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(54) **Fuel injection device**

Kraftstoffeinspritzventileinrichtung

Dispositif d'injection de carburant

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A (NIPPON SOKEN INC), 27 July 1999
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Description

[0001] The present invention relates to a fuel injection device which is preferably used in common rail fuel injection systems for internal combustion engines.

[0002] One example of a conventional fuel injection device is disclosed in publication of Japanese unexamined patent application No. Hei 11-200981. This fuel injection device injects fuel at high pressure from a common rail into respective cylinders of an internal combustion engine, using a piezoelectric actuator. As shown in FIG. 5, an upper portion of a housing 100 accommodates a piezostack 102. By extending and contracting the piezostack 102, fuel pressure within a control chamber 101 is decreased and increased to drive a needle valve 103 downwardly and upwardly. The control chamber 101 communicates with a high-pressure pump via a pressure regulator. The pressure in the control chamber 101 is adjusted approximately equal to the pressure in the common rail when the piezostack 102 is contracted. At this time, a lower portion 103c of the needle valve 103 is seated on a valve seat 111 to interrupt the communication between a fuel chamber 105 and an injection port 112.

[0003] The needle valve 103 is held such that a middle portion 103b slides within a first guide hole 104 of the housing 100 and an upper portion 103a having a greater diameter slides within a second guide hole 106 of the housing 100. Within a spring chamber 107 located above the upper portion 103a of the needle valve 103, a spring 109 is accommodated to apply a force to the needle valve 103 in the direction of the valve seat 111. On the other hand, the needle valve 103 receives a force in the direction away from the valve seat 111, which corresponds to the sum of a fuel pressure applied to a step 110 between an upper portion 103a and the middle portion 103b of the needle valve 103, a fuel pressure applied to a step 108 between the middle portion 103b and the lower portion 103c of the needle valve 103, and a fuel pressure applied to the area corresponding to the difference in diameter between the lower portion 103c and the valve seat 111. When the force applied in the direction away from the valve seat 111 exceeds the force applied in the direction of the valve seat 111, the needle valve 103 is lifted.

[0004] The operation of the conventional fuel injection device thus arranged will be explained with reference to the time charts shown in FIGS. 6(a) and 6(b). In FIGS. 6(a) and 6(b), at the time (1), a voltage is applied from a driving circuit to the piezostack 102, and the piezostack 102 starts to extend. Next, at the time (2), the needle valve 103 starts to be lifted, and at the time (3), the lift amount of the needle valve 103 reaches the maximum. In FIG. 6(a), before the time (1), the piezostack 102 is in a contracting state. In this state, the force of the spring 109, which is applied for closing the needle valve 103, exceeds the sum of the forces which are applied for opening the needle valve 103. Accordingly, the

needle valve 103 is pressed on the valve seat 111 to close the injection port 112. Both the control chamber 101 and the fuel chamber 105 are at the pressure equal to that in the common rail. At the time (1), when the piezostack 102 starts to extend, the volume of the control chamber 101 decreases, and the pressure therein rises to gradually increase the force applied to the step 110 in the direction away from the valve seat 111.

[0005] When the sum of the forces applied in the direction away from the valve seat increases and exceeds the force applied in the direction of the valve seat 111, the needle valve 103 leaves the valve seat 111 and starts to be lifted, whereby the fuel injection is started. From the time (2) to the time (3), the pressure in the control chamber 101 gradually increases due to the increment of the repulsion force of the spring 109, which is caused by the contraction thereof. At the time (3), the extension amount of the piezostack 102 reaches the maximum and the lift amount of the needle valve 103 reaches the maximum.

[0006] As described above, the conventional fuel injection device has the arrangement that the fuel pressure in the control chamber 101 and that in the fuel chamber 105 exert the force for opening the needle valve 103 while the spring 109 exerts the force for closing the needle valve 103. With this arrangement, however, the fuel pressure in the control chamber 101 and that in the fuel chamber 105 vary with the common rail pressure. When the common rail pressure increases, for example, as shown in FIG. 6(a), the fuel pressure in the control chamber 101 and that in the fuel chamber 105 rise to undesirably increase the force for opening the needle valve 103. Accordingly, the spring force for closing the needle valve must be increased in accordance with the set fuel pressure in the common rail, which depends on vehicle types, by exchanging the spring 109 for another one.

[0007] On the other hand, where the spring 109 is not exchanged for another one, the spring 109 must exhibit a great needle valve closing force (spring force), because the needle valve 103 is needed to be normally closed even under a great common rail pressure. However, when the common rail pressure is low, the needle valve closing force of the spring 109 greatly exceeds the needle valve opening force exerted by the fuel pressure. Accordingly, the fuel pressure in the control chamber 101 for opening the needle valve at the time (2) must be increased greatly. In other words, the volume of the control chamber 101 must be decreased greatly, whereby the extension amount of the piezostack 102 increases. Consequently, the piezoelectric actuator including the piezostack 102 becomes large to increase the dimensions of the overall device.

[0008] Accordingly, it is an object of the present invention to provide a fuel injection device for internal combustion engines, which does not need exchanging of a spring in accordance with a set pressure in a common rail, and which is capable of minimizing the extension

amount of a piezostack upon opening a needle valve, thereby decreasing the dimensions of the device.

[0009] The fuel injection device in accordance with the present invention includes a first control chamber adapted to apply a fuel pressure to a needle valve in a needle valve opening direction, and a spring adapted to apply a biasing force to the needle valve in a needle valve closing direction. By increasing the fuel pressure within the first control chamber with a piezoelectric actuator, the needle valve is lifted. A piston which slides integrally with the needle valve is further provided, and the fuel pressure within the first control chamber is applied to a lower end face of the piston. A second control chamber adapted to apply a fuel pressure to an upper end face of the piston in the needle valve closing direction is provided so as to communicate with a fuel supply line. In addition, a pressure storage chamber for storing a high pressure fuel to be fed to the injection port is provided so as to communicate with the second control chamber via a connection passage.

