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(54) **CARTRIDGE-IN-CHAMBER DETECTION SYSTEM FOR FIREARMS**

(57) The present invention relates to a cartridge-in-chamber detection system for firearms which is independent in situations where the user comes into contact with metal parts of the weapon (5, 11, 101, 102, 206, 217) or situations where said contact does not exist, to provide a reliable indication of the presence or absence of the cartridge (10) in the chamber (5), where the system comprises means to, through a supply voltage, determine the variation of the electrical capacity between the two possible states of the system, when there is no cartridge (10) in the chamber (5) and when there is a cartridge (10) in the chamber (5), making use of at least one electrode (1, 114, 210), regardless of the grip performed by the user.

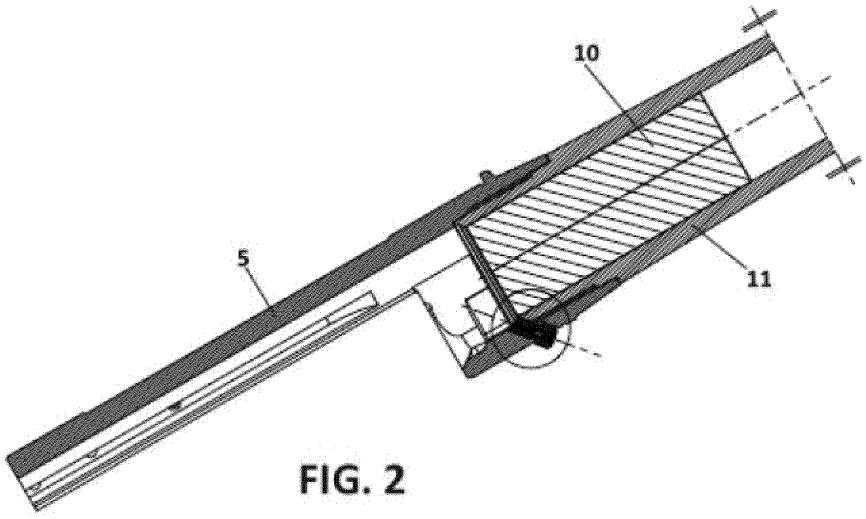

FIG. 2

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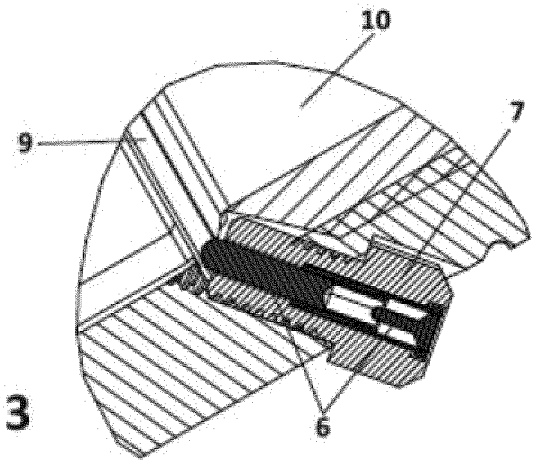

FIG. 3

Description

OBJECT OF THE INVENTION

[0001] The present invention relates to a cartridge-in-chamber detection system for firearms which is independent in situations where the user comes into contact with metal parts of the weapon or situations where said contact does not exist, to provide a reliable indication of the presence or absence of the cartridge in the chamber.

[0002] The object of the present invention is a cartridge-in-chamber detection system for firearms which comprise means to, through a supply voltage, determine the variation of the electrical capacity between two possible states of the system, when there is no cartridge in the chamber and when there is a cartridge in the chamber, making use of at least one electrode, regardless of the grip performed by the user.

BACKGROUND OF THE INVENTION

[0003] Systems are known in the state of the art that make it possible to control an electric weapon by detecting the presence of a cartridge in the chamber, where said systems have means to, through a supply voltage, determine the impedance of the cartridge in two possible states of the system, when there is no cartridge in the chamber and when there is a cartridge in the chamber, making use of two electrodes.

[0004] Among the previous systems is that which is disclosed in patent US5755056A relating to an electronic weapon and to the procedure to control said weapon, where the electrodes are positioned to electrically contact with conductive portions of the ammunition cartridge, means to supply current to at least one of the electrodes, means to measure the resistance between the electrodes and means to compare the measured resistance with at least one reference.

[0005] The system disclosed in the previous patent comprises a comparator circuit to detect the presence of a cartridge, and in particular to detect ammunition which may be electrically fired. The circuit is formed by the contacts between the electrodes and a cartridge. If the cartridge is present between the two electrodes, the current of one of the electrodes, which may be a firing pin, is transmitted through the cartridge, to the second electrode which may be the weapon barrel.

[0006] However, the measurement of the impedance may be affected by the user's presence, since the measurement may be distorted depending on whether the user comes into contact with metal parts of the weapon or not.

[0007] The cartridge-in-chamber detection system for firearms of the present invention has a configuration which makes it possible to resolve all the aforementioned drawbacks, by providing a system which is independent of the situation where the user comes into contact with metal parts of the weapon or not.

DESCRIPTION OF THE INVENTION

[0008] The present invention relates to a cartridge-in-chamber detection system for firearms which is independent in situations where the user comes into contact with metal parts of the weapon or situations where said contact does not exist, to provide a reliable indication of the presence or otherwise of a cartridge in a chamber of the weapon.

[0009] The cartridge-in-chamber detection system for firearms comprises at least one electrical contact connected by a sensor circuit to a microprocessor.

[0010] The at least one electrical contact is insulated with respect to the metal parts of the weapon, preferably the chamber and preferably through insulation means.

[0011] The at least one electrical contact comes into electrical contact with the cartridge when said cartridge is in the chamber, being both elements, cartridge and the at least one electrical contact, and consequently the metal parts of the weapon that are in physical contact with the cartridge, electrically connected.

[0012] The microprocessor, through the sensor circuit detects the capacitive variation between the situation wherein the at least one electrical contact is electrically connected to at least the metal parts of the weapon and the cartridge and the situation wherein the at least one electrical contact is not electrically connected to the at least metal parts of the weapon and the cartridge, thus making it possible to determine the presence or absence of the cartridge in the chamber respectively.

[0013] The electrical capacity associated to the sensor circuit in the situation wherein the at least one electrical contact is not electrically connected to the metal parts of the weapon and the cartridge is very small in comparison with the electrical capacity associated to the situation wherein the at least one electrical contact is electrically connected to the metal parts of the weapon and the cartridge.

[0014] The sensor circuit makes it possible to convert the capacitive variation into a voltage variation.

[0015] When the system attempts to detect if there is a cartridge in the chamber, the microprocessor generates a signal with which the capacity of the sensor circuit is charged, which in turn depends on the status of the system and it will be possible to measure the variations in capacity of the sensor circuit.

[0016] Optionally, the at least one electrical contact is in physical contact with the cartridge in the situation wherein the at least one electrical contact is electrically connected to the metal parts of the weapon and the cartridge.

[0017] The insulation means of the at least one electrical contact with respect to the metal parts of the weapon make it possible to insulate the at least one electrical contact from the metal parts of the weapon, specially from the chamber, so that the capacitive variation is independent in situations where the user comes into contact with metal parts of the weapon or situations where

said contact does not exist, thus providing a reliable indication of the presence or absence of the cartridge in the chamber.

