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(72) Inventors:
• **Sakagami, Nobuyuki**
Tokyo Tokyo (JP)
• **Kameda, Hideaki**
Tokyo Tokyo (JP)
• **Miyashita, Hiroshi**
Tokyo Tokyo (JP)

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(71) Applicant: **Mitsubishi Jidosha Kogyo Kabushiki Kaisha**
Tokyo 108-8410 (JP)

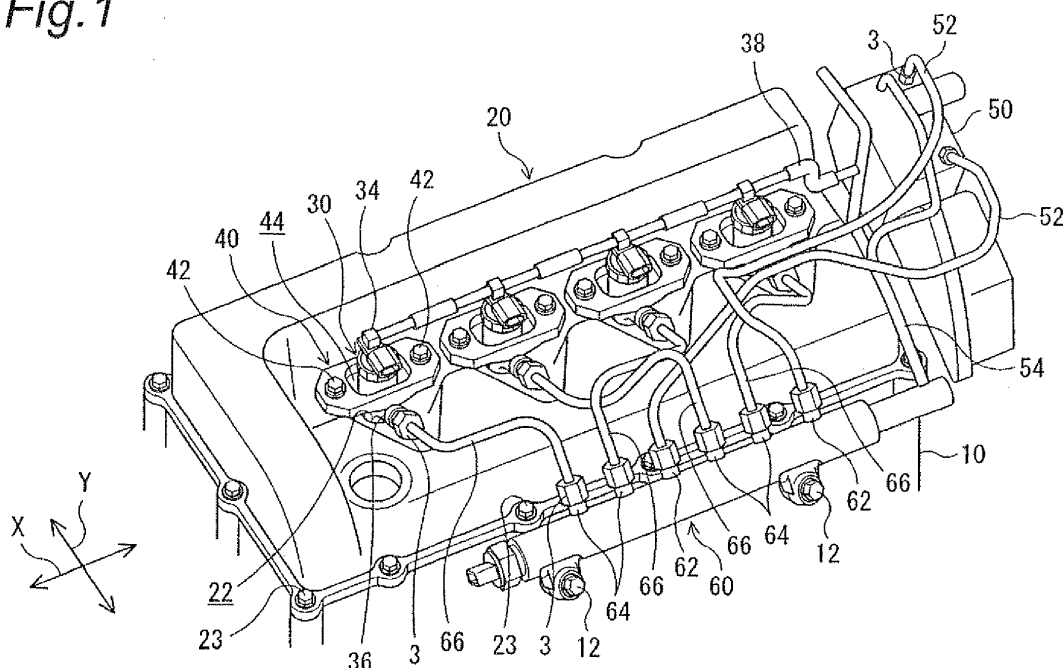
(74) Representative: **Frhr.Schenck zu Schweinsberg, Elard**
Vossius & Partner
Siebertstrasse 3
81675 München (DE)

(54) **Injector removal tool**

(57) There is provided an injector removal tool for removing an injector from a cylinder head. A support platform is fixed to the cylinder head. A pivot portion is mounted on the support platform. A arm portion is provided so as to rotate on the pivot portion as a fulcrum. A transfer

portion is supported on the arm portion at one end in a position lying spaced away from the pivot portion and is locked on the injector at the other end thereof. A force exerted on the one end to rotate the arm portion is transferred as a force to remove the injector at the other end.

Fig.1



Description

BACKGROUND

[0001] The present invention relates to an injector removal tool.

[0002] There is related an injector removal tool for removing injectors from a cylinder head (refer to Patent Document 1). The injectors are removed, by the related injector removal tool, individually by making use of threaded portions provided at head portions of the injectors.

[Patent Document 1] Japanese Patent Publication Number 2008-261273 A

SUMMARY

[0003] The related injector removal tool is designed to remove the injectors individually from the cylinder head. Consequently, in the work using the related tool, the injectors need to be disconnected from the fuel pipe so that the injectors can be removed from the cylinder head. Consequently, man-hours involved in the removal of the injectors are increased. In addition, when reinstalling the cylinder head, the injectors need to be aligned with the fuel pipe, which makes complex the reinstallation work of the injectors.

[0004] It is therefore an object of the invention to provide an injector removal tool which can remove injectors from a cylinder head without involving work to disconnect a fuel pipe from the injectors.

[0005] According to an advantageous aspect of the invention, there is provided an injector removal tool for removing an injector from a cylinder head, comprising:

- a support platform portion adapted to be fixed to the cylinder head;
- a pivot portion which is mounted on the support platform portion;
- an arm portion provided so as to rotate about the pivot portion as a fulcrum; and
- a transfer portion, one end of which is supported on the arm portion in a position spaced away from the pivot portion, and the other end of which is locked on the injector, the transfer portion configured to transfer a force applied on the one end to rotate the arm portion as a force to remove the injector at the other end.

[0006] The arm portion may comprise: a first arm portion, which extends from the pivot portion to the one end of the arm portion; and a second arm portion, which extends from the pivot portion to a point of effort on which a force to rotate the second arm is applied on a side of the pivot portion which is different from a side of the one end of the arm portion, and having a length being longer than a length of the first arm portion.

[0007] The second arm portion may extend upward than the support platform portion.

[0008] A plurality of injectors like the injector may be provided in the cylinder head, and pluralities of transfer portions and arms like the transfer portion and the arm portion are provided so as to correspond individually to the plurality of injectors.

[0009] One ends of the transfer portions may be disposed above the injectors in the vertical direction of the vehicle and on extensions of the injectors.

[0010] Each of the injectors may have a branch pipe portion which diverges from a lateral side of the injector, and each of the transfer portions may have: a locking portion configured to be locked in the vicinity of a base end portion of the branch pipe portion; a proximal end portion formed at the one end so as to be mounted rotatably on the arm portion; and a connecting portion connecting the locking portion with the proximal end portion.

[0011] Proximal end portions like the proximal end portion may be disposed at both sides of the injector in pair and are each mounted rotatably on the arm portion, and the locking portion and the connecting portion may be formed into a U-shape when viewed from thereabove which connects the pair of proximal end portions together.