[0010] With the fuel injection device thus arranged, by providing the second control chamber adapted to apply a fuel pressure in a needle valve closing direction to the upper end face of the piston which is integral with the needle valve, the fuel pressure in the second control chamber is approximately balanced with the fuel pressure in the pressure storage chamber, which is applied in a needle valve opening direction. Accordingly, the needle valve receives only the closing force of the spring. Consequently, the spring is not required to be exchanged with the set pressure in a common rail, and the increment of the fuel pressure in the first control chamber, which is required for opening the needle valve, can be kept constant.

[0011] Furthermore, as the second control chamber communicates with the pressure storage chamber via communication means, when the volume of the second control chamber decreases with the axial stroke of the piston, for example, the fuel within the second control chamber is discharged to the pressure storage chamber via the communication means, thereby preventing increasing of the pressure in the second control chamber. Accordingly, the needle valve can be lifted speedily to minimize the extension amount of the piezoelectric actuator, which is required for opening the needle valve, thereby decreasing the dimensions of the piezoelectric actuator.

[0012] In a preferred embodiment of the present invention, the above-described communication means include a plurality of communication passages. With the present embodiment, when the needle valve is opened, fuel can be discharged from the second control chamber to the pressure storage chamber speedily, and when the needle valve is closed, fuel can be supplied from the pressure storage chamber to the second control chamber speedily.

[0013] In another preferred embodiment of the present invention, the above-described pressure stor-

age chamber is defined around the needle valve or an axis member for connecting the needle valve to the piston, and the spring is disposed in the fuel storage chamber. With the present embodiment, a necessary volume of the pressure storage chamber can be obtained without enlarging the diameter of the housing, thereby decreasing the dimensions of the fuel injection device.

[0014] Hereinafter the present invention will be explained with reference to the drawings, in which:

FIG. 1 is a view illustrating an overall construction of a first embodiment of a fuel injection device in accordance with the present invention;

FIG. 2 is a time chart explaining the operation of the fuel injection device of FIG. 1;

FIG. 3 is a view illustrating an overall construction of a second embodiment of a fuel injection device in accordance with the present invention;

FIG. 4 is a time chart explaining the operation of the fuel injection device of FIG. 3;

FIG. 5 is a view illustrating an overall construction of a conventional fuel injection device; and

FIG. 6(a) is a time chart explaining the effect of the variation of the common rail pressure on the operation of the conventional fuel injection device; and FIG. 6(b) is a time chart explaining the effect of the variation of the common rail pressure on the operation of the conventional fuel injection device in the case of a spring being not exchanged.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0015] Hereinafter, a first embodiment of the present invention will be explained with reference to FIGS. 1 and 2.

[0016] FIG. 1 illustrates the overall construction of a first embodiment of a fuel injection device wherein a high pressure fuel pressurized by a high-pressure pump is stored in a common rail and is fed to an injector I which is provided in every cylinder of an engine. Fuel is fed to the high pressure pump from a fuel tank (not shown) via a feed pump. The injector I has a housing 1 in which a piston 2 is slidably disposed. A nozzle holder 31 for accommodating a needle valve 3 is secured to a lower end of the housing 1, and a cover 42 for accommodating a piezostack 41 which defines a piezoelectric actuator 4 is secured to an upper end of the housing 1. The nozzle body 31 is secured to the housing 1 with a nozzle retainer 32, and the cover 42 is secured to the housing 1 with a retainer 43.

[0017] The piezoelectric actuator 4 includes a cup-shaped holder 44 which is fitted in an upper end portion of the housing 1, and a piston 45 which is accommodated in the holder 44. The upper end of the holder 44 abuts a lower end of the cover 42. The retainer 43 is screwed on the housing 1 while fitting around the cover 42 and holder 44. Accordingly, a force is applied to the cover 42 and holder 44 downwardly to bring them into contact

with the housing 1. The piston 45 is slidable on an inner wall of the holder 44 with a small clearance therebetween. An upper face of the piston 45 abuts a lower face of the piezostack 41. A biasing force of a spring 47 which is disposed in a space 46 defined by a lower face of the piston 45 and the holder 44 is applied to the piezostack 41 via the piston 45 upwardly to bring the upper face of the piezostack 41 into contact with a top face of the cover 42. When the piezostack 41 is extended or contracted with an external driving circuit via a lead line 48 which is connected to the upper face of the piezostack 41, the piston 45 moves upwardly or downwardly in contact with the piezostack 41.

[0018] A cylindrical nozzle body 31 has an injection port 33 at a lower end thereof, which projects from a retainer 32. When the needle valve 3 is seated on a valve seat face 34, the injection port 33 is interrupted from the upper stream side thereof. An upper end of the needle valve 3 is connected to a lower end of an axis member 2a which is integrally provided in a lower face of the piston 2 with a connector 21. Accordingly, the needle valve 3 and the piston 2 integrally move upwardly and downwardly. The piston 2 has a diameter smaller than that of the piston 45, and serves to amplify the stroke of the piston 45. A pressure storage chamber 11 is defined in a lower portion of the housing 1 for storing a high pressure fuel around the axis member 2a having a small diameter. The pressure storage chamber 11 feeds a high pressure fuel into a fuel chamber 35 as a space defined between the needle valve 3 and nozzle body 31.

[0019] The pressure storage chamber 11 is divided with a separating member 12 into an upper chamber and lower chamber. A spring 13 is disposed around the axis member 2a in the lower chamber which serves as a spring chamber to bias the piston 2 and the needle valve 3 downwardly (that is a valve closing direction). The upper chamber and lower chamber of the pressure storage chamber 11 communicate with each other via a plurality of communication passages 14 which are provided in the separating member 12.

[0020] An upper end portion of the axis member 2a is held within a first guide hole 15 provided above the pressure storage chamber 11 to be slidable therein with a small clearance. The piston 2 having a greater diameter than that of the axis member 2a is disposed in a second guide hole 16 which has a greater diameter than that of the first guide hole 15 and is provided above the first guide hole 15.