[0018] Optionally, the at least one electrical contact may be a weapon's own element, a weapon's own modified element or an element external to the weapon.

[0019] Optionally, the at least one electrical contact is located in the chamber.

[0020] Optionally, the at least one electrical contact is located outside the chamber.

[0021] Optionally, the at least one electrical contact is not in physical contact with the cartridge in the situation wherein the at least one electrical contact is electrically connected to the metal parts of the weapon and the cartridge.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022]

Figure 1 shows an exploded perspective view of the chamber, the barrel, the second electrical contact together with the insulation means of the cartridge-in-chamber detection system for firearms according to a first embodiment of the present invention.

Figure 2 shows a sectional view of the chamber to which the barrel and the second electrical contact have been coupled together with the insulation means of the cartridge-in-chamber detection system for firearms according to the first embodiment of the present invention.

Figure 3 shows a detailed view of the second electrical contact together with the insulation means shown in figure 2.

Figure 4 shows a perspective view of the handguard of the cartridge-in-chamber detection system for firearms according to the first embodiment of the present invention.

Figure 5 shows an exploded perspective view of the handguard of the cartridge-in-chamber detection system for firearms according to a first embodiment of the present invention.

Figure 6 shows an exploded perspective view of the cartridge-in-chamber detection system for firearms according to a second embodiment of the present invention.

Figure 7 shows a perspective view of the connection between the first electrical contact and the microprocessor carried out by means of three intermediate contacts according to the second embodiment of the present invention.

Figure 8 shows an elevation view of the first and second electrical contact and the elastic element of the cartridge-in-chamber detection system for firearms according to the second embodiment in the extended arrangement of the elastic element.

Figure 9 shows an elevation view of the elements shown in Figure 8 in the compressed arrangement of the elastic element.

Figure 10 shows an exploded perspective view of the cartridge-in-chamber detection system for firearms according to a third embodiment of the present invention.

Figure 11 shows a detailed view of the first, second and third electrical contacts of the cartridge-in-chamber detection system for firearms according to the third embodiment of the present invention.

PREFERRED EMBODIMENT OF THE INVENTION

[0023] Below, the cartridge-in-chamber detection system for firearms of the present invention is described in detail.

[0024] In a first embodiment shown in Figures 1 to 5, the system comprises a first electrical contact (1) disposed in a handguard (2) of the weapon which is connected by a sensor circuit to a microprocessor (3) supplied by a battery (4), both disposed in the handguard (2), where the first electrical contact (1) is disposed in the longitudinal direction of a chamber (5) of the weapon.

[0025] The system further comprises a second electrical contact (6) disposed in the chamber (5) tilted with respect to its longitudinal direction, where the first electrical contact (1) is in physical contact with the second electrical contact (6), in addition to insulation means (7) of the second electrical contact (6) with respect to said chamber (5).

[0026] The insulation means (7) of the second electrical contact (6) with respect to said chamber (5) comprise an externally threaded rod to fix it to the chamber (5), where the interior of the rod is hollow for the housing of the second electrical contact (6).

[0027] The second electrical contact (6) comes into physical contact with a shell (9) of a cartridge (10) when said cartridge (10) is in the chamber (5), being both elements, cartridge (10) and second electrical contact (6), and consequently the metal parts of the weapon which are in physical contact with the cartridge (10), preferably the chamber (5) and a barrel (11), electrically connected through the connection between the first electrical contact (1) and the second electrical contact (6).

[0028] The microprocessor (3), through the sensor circuit, detects the capacitive variation between the situation wherein the first electrical contact (1) is electrically connected to the second electrical contact (6), the metal parts of the weapon (5, 11) and the shell (9) of the cartridge (10) and the situation wherein the first electrical contact (1) is electrically connected to the second electrical contact (6), thus making it possible to determine the presence or absence of the cartridge (10) in the chamber (5) respectively.

[0029] In a second embodiment shown in figures 6 to 9, the system comprises a first electrical contact (114) disposed in a slide (101) of the weapon that is connected via a sensor circuit to a microprocessor (103) supplied by a battery (not shown), where the slide (101) is closed

via a cover plate (115).

[0030] The system further comprises a second electrical contact (112) disposed in the slide (101), where the first electrical contact (114) is coupled to the second electrical contact (112) through an elastic element (113). Preferably, the first electrical contact (114), the second electrical contact (112) and the elastic element (113) are disposed in the longitudinal direction of the slide (101) of the weapon.

[0031] When the cartridge is in the chamber, an extractor (111) pushes the second electrical contact (112) towards the first electrical contact (114), the elastic element (113) adopting a compressed arrangement, both electrical contacts (112, 114) coming into physical contact, and consequently the metal parts of the weapon (101, 102) that are in physical contact with the cartridge, preferably the chamber, a barrel (102) and the slide (101), being electrically connected through the connection between the first electrical contact (114) and the second electrical contact (112).

[0032] When the cartridge is not in the chamber, the extractor (111) does not push the second electrical contact (112) towards the first electrical contact (114), the elastic element (113) regaining this way its expanded position, the first electrical contact (114) being electrically insulated from the second electrical contact (112), the metal parts of the weapon (101, 102), a shell of the cartridge and the extractor (111).

[0033] The microprocessor (103), through the sensor circuit, detects the capacitive variation between the situation wherein the first electrical contact (114) is electrically connected to the second electrical contact (112), the metal parts of the weapon (101, 102), the shell of the cartridge and the extractor (111) and the situation wherein the first electrical contact (114) is not electrically connected to the second electrical contact (112), the metal parts of the weapon (101, 102), the shell of the cartridge and the extractor (111), thus making it possible to determine the presence or absence of the cartridge in the chamber respectively.

[0034] The first electrical contact (114) comprises insulation means (107) with respect to the metal parts of the weapon (101, 102) that allow insulation of the first electrical contact (114) from the metal parts of the weapon (101, 102), in particular from the chamber, in the situation in which there is no cartridge in the chamber.

[0035] In this second embodiment, both the first electrical contact (114) and the second electrical contact (112) are disposed outside the chamber and only come into physical contact with each other (112, 114) when there is a cartridge in the chamber.

[0036] The connection between the first electrical contact (114) and the microprocessor (103) is carried out by means of three intermediate contacts shown in Figure 7, a grub screw (116) to adjust the clearance between the first electrical contact (114) and the second electrical contact (112), an insert (117) and a moveable contact (118) connected to the microprocessor (103), in order to ensure the electrical connection between the first electrical contact (114) and the microprocessor (103).

[0037] In a third embodiment shown in Figures 10 and 11, the system comprises a first electrical contact (210) disposed in a bolt carrier (206) of the weapon that is connected via a sensor circuit to a microprocessor (203), which is preferably supplied by a battery (not shown).

[0038] The system further comprises a second electrical contact (212) disposed in a bolt head (217), where the second electrical contact (212) is optionally at least partially disposed in the chamber, where the first electrical contact (210) is in physical contact with a third electrical contact (211) disposed between the first electrical contact (210) and the second electrical contact (212). The system comprises insulation means (207) of the first electrical contact (210), the second electrical contact (212) and the third electrical contact (211) with respect to the metal parts of the weapon (206, 217), specially with respect to the bolt head (217) and the bolt carrier (206).