[0012] The connecting portion may be formed by being bent at an intermediate position along the length thereof so as to apply as a force removing the injector upward..

[0013] The proximal end portion may be made detachable with respect to the arm portion.

[0014] The support platform may be disposed above the injectors, and have: a pedestal portion on which the pivot portion is positioned; and a leg portion which supports the pedestal portion on the cylinder head.

[0015] The leg portion may be seated in the cylinder head while being inserted in a rocker cover mounting hole formed in the cylinder head to be positioned therein.

[0016] According to the injector removal tool of the invention, the injectors can be removed from the cylinder head without involving work to disconnect the fuel pipe from the injectors.

BRIEF DESCRIPTION OF THE DRAWING

[0017]

Fig. 1 is a perspective view showing an external appearance of an upper portion of an engine.

Fig. 2 is a perspective view showing a state in which an injector removal tool according to an embodiment of the invention is placed on a cylinder cover of the engine in Fig. 1.

Fig. 3 is a perspective view showing the injector removal tool shown in Fig. 2 and an injector unit which is removed.

Fig. 4 is a side view showing the injector removal tool shown in Fig. 2 and the injector unit which is removed.

Fig. 5 is a perspective view showing a working step of removing the injector unit from the cylinder head by use of the injector removal tool shown in Fig. 2. Fig. 6 is a perspective view showing a working step of removing the injector unit from the cylinder head by use of the injector removal tool shown in Fig. 2. Fig. 7 is a perspective view showing a working step of removing the injector unit from the cylinder head by use of the injector removal tool shown in Fig. 2. Fig. 8 is a perspective view showing a working step of removing the injector unit from the cylinder head by use of the injector removal tool shown in Fig. 2. Fig. 9 is a perspective view showing a working step of removing the injector unit from the cylinder head by use of the injector removal tool shown in Fig. 2. Fig. 10 is a perspective view showing a working step of removing the injector unit from the cylinder head by use of the injector removal tool shown in Fig. 2. Fig. 11 is a side view showing a working step of removing the injector unit from the cylinder head by use of the injector removal tool shown in Fig. 2. Fig. 12 is a perspective view showing a working step of removing the injector unit from the cylinder head by use of the injector removal tool shown in Fig. 2.

DETAILED DESCRIPTION OF EXEMPLIFIED EMBODIMENTS

[0018] Hereinafter, an embodiment of the invention will be described.

[0019] Fig. 1 is a perspective view showing an external appearance of an upper portion of an engine. As is shown in the figure, a cylinder cover 20 is fixed to a cylinder head 10 of the engine, and a number of insertion holes 22 which corresponds to the number of cylinders are provided in an upper surface of the cylinder cover (a rocker cover) 20. An injector 30 is inserted into each insertion hole 22. In this embodiment, the engine is an in-line, four-cylinder engine, and four insertion holes 22 are provided. The injector 30 is held in the cylinder head 10 in such a state that a distal end faces a combustion chamber and is fixed to the upper surface of the cylinder head cover 20 with a metallic support fixture 40 and two bolts 41. A direction in which the injectors 30 are aligned or an axial direction of a crankshaft is referred to as an X-direction, and a horizontal direction which intersects the axial direction of the crankshaft at right angles is referred to a Y-direction.

[0020] The metallic support fixture 40 is a rectangular plate which extends lengthwise in the X-direction, and an insertion hole 44 is formed in a central portion of the metallic support fixture 40 so that the injector 30 is inserted therethrough. This insertion hole 44 is an oval through hole which extends lengthwise in the X-direction, and the cylindrical injector 30 is inserted through a longitudinal central portion of the insertion hole 44. Because of this, longitudinal end portions of the through hole 44 are left open without being closed by the injector 30. A

holding portion 32 (refer to Fig. 4) is provided at an upper portion of the injector 30 so as to hold the metallic support fixture 40. The holding portion 32 has stepped portions which project in the Y-direction from both sides of the injector 30, whereby end portions in the Y-direction of the metallic support fixture 40 are held by the stepped portions. In addition, through holes are formed in longitudinal end portions of the metallic support fixture 40 so that the bolts 42 are inserted therethrough. The metallic support fixture 40 is fixed to the upper surface of the cylinder head 20 by the bolts 42 at the longitudinal end portions thereof.

[0021] A high-pressure injection pump 50 is attached to one end of the cylinder head 10 in the X-direction, and a common rail 60, which extends in the X-direction, is attached to one side (a near side in Fig. 1) of the cylinder head 10 in the Y-direction. Pipe connecting ports 62 are provided in the common rail 60 at an axial end and a central portion thereof. Fuel supply pipes 52 which extend from the high-pressure injection pump 50 connect to these pipe connecting ports 62. In addition, four pipe connecting ports 64 are disposed in the common rail 60 along an axial direction of the common rail 60. Fuel supply pipes 66 which extend from the injectors 30 connect to these pipe connecting ports 64.

[0022] End portions of the fuel supply pipes 52 which connect the high-pressure injection pump 50 with the common rail 60 and end portions of the fuel supply pipes 66 (a manifold portion) which connect the common rail 60 with the injectors 30 are pressed against connecting ports in the high-pressure injection pump 50 and the injectors 30 and the corresponding pipe connecting ports 62, 64 in the common rail 60 for connection in a sealed state with flared nuts 3. Namely, the connection between the high-pressure injection pump 50 and the fuel supply pipes 52, the connection between the pipe connecting ports 62 in the common rail 60 and the fuel supply pipes 52, the connection between the pipe connecting ports 64 in the common rail 60 and the fuel supply pipes 66 and the connection between the injectors 30 and the fuel supply pipes 66 are effected by tightening the flared nuts 3. By tightening the flared nuts 3, the end portions of the fuel supply pipes 52, 66 are pressed against the corresponding connecting ports and pipe connecting ports so as to be fixed thereto in the sealed state through metallic contact.