[0021] An annular space which is defined by a lower face of the piston 2 and a bottom wall of the second guide hole 16 serves as the first control chamber 5. The first control chamber 5 communicates with a space 46 defined below the piston 45 via a passage 51 which is formed in the housing 1 and the holder 44. The first control chamber 5, the passage 51 and the space 46 are respectively charged with a high pressure fuel which is fed from a common rail via an orifice passage (not

shown), thereby applying a fuel pressure to the piston 2 upwardly (that is a valve opening direction).

[0022] A space defined by an upper face 2c of the piston 2 and a top wall of the second guide hole 16 serves as a second control chamber 6. This second control chamber 6 communicates with a common rail via a fuel supply line 17 which projects sidewardly of the housing 1, and a bar filter 18, and applies a fuel pressure of a high pressure fuel fed from the common rail to the piston 2 downwardly (that is a valve closing direction). A communication passage 22 which is provided in the housing 1 so as to communicate with the pressure storage chamber 11 and the fuel supply line 17 in the vicinity of the second control chamber 6. Thus, the second control chamber 6 communicates with the pressure storage chamber 11 via the communication passage 22.

[0023] The operation of the fuel injection device thus arranged will be explained using the time chart of FIG. 2. As shown, before the time ①, no voltage is applied to the piezostack 41 from the driving circuit, and the piezostack 41 is contracted. At this time, the first control chamber 5, the second control chamber 6 and the pressure storage chamber 11 are at the fuel pressure equal to that within the common rail. Accordingly, the force for closing the needle valve 3, which is applied on the upper face 2c of the piston 2 due to the fuel pressure within the second control chamber 6, is approximately balanced with the force for opening the needle valve 3, which is applied on the lower face 2b of the piston 2 due to the fuel pressure within the first control chamber 5, and is applied to the area corresponding to the difference in diameter between the needle valve 3 and the valve seat face 34 due to the fuel pressure within the fuel chamber 35. Accordingly, the needle valve 3 only receives the force in the valve closing direction, which corresponds to the biasing force of the spring 13, and is seated on the valve seat 34. Consequently no fuel injection is performed.

[0024] Next, at the time ①, the voltage for application to the piezostack 41 is increased to open the needle valve 3. This results in the piezostack 41 extending and the piston 45 which is integral with the piezostack 41 moving downwardly, overcoming the biasing force of the spring 47. Consequently, the volume of the space 46 positioned below the piston 45 is reduced, and the pressure within the first control chamber 5 which communicates with the space 46 via the passage 51 rises to enlarge the force for opening the needle valve 3, which is applied to the lower face 2b of the piston 2. When the force for opening the needle valve 3 exceeds the force for closing the needle valve 3, which is due to the spring 13, the piston 2 starts to lift at the time ②. At the same time, the needle valve 3 which is integral with the piston 2 starts to lift. When the needle valve 3 leaves the valve seat face 34, fuel which has been fed to the fuel chamber 35 from the pressure storage chamber 11 is injected from the injection port 33.

[0025] When the piston 2 starts to lift, the volume of

the second control chamber 6 decreases. With the arrangement of the present embodiment, however, resulting rising of the pressure in the second control chamber 6, which is applied to the piston 2 in the needle valve closing direction, is restrained, because the second control chamber 6 communicates with the pressure storage chamber 11 via the communication passage 22. When the needle valve 3 is lifted and the fuel is injected, the pressure within the pressure storage chamber 11 decreases. By enlarging the diameter of the communication passage 22 sufficiently, the fuel within the second control chamber 6 can be discharged to the pressure storage chamber 11 speedily. Consequently, rising of the pressure applied to the piston 2 in the needle valve closing direction can be restrained, and the piston 2 can be lifted in accordance with the spontaneous movement of the piezostack 41.

[0026] Furthermore, where the set pressure in the common rail varies, the fuel pressure in the needle valve opening direction and the fuel pressure in the needle valve closing direction, which are applied to the piston 2, are balanced with each other, and consequently only the force for closing the needle valve 3, which is exerted by the spring 13, is applied to the piston 2. This results in a necessary pressure increase in the first control chamber 5 can be kept constant irrespective of the variation of the pressure in the common rail, and at the time ③, the extension amount of the piezostack 41 reaches the maximum and the lift amount of the valve needle 3 reaches the maximum. Accordingly, the spring 13 is not needed to be exchanged in accordance with the pressure in the common rail, and the spring force can be determined such that the extension amount of the piezostack 41 is the minimum. Consequently, the dimensions of the piezoelectric actuator can be decreased. In addition, since the pressure storage chamber 11 is provided around the axis member 2a and the spring 13 is disposed in the pressure storage chamber 11, the overall device can be minimized further.

[0027] FIG. 3 illustrates a second embodiment of the present invention. In the second embodiment, a plurality of communication passages 22 are provided for communicating with the second control chamber 6 and the pressure storage chamber 11. With this arrangement, when the piston 2 is lifted, the fuel can be discharged from the second control chamber 6 to the pressure storage chamber 11 more speedily.

[0028] In addition, in the present embodiment, a fuel supply line (not shown) is formed in a housing 1 for supplying a fuel pressure from a common rail to the second control chamber 6. The remainder of construction of the present embodiment is substantially equal to that of the first embodiment.

[0029] FIG. 4 is a time chart which explains the operation of the second embodiment in comparison with that of the first embodiment. Before the time ②, the operation of the second embodiment is similar to that of the first embodiment. In the second embodiment, when the

needle valve 3 starts to lift at the time ②, the fuel is readily discharged from the second control chamber 6 to the pressure storage chamber 11 via a plurality of communication passages 22. Accordingly, rising of the pressure in the second control chamber 6 is restrained. On the other hand, the pressure in the first control chamber 5 rises speedily.

[0030] As a result, the lift amount of the piston 2 reaches the maximum at the time ③ earlier than that of the first embodiment.