[0039] The second electrical contact (212) comes into physical contact with a shell of a cartridge when said cartridge is in the chamber, being both elements, cartridge and second electrical contact (212), and consequently the metal parts of the weapon (206, 217) that are in physical contact with the cartridge, preferably the chamber, a barrel, the bolt head (217) and the bolt carrier (206), electrically connected through the connection between the first electrical contact (210), the third electrical contact (211) and the second electrical contact (212).

[0040] The microprocessor (203), through the sensor circuit, detects the capacitive variation between the situation in which the first electrical contact (210) is electrically connected to the second electrical contact (212), the third electrical contact (211), the metal parts of the weapon (206, 217) and the shell of the cartridge and the situation in which the first electrical contact (210) is electrically connected to the second electrical contact (212) and the third electrical contact (211), thus making it possible to determine the presence or absence of the cartridge in the chamber respectively.

[0041] For all the embodiments described, when the system attempts to detect if there is a cartridge (10) in the chamber (5), the microprocessor (3, 103, 203) generates a signal, preferably square, of preset frequency with which the capacity of the sensor circuit is charged to measure the variations thereof.

[0042] The measurement of the capacity of the sensor circuit, which varies depending on the presence or otherwise of the cartridge (10) in the chamber (5), is carried out through a diode (not shown). The system of the present invention, through the microprocessor (3, 103, 203), captures the voltage provided by the sensor circuit, which is compared with a threshold voltage of the system to detect the presence of the cartridge (10) in the chamber (5).

[0043] Due to the presence of the diode to measure the circuit capacity, the temperature has an important

influence on its operation. This is because the conduction voltage of the diode has a variation of around 200 mV throughout the dynamic temperature range. This variation depends on the temperature linearly. Therefore, and to decrease the error rate to the maximum, the microprocessor (3, 103, 203) comprises a temperature sensor (not shown) which measures the temperature in each reading and makes a temperature compensation throughout the whole operating range.

[0044] The system comprises a DC to DC current converter (DC/DC step-up) (not shown) to stabilize the input voltage and make it invariable from the charging status of the battery (4).

[0045] The system has a response time of less than 1 ms to determine if the cartridge (10) is present in the chamber (5) or otherwise.

[0046] The system further comprises an electrostatic protection device (not shown) against residual currents, since the second electrical contact (6, 112, 212) is in physical contact with the metal parts of the weapon (5, 11, 101, 102, 206, 217), which are accessible by the user, when the cartridge (10) is present in the chamber (5).

[0047] The system uses a high operating frequency, around 20 MHz, which makes it possible to discern the presence or otherwise of a cartridge (10) in the chamber (5) even in short-circuit conditions due to fresh water between the second electrical contact (6, 212) and the chamber (5), for the first and the third embodiments.

Claims

1. A cartridge-in-chamber detection system for firearms which comprises at least one electrical contact (1, 114, 210) which is connected by a sensor circuit to a microprocessor (3, 103, 203), **characterised in that** the at least one electrical contact (1, 114, 210) is in electrical contact with a cartridge (10) when said cartridge (10) is in the chamber (5), being both elements, cartridge (10) and the at least one electrical contact (1, 114, 210), and consequently the metal parts of the weapon (5, 11, 101, 102, 206, 217) which are in electrical contact with the cartridge (10), electrically connected, and where the microprocessor (3, 103, 203), through the sensor circuit, detects the capacitive variation between the situation in which the at least one electrical contact (1, 114, 210) is electrically connected to at least the metal parts of the weapon (5, 11, 101, 102, 206, 217) and the cartridge (10), and the situation in which the at least one electrical contact (1, 114, 210) is not electrically connected to at least the metal parts of the weapon (5, 11, 101, 102, 206, 217) and the cartridge (10), thus making it possible to determine the presence or absence of the cartridge (10) in the chamber (5) respectively.

2. The cartridge-in-chamber detection system for firearms according to claim 1, **characterised in that** a first electrical contact (1) is connected via the sensor circuit to the microprocessor (3), and a second electrical contact (6) disposed in the chamber (5) of the weapon, where the first electrical contact (1) is in physical contact with the second electrical contact (6), and where the second electrical contact (6) comes into physical contact with a shell (9) of the cartridge (10) when said cartridge (10) is in the chamber (5), being both elements, cartridge (10) and second electrical contact (6), and consequently the metal parts of the weapon (5, 11) that are in physical contact with the cartridge (10), electrically connected through the connection between the first electrical contact (1) and the second electrical contact (6), and where the microprocessor (3), through the sensor circuit, detects the capacitive variation between the situation in which the first electrical contact (1) is electrically connected to the second electrical contact (6), the metal parts of the weapon (5, 11) and the shell (9) of the cartridge (10) and the situation in which the first electrical contact (1) is electrically connected to the second electrical contact (6), thus making it possible to determine the presence or absence of the cartridge (10) in the chamber (5) respectively.

3. The cartridge-in-chamber detection system for firearms according to claim 2, **characterised in that** the first electrical contact (1) is disposed in a handguard (2) of the weapon.

4. The cartridge-in-chamber detection system for firearms according to any of the claims 2 to 3, **characterised in that** the first electrical contact (1) is disposed in the longitudinal direction of the chamber (5).

5. The cartridge-in-chamber detection system for firearms according to any of the claims 2 to 4, **characterised in that** the second electrical contact (6) is disposed tilted with respect to the longitudinal direction of the chamber (5).

6. The cartridge-in-chamber detection system for firearms according to any of the claims 2 to 5, **characterised in that** it comprises insulation means (7) of the second electrical contact (6) with respect to the chamber (5).

7. The cartridge-in-chamber detection system for firearms according to claim 6, **characterised in that** the insulation means (7) of the second electrical contact (6) with respect to the chamber (5) comprise an externally threaded rod to fix it to the chamber (5), where the interior of the rod is hollow to house the second electrical contact (6).

8. The cartridge-in-chamber detection system for firearms according to claim 1, **characterised in that** it comprises a first electrical contact (114) disposed in

a slide (101) of the weapon that is connected via the sensor circuit to the microprocessor (103), and a second electrical contact (112) disposed in the slide (101), where the first electrical contact (114) is coupled to the second electrical contact (112) through an elastic element (113), so that when the cartridge is in the chamber, an extractor (111) pushes the second electrical contact (112) towards the first electrical contact (114), the elastic element (113) adopting a compressed arrangement, both electrical contacts (112, 114) coming into physical contact, and consequently the metal parts of the weapon (101, 102) that are in physical contact with the cartridge, being electrically connected through the connection between the first electrical contact (114) and the second electrical contact (112), whilst when the cartridge is not in the chamber, the extractor (111) does not push the second electrical contact (112) towards the first electrical contact (114), the elastic element (113) regaining this way its expanded position, the first electrical contact (114) being electrically insulated from the second electrical contact (112), the metal parts of the weapon (101, 102), a shell of the cartridge and the extractor (111), where the microprocessor (103), through the sensor circuit, detects the capacitive variation between the situation in which the first electrical contact (114) is electrically connected to the second electrical contact (112), the metal parts of the weapon (101, 102), the shell of the cartridge and the extractor (111) and the situation in which the first electrical contact (114) is not electrically connected to the second electrical contact (112), the metal parts of the weapon (101, 102), the shell of the cartridge and the extractor (111), thus making it possible to determine the presence or absence of the cartridge in the chamber respectively.