[0023] The longitudinal end portion of the common rail 60 and the high-pressure injection pump 50 is connected together by a return pipe 54. A communication pipe connecting portion 34 is provided at an upper portion of the injector 30 so that a communication pipe 38 connecting to the return pipe 54 is connected thereto. The plurality of injectors 30 are connected to the high-pressure injection pump 50 by the communication pipes 38 and the return pipe 54. Drain fuel from the injectors 30 and the common rail 60 is designed to return to a fuel tank through the communication pipes 38 and the fuel return pipe 54.

[0024] The common rail 60 is disposed further out-

wards of the one side of the cylinder head cover 20 in the Y-direction and further downwards thereof and is fixed on a sloping surface on one side of the cylinder head 10 in the Y-direction with bolts 12. The cylinder head cover 20 is a rectangular member when viewed from thereabove which extends lengthwise in the X-direction. A plurality of insertion holes 24 (refer to Fig. 2) are formed in each of one side edge and the other side edge in the Y-direction of the cylinder head cover 20, and the cylinder head cover 20 is fixed to an upper portion of the cylinder head 10 with bolts 23 which are inserted through these insertion holes 24. Namely, the insertion holes 24 are rocker cover mounting bolt holes.

[0025] Here, one insertion hole 24 of the plurality of insertion holes 24 which are disposed in the side edge on the common rail 60 side (the one side in the Y-direction) of the cylinder head cover 20 is disposed close to the pipe connecting port 62 disposed in the axially central portion of the common rail 60. On the other hand, the other insertion hole 24 is disposed further outwards in the X-direction than the plurality of pipe connecting ports 64 provided in the common rail 60.

[0026] A pair of insertion holes 24' of the insertions holes 24 (refer to Fig. 2) are disposed so as to hold the four pipe connecting ports 64 therebetween in the X-direction. In addition, the pair of insertion holes 24' are also disposed in the opposite side edge of the cylinder head cover 20 to the side edge thereof which faces the common rail 60. Thus, the four insertion holes 24' are disposed in a rectangular configuration.

[0027] The four fuel supply pipes 66 extend in the Y-direction and upwards from the corresponding pipe connecting ports 66, bend in the X-direction and bend further in the Y-direction on the upper surface of the cylinder head cover 20 and extend as far as the corresponding injectors 30. Pipe connecting portions 36 are provided at common rail 60 sides of upper portions of the injectors 30. These pipe connecting portions 36 are disposed between the corresponding metallic support fixtures 40 and the upper surface of the cylinder head cover 20. The fuel supply pipes 66 branch off lateral surfaces of main body portions of the corresponding injectors 30.

[0028] Fig. 2 is a perspective view showing a state in which an injector removal tool 100 is placed on the cylinder head cover 20. As is shown in this figure, the injector removal tool 100 includes a support platform portion 110, a pivot portion 120 and a number of hangers (transfer portions) 130 which corresponds to the number of the injectors 30. In this embodiment, four hangers 130 are provided.

[0029] Fig. 3 is a perspective view showing the injector removal tool 100 and an injector unit 1 which is removed. Fig. 4 is a side view showing the injector removal tool 100 and the removed injector unit 1. As is shown in these figures, the support platform portion 110 includes a pedestal portion 112 which is arranged in a rectangular frame-like configuration and four leg portions 114A to D which support the pedestal portion 112 on the cylinder

head cover 20. In the pedestal portion 112, four rectangular plate members 113A to D constitute corresponding rectangular members of the pedestal portion 112. Longitudinal end portions of any two adjacent plate members of the four plate members 113A to D are superposed one on the other at corner portions of the pedestal portion 112.

[0030] In the pedestal portion 112, the plate member 113A and the plate member 113C are disposed parallel, and the plate member 113B and the plate member 113D are placed parallel. A pair of pins 115 are attached to a longitudinally central portion of each of the plate member 113A and the plate member 113C. The pair of pins 115 on each of the plate members 113A, 113C are disposed so as to be spaced apart from each other in a longitudinal direction thereof (the Y-direction). The pivot portion 120 is disposed between the pairs of pins 115.

[0031] The leg portions 114A to D are cylindrical support shaft members. Threaded portions 117 are formed at one axial end portions of the leg portions 114A to D. Stepped portions 119 (refer to Fig. 4) are formed at the other axial end portions of the leg portions 114A to D so as to be thinner than axial central portions of the leg portions 114A to D. Insertion holes are formed in the longitudinal end portions of the plate members 113A to D so that the threaded portions 117 are inserted therethrough. In the corner portions of the pedestal portion 112, the threaded portions 117 are inserted through the insertion holes which are superposed one on the other, whereby the plate member 113A and the plate member 113B, the plate member 113B and the plate member 113C, the plate member 113C and the plate member 113D and the plate member 113D and the plate member 113A are fastened together by the threaded portions 117 and nuts 109. The plate members 113D, 113A are fastened together with the leg portion 114A= the plate members 113A, 113B with the leg portion 114B, the plate members 113B, 113C with the leg portion 114C and the plate members 113C, 113D with the leg portion 114D.

[0032] Here, a space between the leg portion 114A and the leg portion 114D is set so as to be the same as a space between the two insertion holes 24' which are disposed in the side edge on the common rail 60 side of the cylinder head cover 20. A space between the leg portion 114B and the leg portion 114C is set so as to be the same as a space between the two insertion holes 24' which are disposed in the side edge on the opposite side of the cylinder head cover 20 to the side thereof which faces the common rail 60. A space between the leg portion 114A and the leg portion 114B and a space between the leg portion 114C and the leg portion 114D are set so as to be the same as a space between the two insertion holes 24' which are aligned in the Y-direction.

[0033] A diameter of the stepped portion 119 of each of the leg portions 114A to D is set so as to be smaller than an inside diameter of the insertion hole 24', and a diameter of a support shaft portion between the threaded portion 117 and the stepped portion 119 of each of the leg portions 114A to D is set so as to be larger than the

inside diameter of the insertion hole 24'.

[0034] Because of this, the stepped portions 119 of the leg portions 114A to D which are disposed in a rectangular configuration are inserted through the four insertion holes 24' which are disposed in the rectangular configuration so as to be seated in the cylinder head 10 while being positioned properly by the insertion holes 24', thereby making it possible to erect the leg portions 114A to D on the cylinder head cover 20 (refer to Fig. 20). The leg portions 114A to D extend upwards to a position lying higher than the injectors 30. By this configuration, the pedestal portion 112 is supported above the injectors 30 by the leg portions 114A to D.

