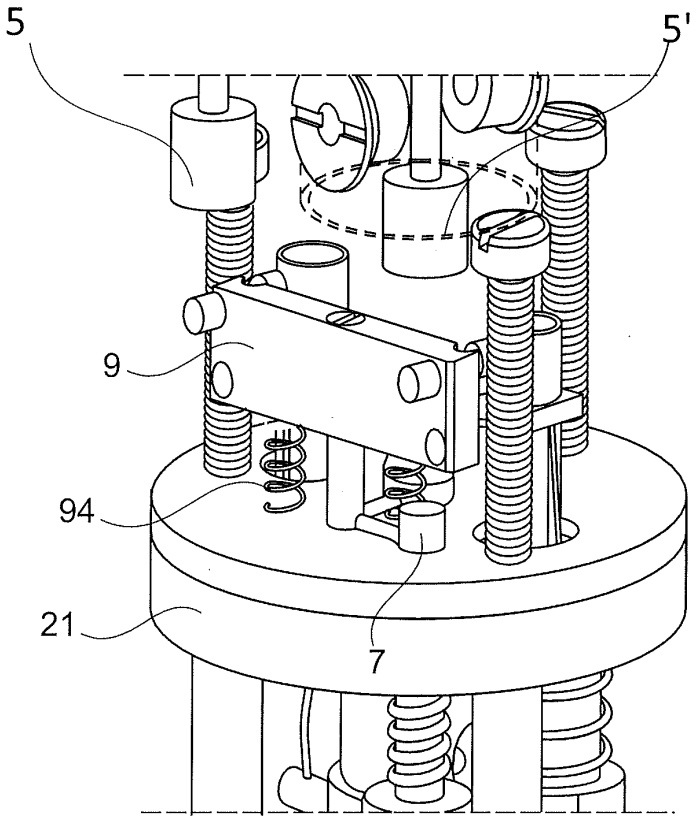


Fig. 5e

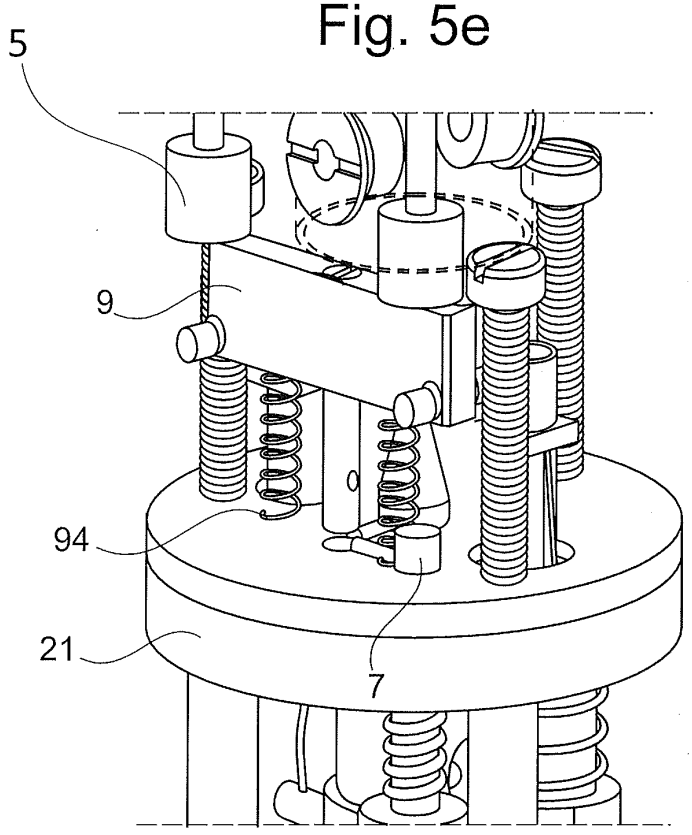


Fig. 5f