9. The cartridge-in-chamber detection system for firearms according to claim 8, **characterised in that** the first electrical contact (114) comprises insulation means (107) with respect to the metal parts of the weapon (101, 102) that allow insulation of the first electrical contact (114) from the metal parts of the weapon (101, 102) in the situation in which there is no cartridge in the chamber.

10. The cartridge-in-chamber detection system for firearms according to any of the claims 8 or 9, **characterised in that** both the first electrical contact (114) and the second electrical contact (112) are disposed outside the chamber and only come into physical contact with each other (112, 114) when there is a cartridge in the chamber.

11. The cartridge-in-chamber detection system for firearms according to claim 1, **characterised in that** it comprises a first electrical contact (210) disposed in a bolt carrier (206) of the weapon that is connected via the sensor circuit to the microprocessor (203), and a second electrical contact (212) disposed in a bolt head (217), where the first electrical contact (210) is in physical contact with a third electrical contact (211) disposed between the first electrical contact (210) and the second electrical contact (212), where the second electrical contact (212) comes into physical contact with a shell of a cartridge when said cartridge is in the chamber, being both elements, cartridge and second electrical contact (212), and consequently the metal parts of the weapon (206, 217) that are in physical contact with the cartridge, being electrically connected through the connection between the first electrical contact (210), the third electrical contact (211) and the second electrical contact (212), and where the microprocessor (203), through the sensor circuit, detects the capacitive variation between the situation in which the first electrical contact (210) is electrically connected to the second electrical contact (212), the third electrical contact (211), the metal parts of the weapon (206, 217) and the shell of the cartridge and the situation in which the first electrical contact (210) is electrically connected to the second electrical contact (212) and the third electrical contact (211), thus making it possible to determine the presence or absence of the cartridge in the chamber respectively.

12. The cartridge-in-chamber detection system for firearms according to claim 11, **characterised in that** the second electrical contact (212) is at least partially disposed in the chamber.

13. The cartridge-in-chamber detection system for firearms according to any of the claims 11 or 12, **characterised in that** it comprises insulation means (207) of the first electrical contact (210), the second electrical contact (212) and the third electrical contact (211) with respect to the metal parts of the weapon (206, 217).

14. The cartridge-in-chamber detection system for firearms according to any of the preceding claims, **characterised in that** the microprocessor (3, 103, 203), through the sensor circuit, converts the capacitive variation into a voltage variation.

15. The cartridge-in-chamber detection system for firearms according to any of the preceding claims, **characterised in that** the microprocessor (3, 103, 203) generates a square signal of preset frequency with which the capacity of the sensor circuit is charged to measure the capacity variations thereof.

16. The cartridge-in-chamber detection system for firearms according to any of the preceding claims, **characterised in that** the microprocessor (3, 103, 203) captures the voltage provided by the sensor circuit,

which is compared to a threshold voltage.

17. The cartridge-in-chamber detection system for firearms according to any of the preceding claims, **characterised in that** the microprocessor (3, 103, 203) comprises a temperature sensor which measures the temperature in each reading of the microprocessor (3, 103, 203) and makes a temperature compensation throughout a whole operating range.

18. The cartridge-in-chamber detection system for firearms according to any of the preceding claims, **characterised in that** it comprises supply means (4).

19. The cartridge-in-chamber detection system for firearms according to claim 18, **characterised in that** the supply means are a battery (4).

20. The cartridge-in-chamber detection system for firearms according to claim 19, **characterised in that** it comprises a DC to DC current converter to stabilize the input voltage and make it invariable from the charging status of the battery (4).

21. The cartridge-in-chamber detection system for firearms according to any of the preceding claims, **characterised in that** the operating frequency is 20 MHz.

22. The cartridge-in-chamber detection system for firearms according to any of the preceding claims, **characterised in that** it comprises an electrostatic protection device.

23. The cartridge-in-chamber detection system for firearms according to any of the preceding claims, **characterised in that** it has a response time of less than 1 ms to determine if the cartridge (10) is present in the chamber (5) or otherwise.

24. The cartridge-in-chamber detection system for firearms according to any of the claims 2-7, 11, 12, **characterised in that** the second electrical contact (6, 212) is completely or partially disposed in the chamber (5).

25. The cartridge-in-chamber detection system for firearms according to claim 1, **characterised in that** the at least one electrical contact is in physical contact with the cartridge (10) in the situation in which the at least one electrical contact is electrically connected to the metal parts of the weapon (5, 11, 101, 102, 206, 217) and the cartridge (10).

26. The cartridge-in-chamber detection system for firearms according to claim 1, **characterised in that** the at least one electrical contact is insulated with respect to the metal parts of the weapon (5, 11, 101, 102, 206, 217).

27. The cartridge-in-chamber detection system for firearms according to claim 1, **characterised in that** the at least one electrical contact is a firearm's own element.

28. The cartridge-in-chamber detection system for firearms according to claim 1, **characterised in that** the at least one electrical contact is a firearm's own modified element.

29. The cartridge-in-chamber detection system for firearms according to claim 1, **characterised in that** the at least one electrical contact is an external element to the firearm.

30. The cartridge-in-chamber detection system for firearms according to claim 1, **characterised in that** the at least one electrical contact is located in the chamber.

31. The cartridge-in-chamber detection system for firearms according to claim 1, **characterised in that** the at least one electrical contact (1, 114, 210) is located outside the chamber (5).

32. The cartridge-in-chamber detection system for firearms according to claim 31, **characterised in that** the at least one electrical contact (1) is disposed in a handguard (2) of the weapon.

33. The cartridge-in-chamber detection system for firearms according to claim 1, **characterised in that** the at least one electrical contact is not in physical contact with the cartridge (10) in the situation in which the at least one electrical contact is electrically connected to the metal parts of the weapon (5, 11, 101, 102, 206, 217) and the cartridge (10).

Amended claims under Art. 19.1 PCT

1. A cartridge-in-chamber detection system for firearms which comprises at least one electrical contact (1, 114, 210) which is connected by a sensor circuit to a microprocessor (3, 103, 203), **characterised in that** the at least one electrical contact (1, 114, 210) is in electrical contact with a cartridge (10) when said cartridge (10) is in the chamber (5), being both elements, cartridge (10) and the at least one electrical contact (1, 114, 210), and consequently the metal parts of the weapon (5, 11, 101, 102, 206, 217) which are in physical contact with the cartridge (10), electrically connected, and where the microprocessor (3, 103, 203), through the sensor circuit, detects the capacitive variation between the situation in which the at least one electrical contact (1, 114, 210) is electrically connected to at least the metal parts of the weapon (5, 11, 101, 102, 206, 217) and the cartridge

(10), and the situation in which the at least one electrical contact (1, 114, 210) is not electrically connected to at least the metal parts of the weapon (5, 11, 101, 102, 206, 217) and the cartridge (10), thus making it possible to determine the presence or absence of the cartridge (10) in the chamber (5) respectively.