[0035] The pivot portion 120 is supported above the cylinder head cover 20 by the support platform portion 110 in such a state that the pivot portion 120 is placed on the plate members 113A, 113C. The pairs of pins 115 which are provided individually on the plate members 113A, 113C function as bearings which support rotatably the pivot portion 120 while positioning the same portion. The pair of pins 115 provided on the plate member 113A and the pair of pins 115 provided on the plate member 113C are aligned with each other in the X-direction. Consequently, an axial direction of the pivot portion 120 becomes parallel to the X-direction. The pins 115 are disposed closer to the common rail 60 than the injectors 30. Consequently, the pivot portion 120 is disposed closer to the common rail 60 than the injectors 30.

[0036] A tool installing portion 122 is provided at an axially central portion of the pivot portion 120, and this tool installing portion 122 has a polygonal section as viewed from an axial direction thereof (the X-direction). In this embodiment, the tool installing portion 122 has a hexagonal section. This tool installing portion 122 is a portion on which a nut turning tool 2 (a second arm portion) such as a wrench or a spanner is installed. By installing the nut turning tool 2 on the tool installing portion 122, the pivot portion 120 is designed to be rotated by a torque inputted from the same tool 2.

[0037] Four arm portions 124 are formed integrally on the pivot portion 120. Each arm portion 124 is a quadrangular prism-shaped member which extends radially outwards from an axis of the pivot portion 120. The four arm portions 124 are disposed along the axial direction of the pivot portion 120 at intervals which are equal to intervals at which the projectors 30 are disposed. The four arm portions 124 are also disposed parallel to one another. A pin 126 is provided at a radially outward portion of the arm portion 124 in the direction of a turning radius thereof. This pin 126 is disposed parallel to the axial direction of the pivot portion 120 and projects from both sides in the X-direction of the arm portion 124. Here, the pin 126 is disposed in a position which lies apart from the axis of the pivot portion 120 radially outwards.

[0038] The hanger 130 is a rod member which is suspended from the arm portion 124 via the pin 126. A locking portion 132, which is curved into a U-shape, is formed at an axially central portion of the rod member. Axial end

portions of the rod member are configured as parallel arm portions 134 (connecting portions) which lie parallel to each other. Bearing portions 136 (proximal end portions) are provided at ends of the pair of arm portions 134 rotatably and detachably on the pin 126. A U-shaped groove is formed in the bearing portion 136 so as to be open towards the locking portion 132, and the pin 126 is inserted in the U-shaped groove. By this configuration, the hanger 130 is supported rotatably and detachably on the pin 126 which is disposed spaced apart from the axis of the pivot portion 120 radially outwards.

[0039] The pair of arm portions 134 are each configured as a straight line when viewed in the Y-direction and as a shape which bends at an obtuse angle when viewed in the X-direction to form a chevron shape. The locking portion 132 is locked on the pipe connecting portion 36 which lies in the vicinity of a base end of the fuel supply pipe 66 and constitutes the branching point from the injector 30 by being hooked thereon from a cylinder head cover 20 side of the pipe connecting portion 36. A distal end portion of each arm portion 134 is inserted through the insertion hole 44 in the metallic support fixture 40. A proximal end portion of each arm portion 134 is bent in a position which lies closer to the opposite side to the common rail 60 side than the injector 30 and extends above the injector 30. When the pivot portion 120 is rotated to a predetermined rotational position, the pin 126 is positioned vertically above the injector 30 (on an extension of an axis of the injector 30). Namely, the hanger 130 is suspended from the pin 126 which is now situated above the injector 30 with the locking portion 132 hooked on the pipe connecting portion 36 from the cylinder head cover 20 side thereof.

[0040] Here, the arm portion 124 extends from the pivot portion 120 towards a support end on which one end of the hanger portion 130 is supported. The tool 2 extends towards a point of effort on which a force is applied to swing or rotate the arm portion 124 from an end of the arm portion 124 which differs from the support end thereof. A distance from the pivot portion 120 to the point of effort on the tool 2 which constitutes an end portion of the tool 2 at which the tool 2 is held is set longer than a distance from the pivot portion 120 to the pin 126.

[0041] When inspecting an interior of the engine as when inspecting valve clearances, work to remove the injectors 30 from the cylinder head 10 becomes necessary. Here, in the work to remove the injectors 30 from the cylinder head 10 by use of the injector removal tool 100 according to the embodiment, the injectors 30 are not removed individually from the cylinder head 10 but the injector unit 1 into which the four injectors 30, the four fuel supply pipes 66 and the common rail 60 are integrated is removed from the cylinder head 10. Hereinafter, a method will be described of removing the injector unit 1 from the cylinder head 10 by use of the injector removal tool 100.

[0042] To remove the injectors, firstly, the bolts 42 which fasten the metallic support fixtures 40 to the cylin-

der head cover 20 are loosened, so that the fastening of the metallic support fixtures 40 to the cylinder head cover 20 is released. Then, the bolts 12 which fasten the common rail 60 to the cylinder head 10 are loosened, so that the fastening of the common rail 60 to the cylinder head 10 is released. Additionally, the two fuel supply pipes 52 are removed from the pipe connecting ports 62 and the fuel pipe 50. Further, the bolts 23 are removed which are inserted through the through holes 24' in the cylinder head cover 20 to fasten the cylinder head cover 20 to the cylinder head 10.

[0043] Next, as is shown in Fig. 5, the hanger 130 is inserted into a gap defined between the fuel supply pipe 66 and the upper surface of the cylinder head cover 20 in such a state that the bearing portions 136 are directed towards the injector 30 and the distal end portions of the arm portions 134 rise. Here, the distal end portions of the arm portions 134 are bent so as to be inserted through the insertion hole 44 in the metallic support fixture 40.