[0031] At the time ④, the voltage which has been applied to the piezostack 41 is decreased to close the needle valve 3. This results in the piezostack 41 being contracted and the piston 45 moving upwardly to decrease the pressure in the first control chamber 5. Consequently, the piston 2 starts to descend. When the force for opening the valve needle becomes less than that for closing the valve needle with the spring 13, the needle valve 3 is seated on the valve seat face 34 to finish fuel injection. At this time, as the piston 2 descends, the volume of the second control chamber 6 increases. With the arrangement of the second embodiment, which includes a plurality of communication passages 22, the fuel which corresponds to the increment of the volume of the second control chamber 6 is immediately fed from the pressure storage chamber 11 to the second control chamber 6. Accordingly, the decrease in pressure in the second control chamber 6 is very small so that the piston 2 descends speedily to finish fuel injection before the time ⑤ when the contraction of the piezostack 41 is finished.

[0032] With the present embodiment, the needle valve can be opened and closed more speedily, and the fuel injection properties can be improved.

[0033] A fuel injection device for internal combustion engines includes a needle valve (3) for opening and closing an injection port (33), a control chamber (5) for applying a fuel pressure to the needle valve (3) in a needle valve opening direction, a spring (13) for applying a biasing force to the needle valve (3) in a needle valve closing direction, a piezoelectric actuator (4) for increasing and decreasing a fuel pressure in the control chamber (5), a piston (2) which slides with the needle valve (3) so as to receive the fuel pressure in the control chamber (5) at a lower end face (2b) thereof, and a pressure storage chamber (11) for storing a fuel to be supplied to the injection port (33). The fuel injection device further includes another control chamber (6) which communicates with a fuel supply line (17) for applying a fuel pressure to an upper end face (2c) of the piston (2) in a needle valve closing direction. The another control chamber (6) communicates with the pressure storage chamber (11) via communication means (22).

Claims

1. A fuel injection device for an internal combustion

engine comprising a housing (1) defining an injection port (33), a needle valve (3) for opening and closing said injection port (33), a control chamber (5) defined by said housing (1) for applying a fuel pressure to said needle valve (3) in a needle valve opening direction, a spring (13) for applying a biasing force to said needle valve (3) in a needle valve closing direction, a piezoelectric actuator (4) for increasing and decreasing a fuel pressure in said control chamber (5), a piston (2) which slides with said needle valve (3), said piston (2) receiving said fuel pressure in said control chamber (5), and a pressure storage chamber (11) defined by said housing (1) for storing a fuel to be supplied to said injection port (33), **characterized in that** said housing (1) further defines another control chamber (6) which communicates with a fuel supply line (17) for applying a fuel pressure to an upper end face (2c) of said piston (2) in a needle valve closing direction, said piston (2) receives said fuel pressure in said control chamber (5) in said needle valve opening direction on a lower end face (2b) thereof, and said another control chamber (6) communicates with said pressure storage chamber (11) via communication means (22).

2. A fuel injection device as claimed in claim 1, wherein said communication means (22) for communicating with said another control chamber (6) and said pressure storage chamber (11) includes a plurality of communication passages (22) provided in said housing (1).
3. A fuel injection device as claimed in claim 1, wherein said pressure storage chamber (11) is provided around one of said needle valve (3) and an axis member (2a) for connecting said needle valve (3) to said piston (2), and said spring (13) is provided in said pressure storage chamber (11).
4. A fuel injection device as claimed in claim 1, wherein when said piezoelectric actuator (4) is extended, said fuel pressure in said control chamber (5) is increased to lift said needle valve (3).
5. A fuel injection device as claimed in claim 1, wherein when said piezoelectric actuator (4) is contracted, said fuel pressure in said control chamber (5) in said needle valve opening direction is balanced with said fuel pressure in said another control chamber (6) in said needle valve closing direction.

Patentansprüche

1. Kraftstoffeinspritzventileinrichtung für eine interne Verbrennungskraftmaschine, umfassend ein Gehäuse (1) mit einer darin ausgebildeten Einspritz-

öffnung (33), ein Nadelventil (3) zum Öffnen und Schließen der Einspritzöffnung (33), eine in dem Gehäuse (1) ausgebildete Steuerkammer (5) zum Aufbringen eines Kraftstoffdrucks auf das Nadelventil (3) in einer Öffnungsrichtung des Nadelventils, eine Feder (13) zum Aufbringen einer Vorspannkraft auf das Nadelventil (3) in einer Schließrichtung des Nadelventils, eine piezoelektrische Betätigungseinrichtung (4) zum Steigern und Vermindern eines Kraftstoffdrucks in der Steuerkammer (5), einen Kolben (2), der mit dem Nadelventil (3) gleitet und der mit dem Kraftstoffdruck der Steuerkammer (5) beaufschlagt wird, und eine in dem Gehäuse (1) ausgebildete Druckspeicherkammer (11) zum Speichern eines der Einspritzöffnung (33) zuzuführenden Kraftstoffs,

dadurch gekennzeichnet, dass

in dem Gehäuse (1) eine weitere Steuerkammer (6) ausgebildet ist, die mit einer Kraftstoffzuführleitung (17) in Verbindung steht, um einen Kraftstoffdruck auf eine obere Endfläche (2c) des Kolbens (2) in Schließrichtung des Nadelventils aufzubringen, dass der Kolben (2) an seiner unteren Endfläche (2b) in der Steuerkammer (5) mit einem Kraftstoffdruck in Öffnungsrichtung des Nadelventils beaufschlagt wird, und dass die weitere Steuerkammer (6) über eine Verbindungseinrichtung (22) mit der Druckspeicherkammer (11) in Verbindung steht.

2. Kraftstoffeinspritzventileinrichtung für eine interne Verbrennungskraftmaschine nach Anspruch 1, wobei die Verbindungseinrichtung (22) zur Verbindung der weiteren Steuerkammer (6) mit der Druckspeicherkammer (11) mehrere in dem Gehäuse (1) ausgebildete Verbindungskanäle (22) umfaßt.
3. Kraftstoffeinspritzventileinrichtung für eine interne Verbrennungskraftmaschine nach Anspruch 1, wobei die Druckspeicherkammer (11) rings um das Nadelventil (3) und eine Stange (2a) zur Verbindung des Nadelventils (3) mit dem Kolben (2) vorgesehen ist, und wobei die Feder (13) in der Druckspeicherkammer (11) vorgesehen ist.
4. Kraftstoffeinspritzventileinrichtung für eine interne Verbrennungskraftmaschine nach Anspruch 1, wobei, wenn sich die piezoelektrische Betätigungseinrichtung (4) ausdehnt, der Kraftstoffdruck in der Steuerkammer zum Anheben des Nadelventils (3) erhöht wird.
5. Kraftstoffeinspritzventileinrichtung für eine interne Verbrennungskraftmaschine nach Anspruch 1, wobei, wenn sich die piezoelektrische Betätigungseinrichtung (4) zusammenzieht, der Kraftstoffdruck in der Steuerkammer (5) in Öffnungsrichtung des Nadelventils (3) mit dem Kraftstoffdruck in der weiteren Steuerkammer (6) in Schließrichtung des Na-

delventils (3) ausgeglichen wird.