2. The cartridge-in-chamber detection system for firearms according to claim 1, **characterised in that** a first electrical contact (1) is connected via the sensor circuit to the microprocessor (3), and a second electrical contact (6) disposed in the chamber (5) of the weapon, where the first electrical contact (1) is in physical contact with the second electrical contact (6), and where the second electrical contact (6) comes into physical contact with a shell (9) of the cartridge (10) when said cartridge (10) is in the chamber (5), being both elements, cartridge (10) and second electrical contact (6), and consequently the metal parts of the weapon (5, 11) that are in physical contact with the cartridge (10), electrically connected through the connection between the first electrical contact (1) and the second electrical contact (6), and where the microprocessor (3), through the sensor circuit, detects the capacitive variation between the situation in which the first electrical contact (1) is electrically connected to the second electrical contact (6), the metal parts of the weapon (5, 11) and the shell (9) of the cartridge (10) and the situation in which the first electrical contact (1) is electrically connected to the second electrical contact (6), thus making it possible to determine the presence or absence of the cartridge (10) in the chamber (5) respectively.

3. The cartridge-in-chamber detection system for firearms according to claim 2, **characterised in that** the first electrical contact (1) is disposed in a handguard (2) of the weapon.

4. The cartridge-in-chamber detection system for firearms according to any of the claims 2 to 3, **characterised in that** the first electrical contact (1) is disposed in the longitudinal direction of the chamber (5).

5. The cartridge-in-chamber detection system for firearms according to any of the claims 2 to 4, **characterised in that** the second electrical contact (6) is disposed tilted with respect to the longitudinal direction of the chamber (5).

6. The cartridge-in-chamber detection system for firearms according to any of the claims 2 to 5, **characterised in that** it comprises insulation means (7) of the second electrical contact (6) with respect to the chamber (5).

7. The cartridge-in-chamber detection system for firearms according to claim 6, **characterised in that** the insulation means (7) of the second electrical contact (6) with respect to the chamber (5) comprise an externally threaded rod to fix it to the chamber (5), where the interior of the rod is hollow to house the second electrical contact (6).

8. The cartridge-in-chamber detection system for firearms according to claim 1, **characterised in that** it comprises a first electrical contact (114) disposed in a slide (101) of the weapon that is connected via the sensor circuit to the microprocessor (103), and a second electrical contact (112) disposed in the slide (101), where the first electrical contact (114) is coupled to the second electrical contact (112) through an elastic element (113), so that when the cartridge is in the chamber, an extractor (111) pushes the second electrical contact (112) towards the first electrical contact (114), the elastic element (113) adopting a compressed arrangement, both electrical contacts (112, 114) coming into physical contact, and consequently the metal parts of the weapon (101, 102) that are in physical contact with the cartridge, being electrically connected through the connection between the first electrical contact (114) and the second electrical contact (112), whilst when the cartridge is not in the chamber, the extractor (111) does not push the second electrical contact (112) towards the first electrical contact (114), the elastic element (113) regaining this way its expanded position, the first electrical contact (114) being electrically insulated from the second electrical contact (112), the metal parts of the weapon (101, 102), a shell of the cartridge and the extractor (111), where the microprocessor (103), through the sensor circuit, detects the capacitive variation between the situation in which the first electrical contact (114) is electrically connected to the second electrical contact (112), the metal parts of the weapon (101, 102), the shell of the cartridge and the extractor (111) and the situation in which the first electrical contact (114) is not electrically connected to the second electrical contact (112), the metal parts of the weapon (101, 102), the shell of the cartridge and the extractor (111), thus making it possible to determine the presence or absence of the cartridge in the chamber respectively.

9. The cartridge-in-chamber detection system for firearms according to claim 8, **characterised in that** the first electrical contact (114) comprises insulation means (107) with respect to the metal parts of the weapon (101, 102) that allow insulation of the first electrical contact (114) from the metal parts of the weapon (101, 102) in the situation in which there is no cartridge in the chamber.

10. The cartridge-in-chamber detection system for firearms according to any of the claims 8 or 9, **characterised in that** both the first electrical contact (114)

and the second electrical contact (112) are disposed outside the chamber and only come into physical contact with each other (112, 114) when there is a cartridge in the chamber.

11. The cartridge-in-chamber detection system for firearms according to claim 1, **characterised in that** it comprises a first electrical contact (210) disposed in a bolt carrier (206) of the weapon that is connected via the sensor circuit to the microprocessor (203), and a second electrical contact (212) disposed in a bolt head (217), where the first electrical contact (210) is in physical contact with a third electrical contact (211) disposed between the first electrical contact (210) and the second electrical contact (212), where the second electrical contact (212) comes into physical contact with a shell of a cartridge when said cartridge is in the chamber, being both elements, cartridge and second electrical contact (212), and consequently the metal parts of the weapon (206, 217) that are in physical contact with the cartridge, being electrically connected through the connection between the first electrical contact (210), the third electrical contact (211) and the second electrical contact (212), and where the microprocessor (203), through the sensor circuit, detects the capacitive variation between the situation in which the first electrical contact (210) is electrically connected to the second electrical contact (212), the third electrical contact (211), the metal parts of the weapon (206, 217) and the shell of the cartridge and the situation in which the first electrical contact (210) is electrically connected to the second electrical contact (212) and the third electrical contact (211), thus making it possible to determine the presence or absence of the cartridge in the chamber respectively.

12. The cartridge-in-chamber detection system for firearms according to claim 11, **characterised in that** the second electrical contact (212) is at least partially disposed in the chamber.

13. The cartridge-in-chamber detection system for firearms according to any of the claims 11 or 12, **characterised in that** it comprises insulation means (207) of the first electrical contact (210), the second electrical contact (212) and the third electrical contact (211) with respect to the metal parts of the weapon (206, 217).

14. The cartridge-in-chamber detection system for firearms according to any of the preceding claims, **characterised in that** the microprocessor (3, 103, 203), through the sensor circuit, converts the capacitive variation into a voltage variation.

15. The cartridge-in-chamber detection system for firearms according to any of the preceding claims, **characterised in that** the microprocessor (3, 103, 203) generates a square signal of preset frequency with which the capacity of the sensor circuit is charged to measure the capacity variations thereof.

16. The cartridge-in-chamber detection system for firearms according to any of the preceding claims, **characterised in that** the microprocessor (3, 103, 203) captures the voltage provided by the sensor circuit, which is compared to a threshold voltage.

17. The cartridge-in-chamber detection system for firearms according to any of the preceding claims, **characterised in that** the microprocessor (3, 103, 203) comprises a temperature sensor which measures the temperature in each reading of the microprocessor (3, 103, 203) and makes a temperature compensation throughout a whole operating range.

18. The cartridge-in-chamber detection system for firearms according to any of the preceding claims, **characterised in that** it comprises supply means (4).

19. The cartridge-in-chamber detection system for firearms according to claim 18, **characterised in that** the supply means are a battery (4).