[0044] Next, as is shown in Fig. 6, the hanger 130 is pushed towards the injector 30 until the locking portion 132 is hooked on the pipe connecting portion 36 of the injector 30 from the cylinder head cover 20 side thereof. A bending angle of the arm portions 134 is set so that the bent portions of the arm portions 134 are pushed to a farther side than the communication pipe 38 and the bearing portions 136 are pushed upwards above the injector 30 as the hanger 130 is so pushed.

[0045] Next, as is shown in Fig. 7, the support platform 110 is placed on the cylinder head cover 20. As this occurs, the stepped portions 119 of the leg portions 114A to D are inserted through the insertion holes 24'. By doing so, the support platform portion 110 is seated on the cylinder head 10 while being positioned properly with respect to the cylinder head cover 20. As this occurs, the pair of pins 115 provided on the plate member 113A and the pair of pins 115 provided on the plate member 113C are aligned with each other in the X-direction.

[0046] Next, as is shown in Fig. 8, the pivot portion 120 is inserted between the pair of pins 115 provided on the plate member 113A and the pair of pins 115 provided on the plate member 113C and is placed on the plate members 113A, 113C. As this occurs, the arm portions 124 are disposed from the pivot portion 120 to positions lying above the corresponding injector 30. Then, the bearing portions 136 of the hangers 130 are attached individually to the corresponding pins 126. In this state, the pins 126 and the bearing portions 136 are positioned vertically above the corresponding injectors 30.

[0047] Next, as is shown in Fig. 9, the nut turning tool 2 such as a wrench or a spanner is installed on the tool installing portion 122 of the pivot portion 120. Then, as is shown in Figs. 10, 11, by inputting a torque into the pivot portion 120 by the nut turning tool 2 in a direction in which the pins 126 and the bearing portions 136 rise (in a clockwise direction as viewed in the figures), the pivot portion 120 is rotated in that direction. Here, the principle of leverage works in which the pins 126 and the

bearing portions 136 function as points of application, the pivot portion 120 as a fulcrum and a holding portion of the tool 2 as a point of effort. By this leverage effect, an upward force is applied on the injectors 30 via the corresponding hangers 130, whereby distal end portions of the injectors 30 are removed from the cylinder head 10.

[0048] Next, the pivot portion 120 and the support platform 110 are removed from above the cylinder head cover 20. Then, as is shown in Fig. 12, the injector unit 1 is removed from the cylinder head 10 by holding the fuel pipes 66.

[0049] Thus, as has been described heretofore, in this embodiment, the hangers 130 are set in the positions where they are hooked on the pipe connecting portions 136 of the corresponding injectors 30 with the whole of the injector unit 1 installed on the cylinder head 10, and the support platform 110 is set on the cylinder head cover 20 stably. Further, the hangers 130 can be set on the pivot portion 120 so as to be suspended therefrom in the positions which lie apart from the axis of the pivot portion 120 radially outwards. By rotating the pivot portion 120 with the spanner or wrench in that state, the upward removing force can be applied on the injectors 30 by use of the principle of leverage.

[0050] By applying the force in the way described above, the plurality of injectors 30, the plurality of fuel supply pipes 66 and the common rail 60 can be removed from the cylinder head 10 while the injectors 30, the fuel supply pipes 66 and the common rail 60 are kept assembled together. Consequently, the number of man-hours can be reduced which is involved in the removing work of the injectors 30. In addition, when attempting to reinstall the injector unit 1 in the cylinder head 10, since the positioning work of the injectors 30 is made unnecessary by obviating the necessity of disassembling the injector unit 1, the number of man-hours can be reduced which is involved in the reassembling work of the injector unit 1. Additionally, in this embodiment, a reduction in positioning accuracy of the injectors 30 can be suppressed. There is normally imposed a limitation on the number of times of removing and reinstalling a flared nut like the flared nuts 3 used herein. In this embodiment, however, since the flared nuts 3 fastening the fuel supply pipes 66 to the pipe connecting portions 36, 64 do not have to be removed, the number of times of replacing flared nuts 3 as parts can be reduced.

[0051] Compared with the case in which the upward removing force is applied directly on the injectors 30 for removal of the injectors 30 from the cylinder head 10, the injectors 30 can be removed from the cylinder head 10 with a smaller force in this embodiment.

[0052] In this embodiment, the removing force can be applied on the injectors 30 in the vertical direction (in the axial direction of the injectors 30) by the bearing portions 136 of the hangers 130 and the pins 126 of the arm portions 124 being positioned vertically above the corresponding injectors 30 with the hangers 130 kept hooked on the pipe connecting portions 36 of the injectors 30.

Consequently, the applying of a twisting or bending force on the distal end portions (nozzle portions) of the injectors 30 can be suppressed, thereby making it possible to suppress the damage to the distal end portions of the injectors 30 which would otherwise be made by rubbing with injector nozzle insertion portions in the cylinder head 10.

[0053] In this embodiment, a rotating angle of the pivot portion 120 which is necessary to allow the distal end portions of the injectors 30 from upper walls of combustion chambers in the cylinder head 10 is several tens degrees, in case a clearance between the injectors 30 and an engine compartment hood is narrow, the relevant work can also be performed by reducing the inclination of the tool 2 with respect to the upper surface of the cylinder head cover 20.

[0054] Firstly, the injector removal tool 100 according to the embodiment can be disassembled into the support platform 110, the pivot portion 120 and the hangers 130. Then, the support platform 110 can be disassembled into the plate members 113A to D and the leg portions 114A to D. Consequently, the injector removal tool 100 can be accommodated compact when it is stored.

[0055] Thus, while the embodiment of the invention has been described heretofore, the invention is not limited to the embodiment but can be carried out while being modified variously without departing from the spirit and scope of the invention. For example, in the embodiment, while the injector removal tool according to the invention has been described as being applied to the removal of the plurality of injectors 30 provided in the multi-cylinder engine together with the fuel supply pipes 66 and the common rail 60, the injector removal tool according to the invention can also be applied to the removal of a single injector provided in a single-cylinder engine together with a fuel supply pipe and the like.