Revendications

1. Dispositif d'injection de carburant pour un moteur à combustion interne comprenant un logement (1) définissant un port d'injection (33), un pointeau (3) pour ouvrir et fermer ledit port d'injection (33), une chambre de commande (5) définie par ledit logement (1) pour appliquer une pression de carburant audit pointeau (3) dans une direction d'ouverture du pointeau, un ressort (13) pour appliquer une force de rappel audit pointeau (3) dans une direction de fermeture du pointeau, un actionneur piézoélectrique (4) pour augmenter et diminuer une pression de carburant dans ladite chambre de commande (5), un piston (2) qui coulisse avec ledit pointeau (3), ledit piston (2) recevant ladite pression de carburant dans ladite chambre de commande (5), et une chambre de stockage de pression (11) définie par ledit logement (1) pour stocker un carburant à fournir audit port d'injection (33), **caractérisé en ce que** ledit logement (1) définit de plus une autre chambre de commande (6) qui communique avec une conduite d'alimentation de carburant (17) pour appliquer une pression de carburant à une face d'extrémité supérieure (2c) dudit piston (2) dans une direction de fermeture du pointeau, ledit piston (2) reçoit ladite pression de carburant dans ladite chambre de commande (5) dans ladite direction d'ouverture du pointeau sur sa face d'extrémité inférieure (2b), et ladite autre chambre de commande (6) communique avec ladite chambre de stockage de pression (11) via un moyen de communication (22).
2. Dispositif d'injection de carburant selon la revendication 1, dans lequel ledit moyen de communication (22) pour communiquer avec ladite autre chambre de commande (6) et ladite chambre de stockage de pression (11) comprend une pluralité de passages de communication (22) fournis dans ledit logement (1).
3. Dispositif d'injection de carburant selon la revendication 1, dans lequel ladite chambre de stockage de pression (11) est fournie autour de l'un des dits pointeaux (3) et d'un élément d'axe (2a) pour relier ledit pointeau (3) audit piston (2), et on fournit ledit ressort (13) dans ladite chambre de stockage de pression (11).
4. Dispositif d'injection de carburant selon la revendication 1, dans lequel ledit actionneur piézoélectrique (4) est étendu, on augmente ladite pression de carburant dans ladite chambre de commande (5) pour lever ledit pointeau (3).
5. Dispositif d'injection de carburant selon la revendication 1, dans lequel lorsque ledit actionneur piézoélectrique (4) est contracté, ladite pression de carburant dans ladite chambre de commande (5) dans ladite direction d'ouverture du pointeau est équilibrée avec ladite pression de carburant dans ladite autre chambre de commande (6) dans ladite direction de fermeture du pointeau.