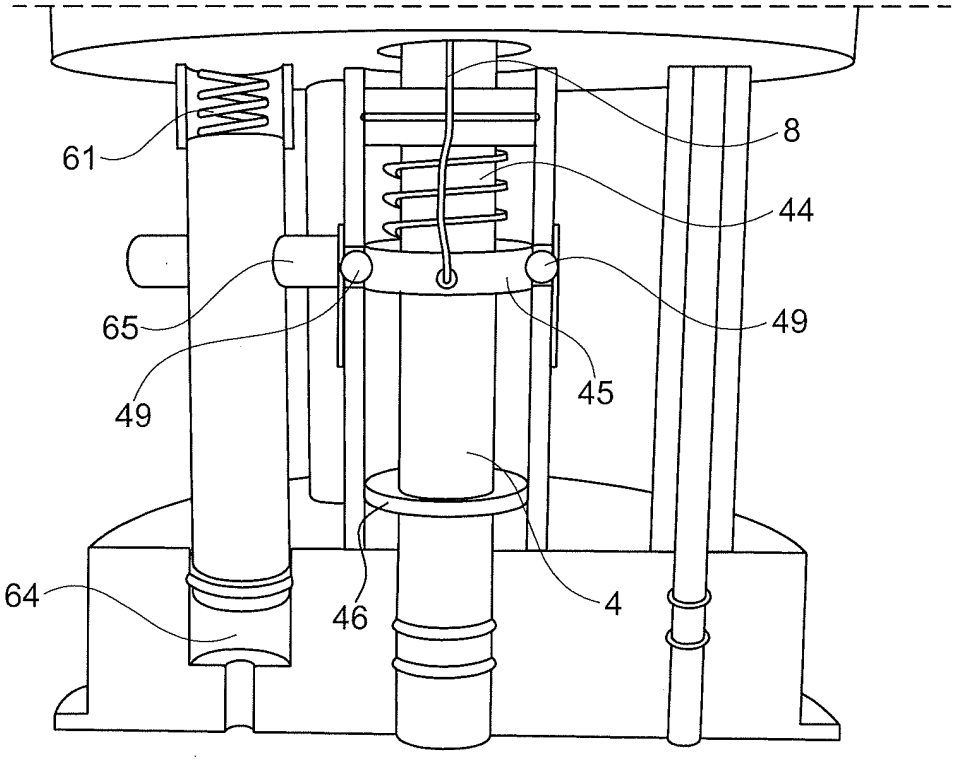


Fig. 6a

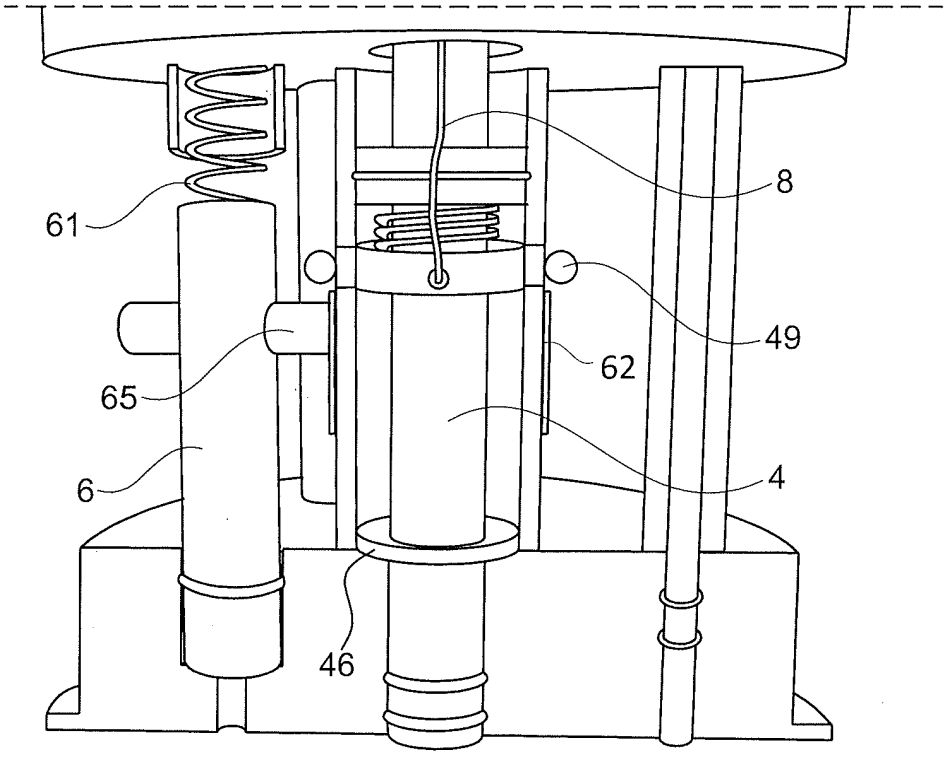


Fig. 6b

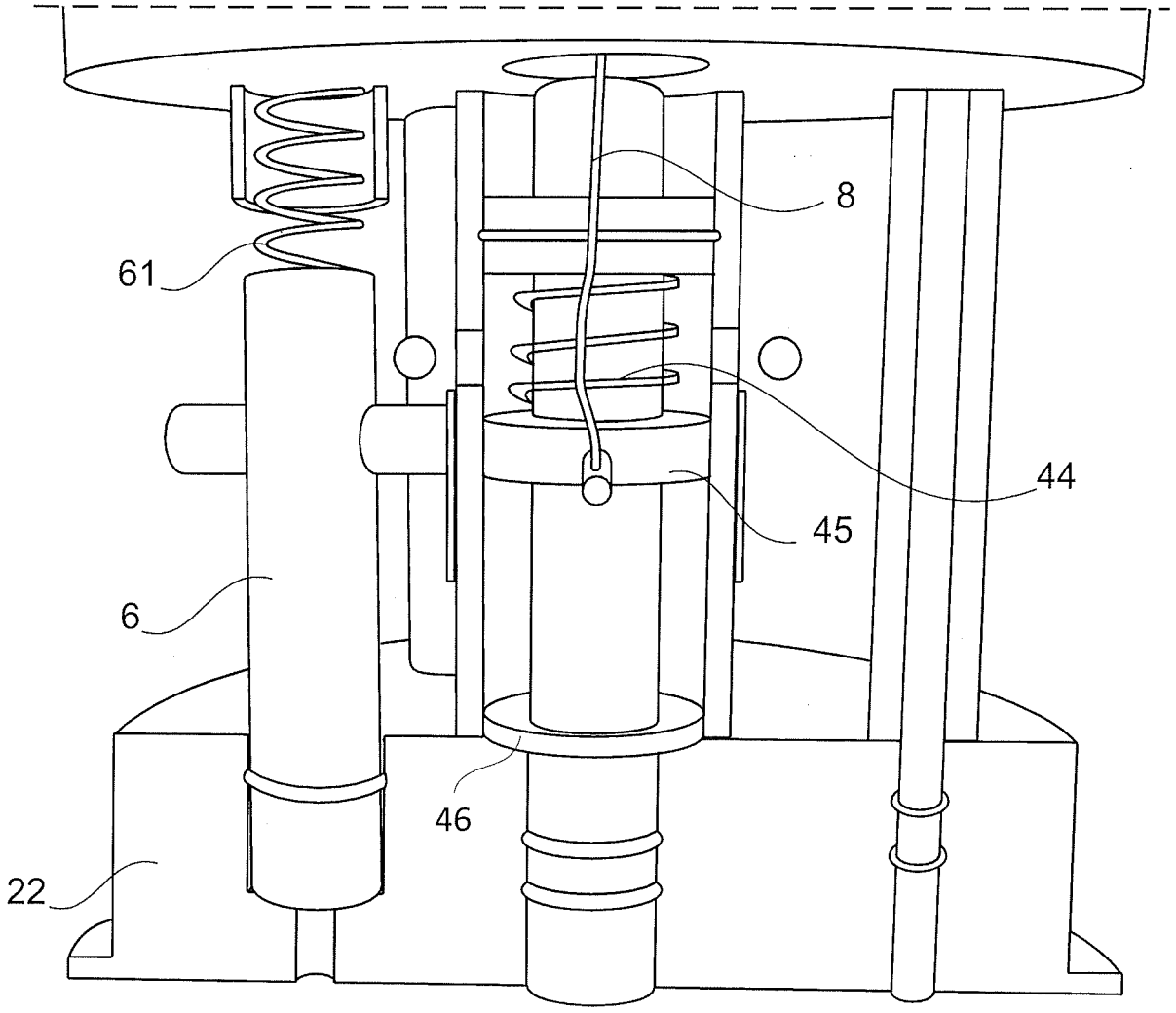


Fig. 6c

## REFERENCES CITED IN THE DESCRIPTION

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