[0056] In the embodiment, while the U-shaped hanger 130 is used which is supported at both the ends of the arm portion 124, a J-shaped hanger may be used which is supported at one end of the arm portion 124. As this occurs, the hanger does not always have to be detachable with respect to the pin 126, provided that the hanger can be hooked on the pipe connecting portion 136 while the hanger is kept installed on the pin 126.

Claims

1. An injector removal tool for removing an injector from a cylinder head, comprising:

a support platform portion adapted to be fixed to the cylinder head;
a pivot portion which is mounted on the support platform portion;
an arm portion provided so as to rotate about the pivot portion as a fulcrum; and
a transfer portion, one end of which is supported on the arm portion in a position spaced away

from the pivot portion, and the other end of which is locked on the injector, the transfer portion configured to transfer a force applied on the one end to rotate the arm portion as a force to remove the injector at the other end.

2. The injector removal tool as set forth in Claim 1, wherein the arm portion comprises:

a first arm portion, which extends from the pivot portion to the one end of the arm portion; and
a second arm portion, which extends from the pivot portion to a point of effort on which a force to rotate the second arm is applied on a side of the pivot portion which is different from a side of the one end of the arm portion, and having a length being longer than a length of the first arm portion.

3. The injector removal tool as set forth in Claim 2, wherein
the second arm portion extends upward than the support platform portion.

4. The injector removal tool as set forth in Claims 2 or 3, wherein
a plurality of injectors like the injector are provided in the cylinder head, and pluralities of transfer portions and first arms like the transfer portion and the first arm portion are provided so as to correspond individually to the plurality of injectors.

5. The injector removal tool as set forth in any one of Claims 1 to 4, wherein
one ends of the transfer portions are disposed above the injectors in the vertical direction of the vehicle and on extensions of the injectors.

6. The injector removal tool as set forth in any one of Claims 1 to 5, wherein
the injectors each have a branch pipe portion which diverges from a lateral side of the injector, and wherein
the transfer portions each have:

a locking portion configured to be locked in the vicinity of a base end portion of the branch pipe portion;
a proximal end portion formed at the one end so as to be mounted rotatably on the arm portion; and
a connecting portion connecting the locking portion with the proximal end portion.

7. The injector removal tool as set forth in Claim 6, wherein
proximal end portions like the proximal end portion are disposed at both sides of the injector in pair and

are each mounted rotatably on the arm portion, and the flocking portion and the connecting portion are formed into a U-shape when viewed from thereabove which connects the pair of proximal end portions together.

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8. The injector removal tool as set forth in Claim 6 or 7, wherein the connecting portion is formed by being bent at an intermediate position along the length thereof so as to apply as a force removing the injector upward.
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9. The injector removal tool as set forth in any one of Claims 6 to 8, wherein the proximal end portion is made detachable with respect to the arm portion.
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10. The injector removal tool as set forth in any one of Claims 1 to 9, wherein the support platform is disposed above the injectors and has:
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a pedestal portion on which the pivot portion is positioned; and

a leg portion which supports the pedestal portion on the cylinder head, and

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the leg portion is seated in the cylinder head while being inserted in a rocker cover mounting hole formed in the cylinder head to be positioned.