FIG. 1

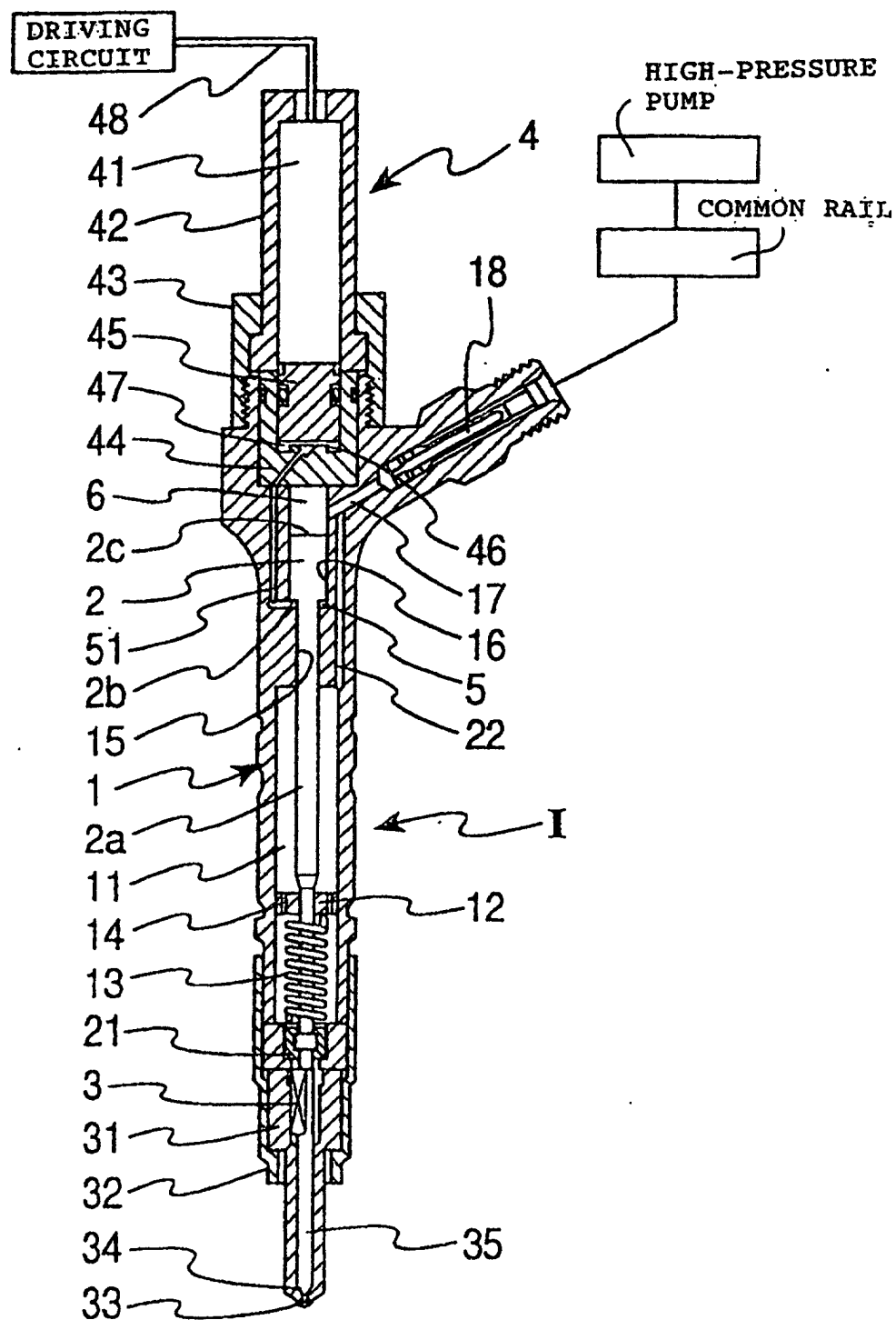
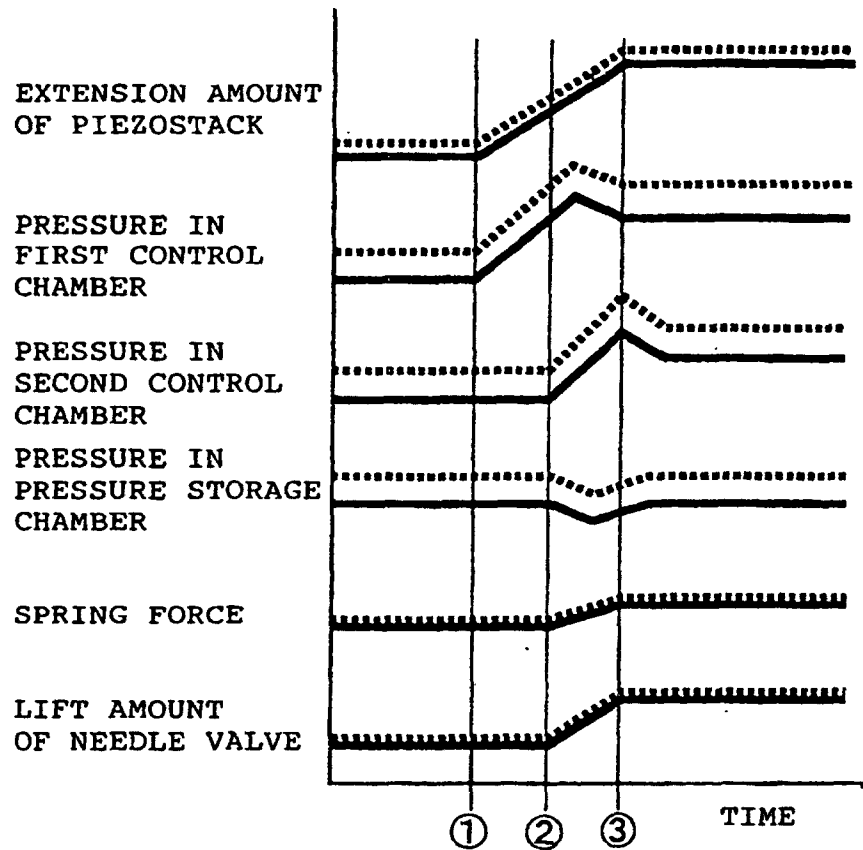


FIG.2



- ① : START OF EXTENSION OF
PIEZOSTACK
- ② : START OF LIFT OF NEEDLE
VALVE
- ③ : END OF LIFT
OF NEEDLE VALVE
(MAXIMUM LIFT AMOUNT)
- : HIGH COMMON RAIL PRESSURE
- : LOW COMMON RAIL PRESSURE