20. The cartridge-in-chamber detection system for firearms according to claim 19, **characterised in that** it comprises a DC to DC current converter to stabilize the input voltage and make it invariable from the charging status of the battery (4).

21. The cartridge-in-chamber detection system for firearms according to any of the preceding claims, **characterised in that** the operating frequency is 20 MHz.

22. The cartridge-in-chamber detection system for firearms according to any of the preceding claims, **characterised in that** it comprises an electrostatic protection device.

23. The cartridge-in-chamber detection system for firearms according to any of the preceding claims, **characterised in that** it has a response time of less than 1 ms to determine if the cartridge (10) is present in the chamber (5) or otherwise.

24. The cartridge-in-chamber detection system for firearms according to any of the claims 2-7, 11, 12, **characterised in that** the second electrical contact (6, 212) is completely or partially disposed in the chamber (5).

25. The cartridge-in-chamber detection system for firearms according to claim 1, **characterised in that** the at least one electrical contact is in physical contact with the cartridge (10) in the situation in which

the at least one electrical contact is electrically connected to the metal parts of the weapon (5, 11, 101, 102, 206, 217) and the cartridge (10).

26. The cartridge-in-chamber detection system for firearms according to claim 1, **characterised in that** the at least one electrical contact is insulated with respect to the metal parts of the weapon (5, 11, 101, 102, 206, 217).

27. The cartridge-in-chamber detection system for firearms according to claim 1, **characterised in that** the at least one electrical contact is a firearm's own element.

28. The cartridge-in-chamber detection system for firearms according to claim 1, **characterised in that** the at least one electrical contact is a firearm's own modified element.

29. The cartridge-in-chamber detection system for firearms according to claim 1, **characterised in that** the at least one electrical contact is an external element to the firearm.

30. The cartridge-in-chamber detection system for firearms according to claim 1, **characterised in that** the at least one electrical contact is located in the chamber.

31. The cartridge-in-chamber detection system for firearms according to claim 1, **characterised in that** the at least one electrical contact (1, 114, 210) is located outside the chamber (5).

32. The cartridge-in-chamber detection system for firearms according to claim 31, **characterised in that** the at least one electrical contact (1) is disposed in a handguard (2) of the weapon.

33. The cartridge-in-chamber detection system for firearms according to claim 1, **characterised in that** the at least one electrical contact is not in physical contact with the cartridge (10) in the situation in which the at least one electrical contact is electrically connected to the metal parts of the weapon (5, 11, 101, 102, 206, 217) and the cartridge (10).