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Fig. 1

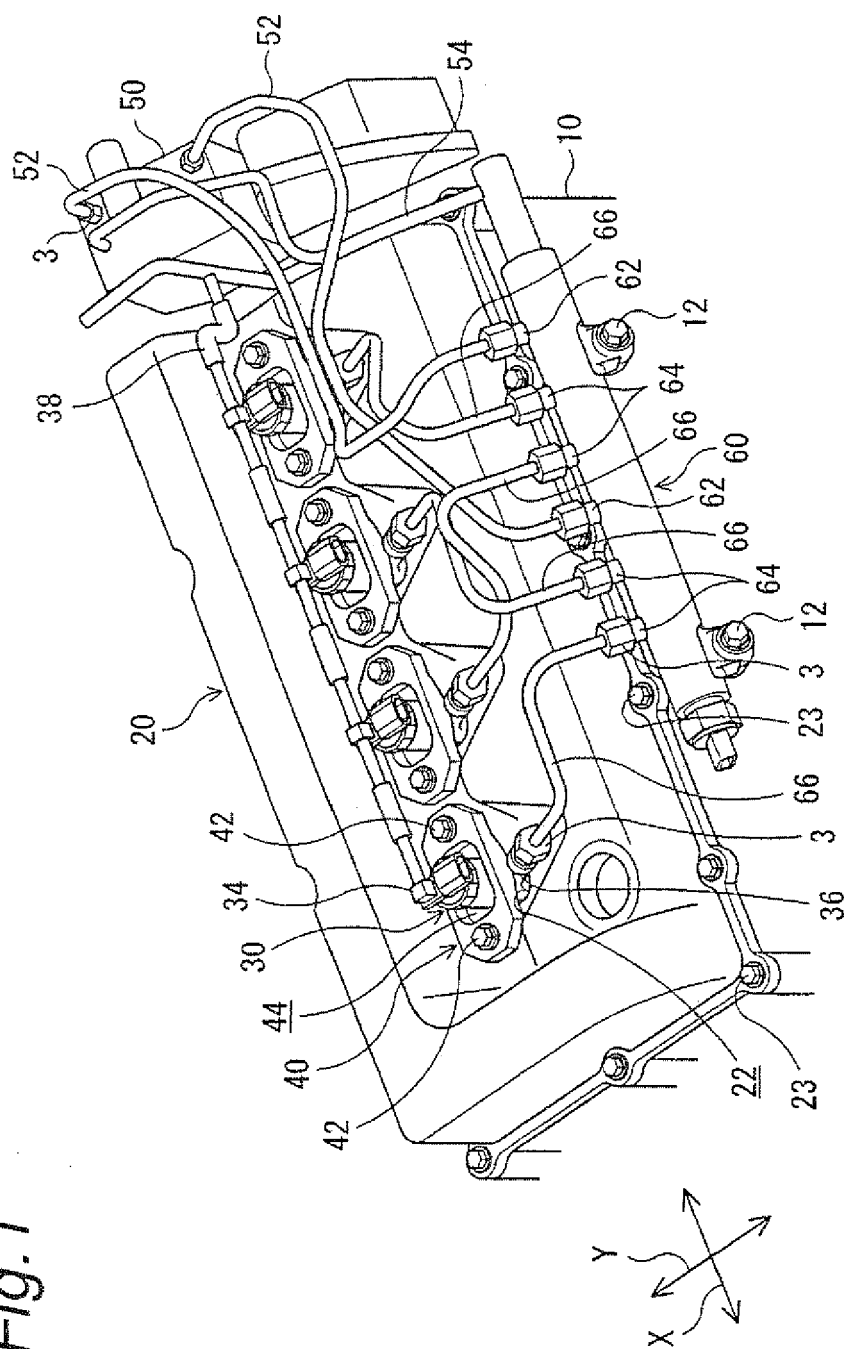


Fig.2