FIG. 3

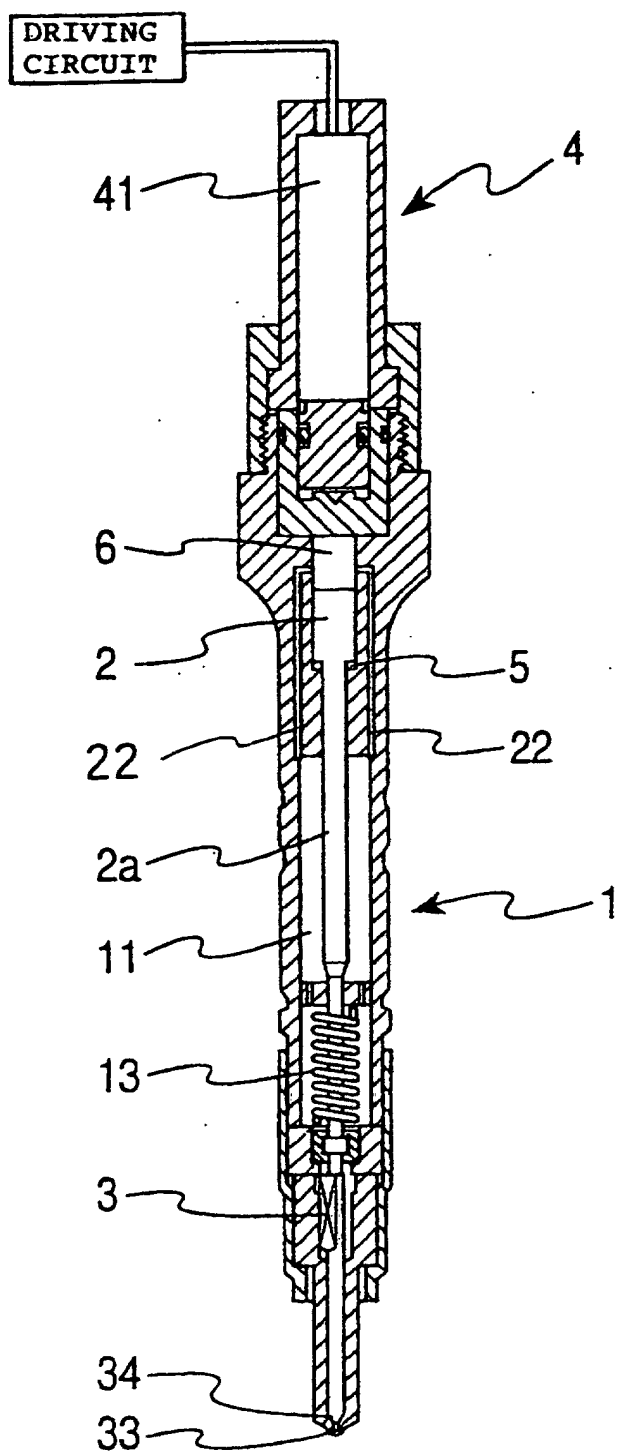


FIG. 4

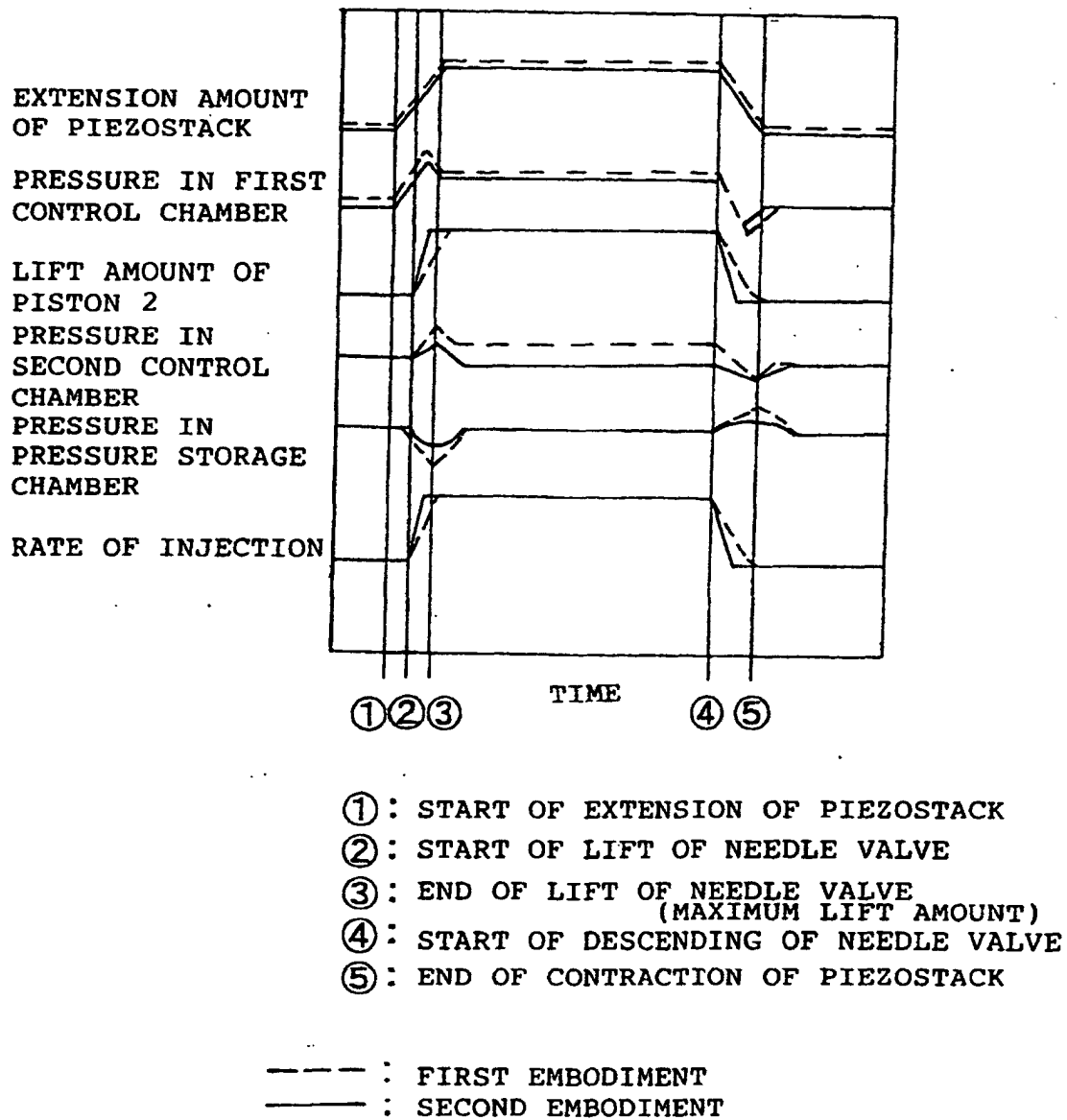


FIG. 5

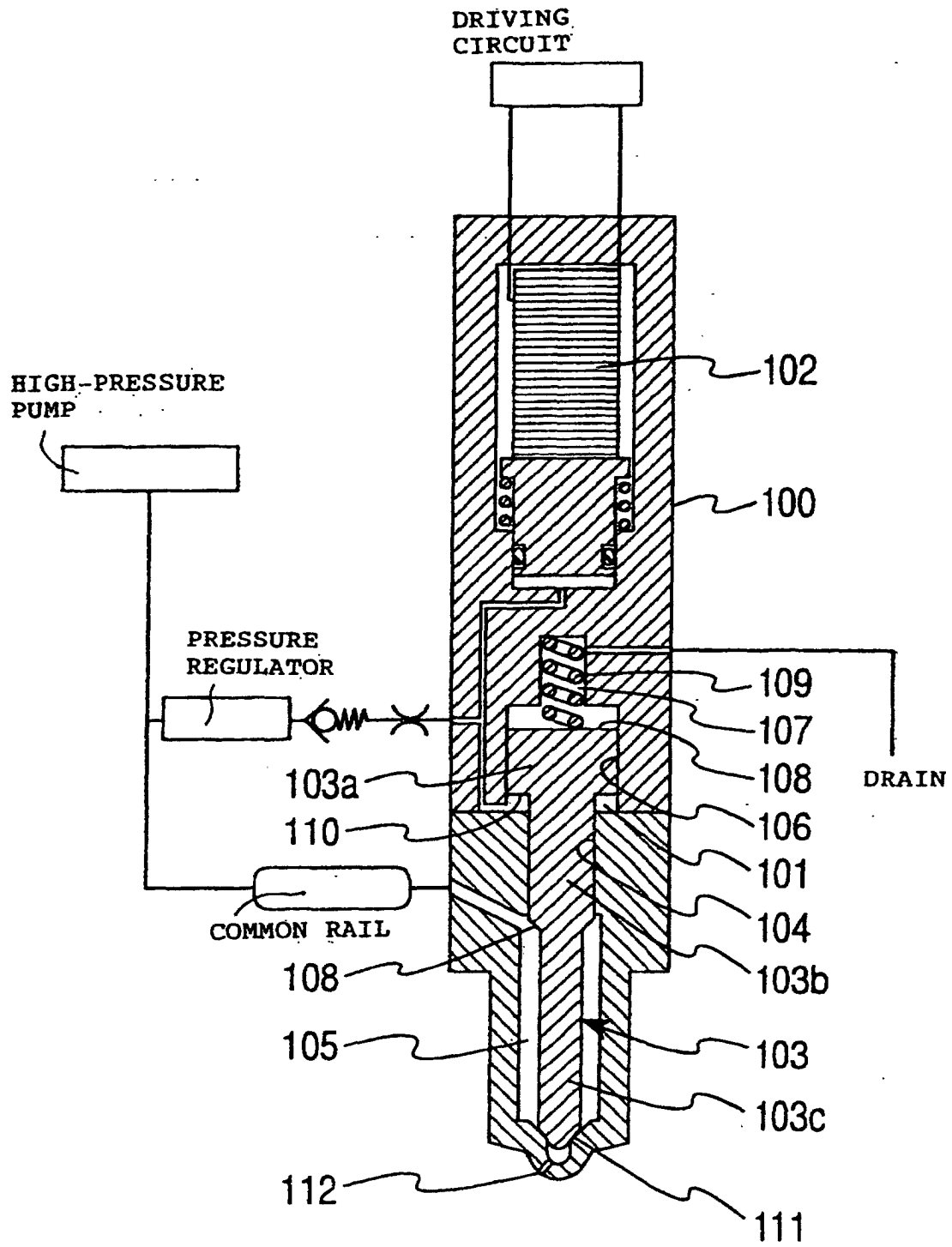


FIG. 6 (a)

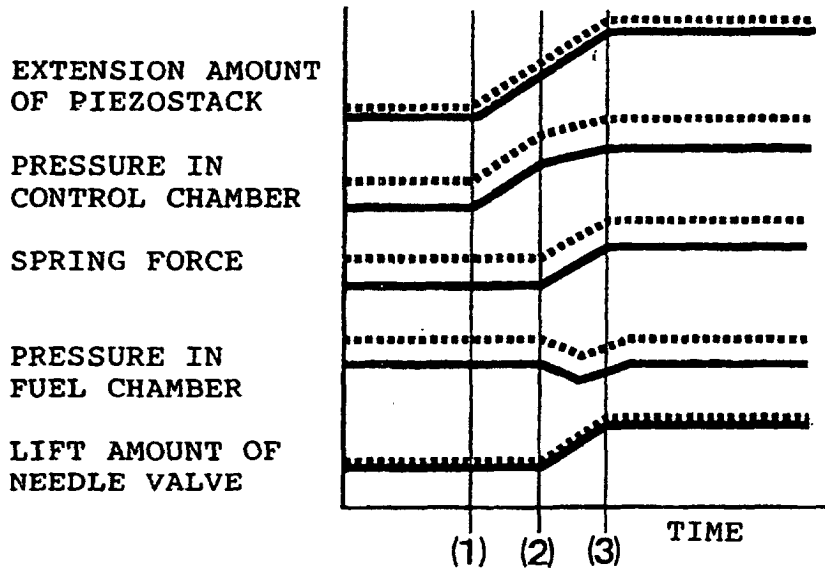
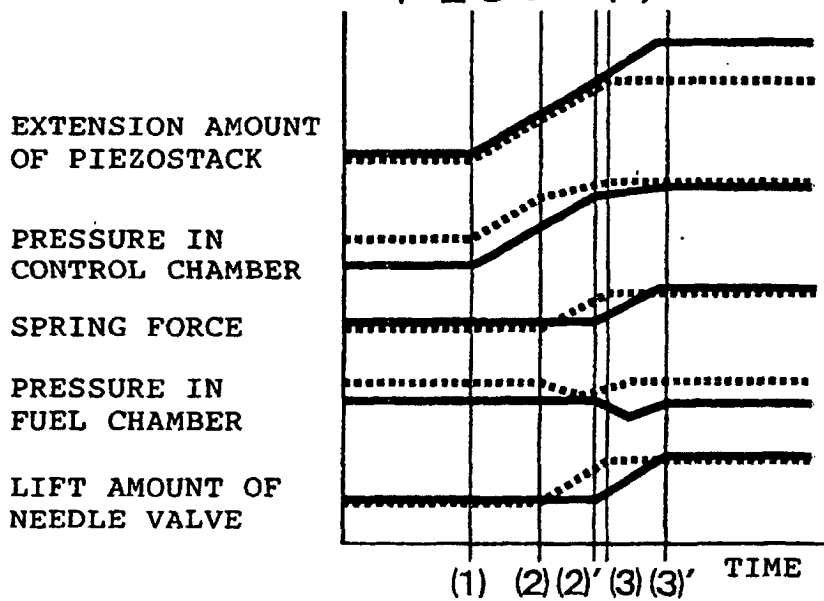


FIG. 6 (b)



- (1): START OF EXTENSION OF PIEZOSTACK
 (2): START OF LIFT OF NEEDLE VALVE
 (3): END OF LIFT OF NEEDLE VALVE (MAXIMUM LIFT AMOUNT)

..... : HIGH COMMON RAIL PRESSURE
 ————— : LOW COMMON RAIL PRESSURE