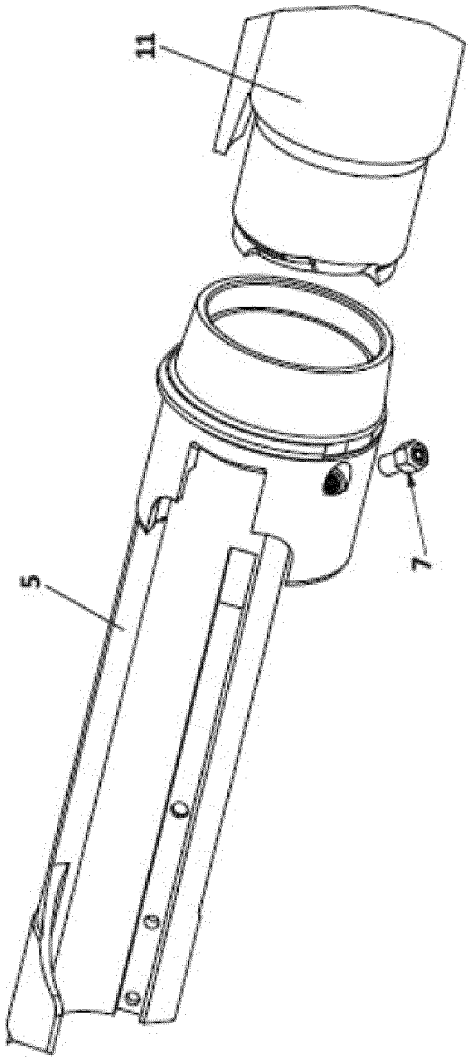

FIG. 1

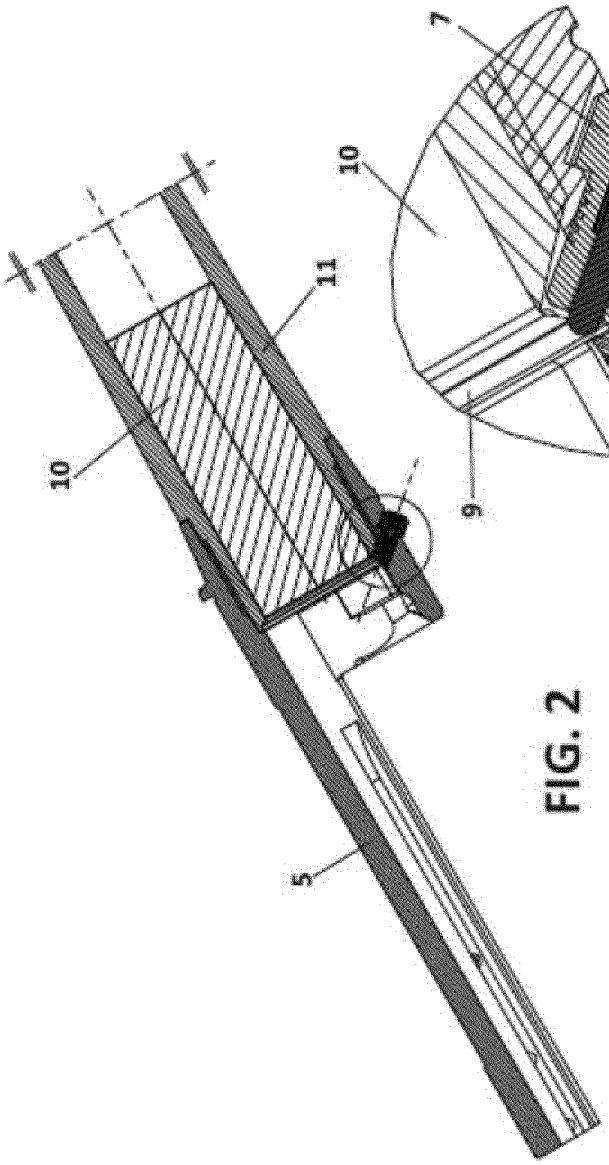

FIG. 2

FIG. 3

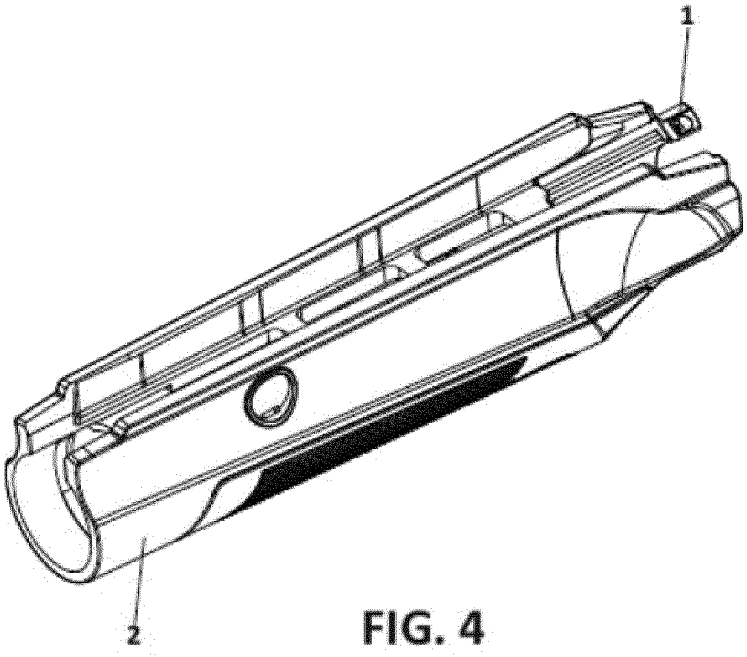

FIG. 4

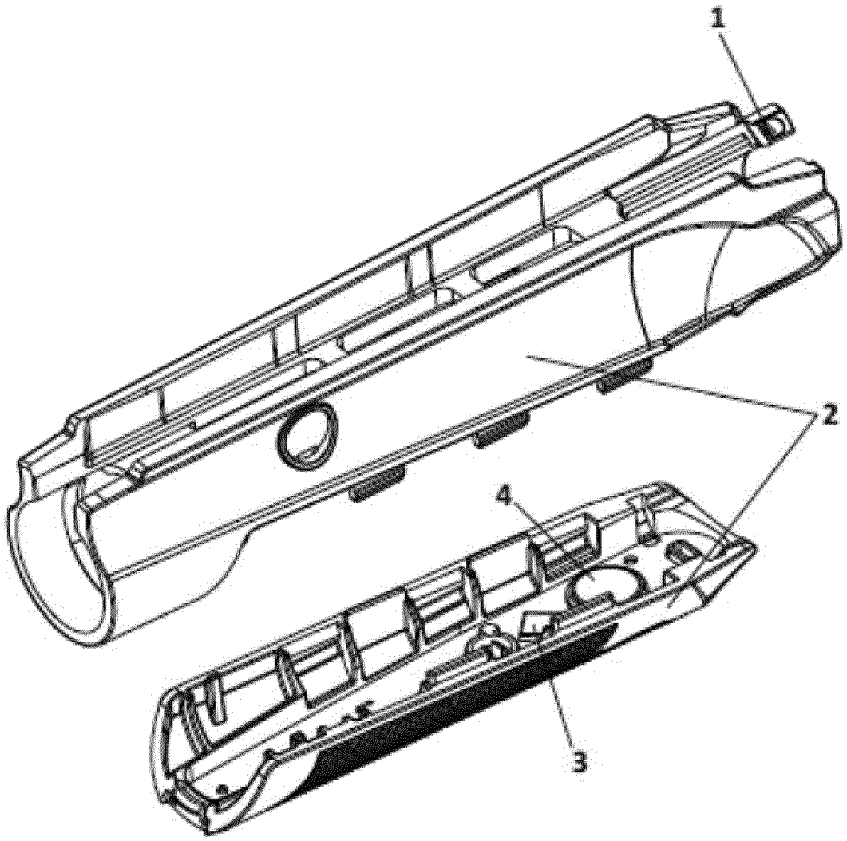

FIG. 5

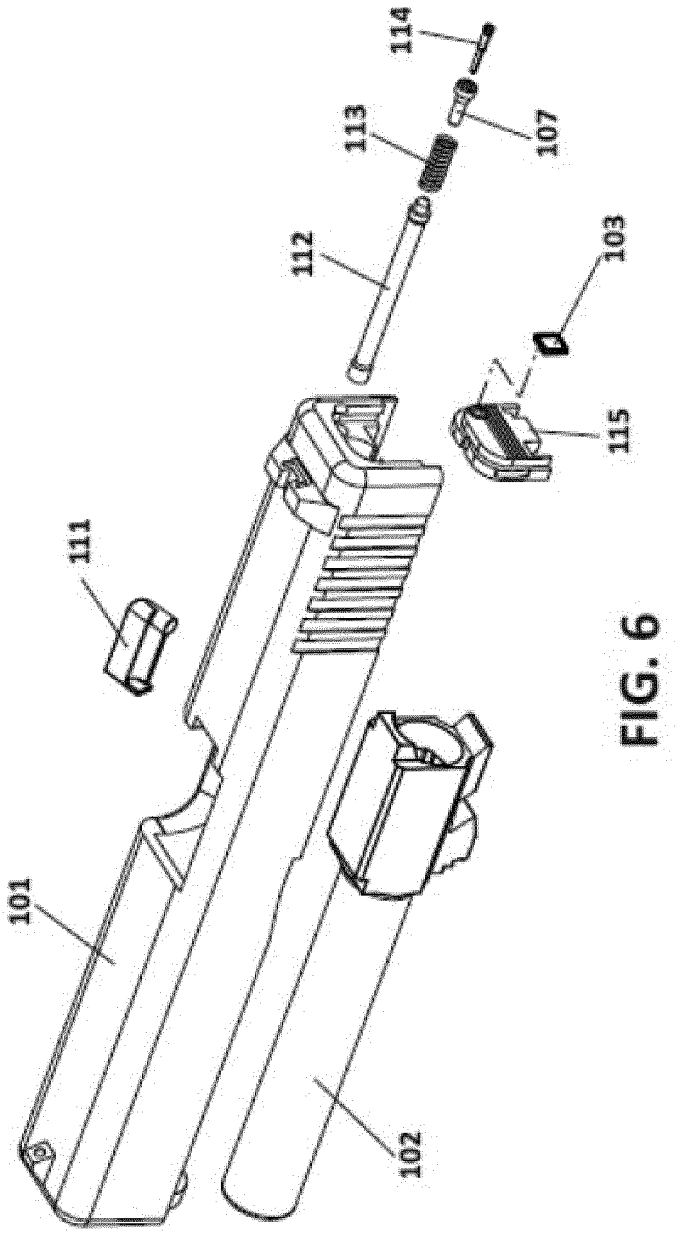

FIG. 6

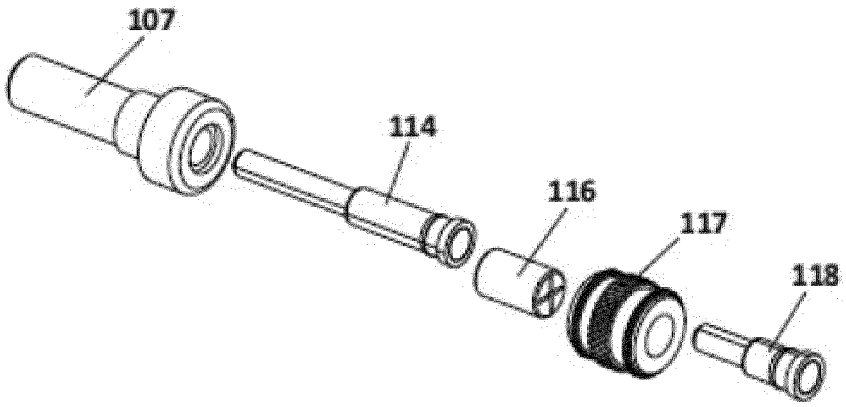

FIG. 7

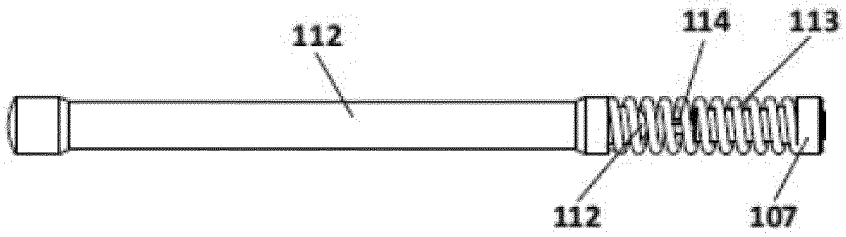

FIG. 8

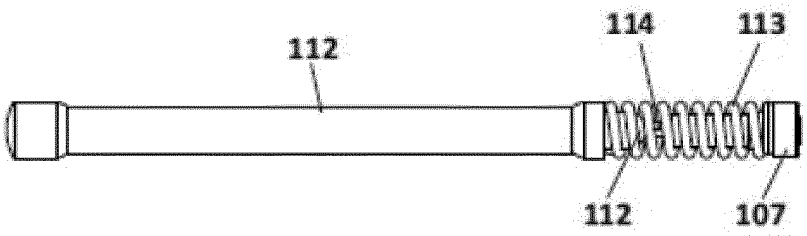

FIG. 9

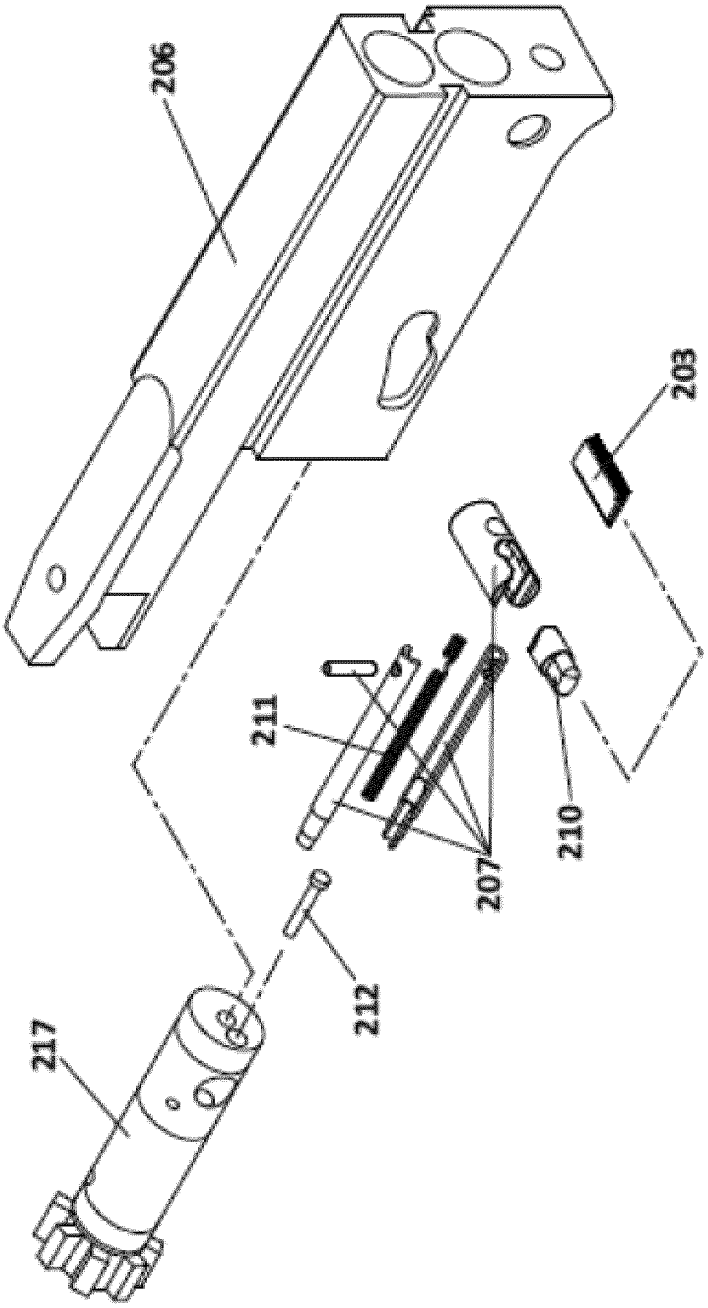

FIG. 10

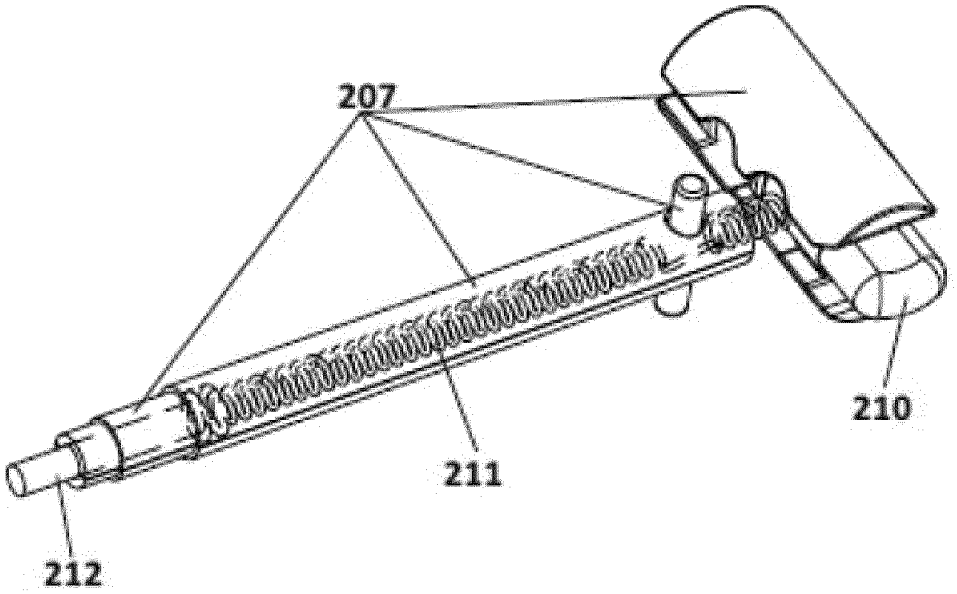

FIG. 11

INTERNATIONAL SEARCH REPORT

International application No
PCT/ES2016/070017

A. CLASSIFICATION OF SUBJECT MATTER
INV. F41A9/53
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F41A

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	EP 0 276 843 A2 (COLT IND INC [US]) 3 August 1988 (1988-08-03) page 5, line 41 - line 55; figures 5,6,8	1
A	US 5 755 056 A (DANNER DALE R [US] ET AL) 26 May 1998 (1998-05-26) cited in the application the whole document	1
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☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
2 May 2016	13/05/2016

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Giesen, Maarten

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/ES2016/070017

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Form PCT/ISA/210 (patent family annex) (April 2005)

REFERENCES CITED IN THE DESCRIPTION

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