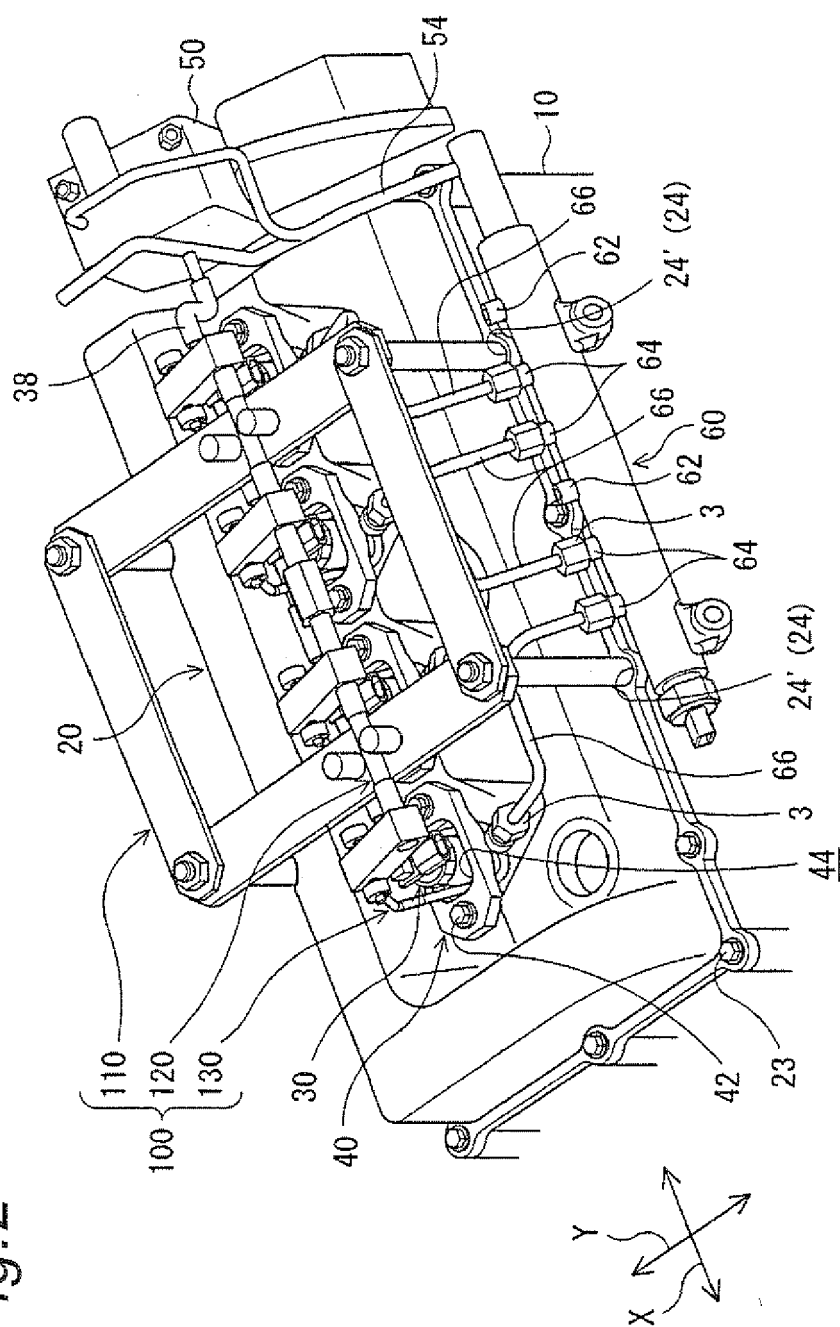


Fig. 3

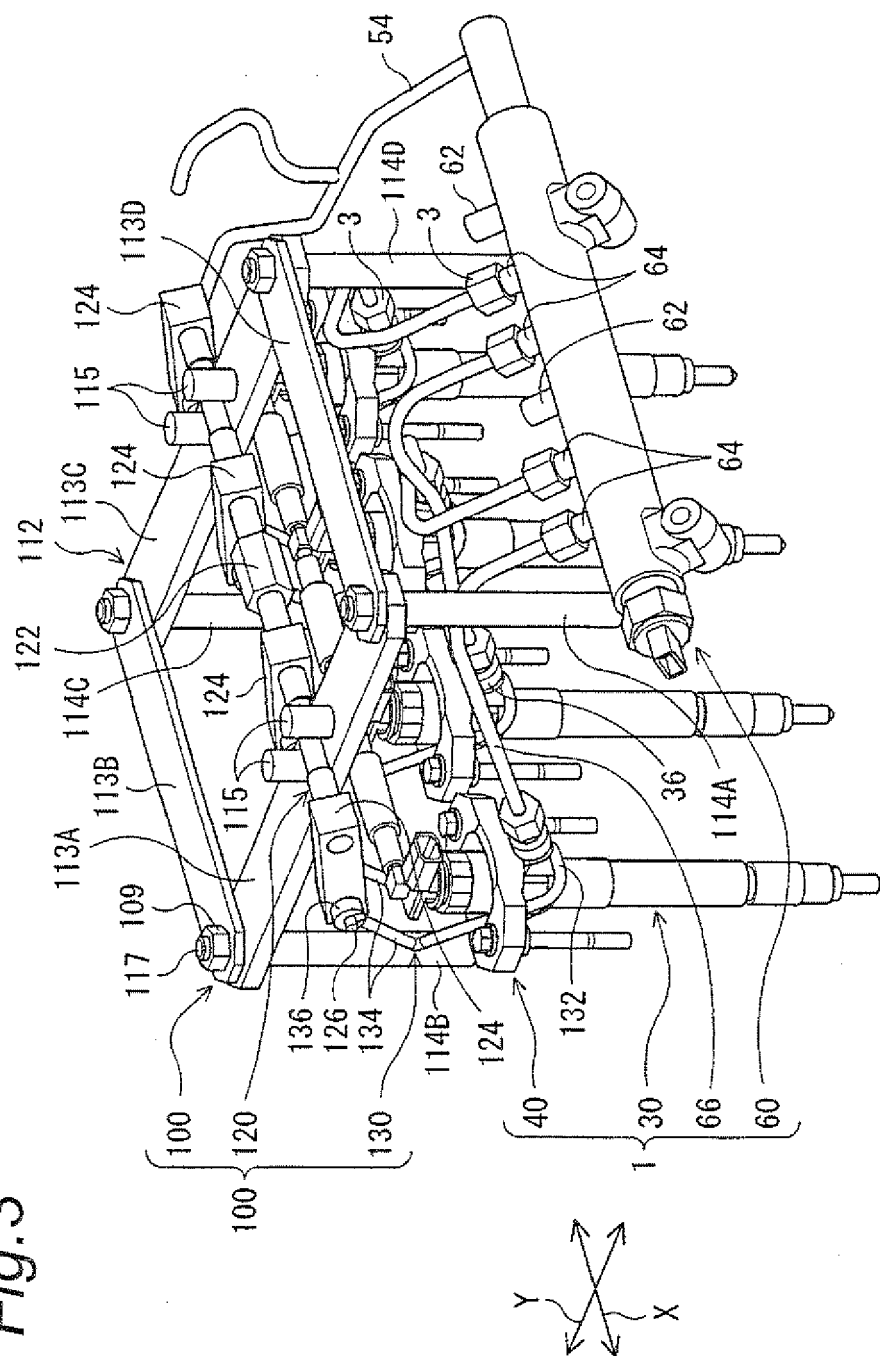


Fig. 4

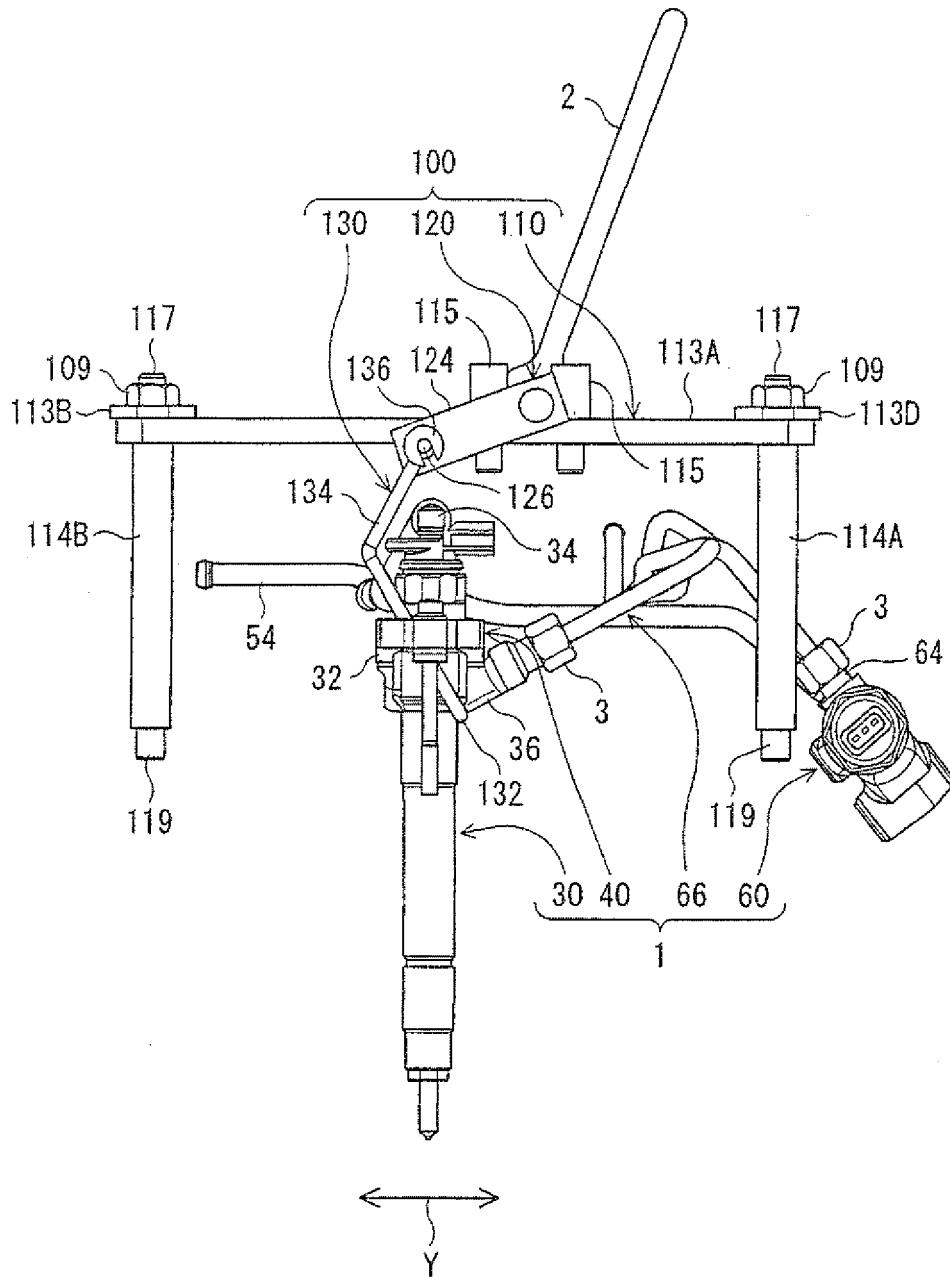
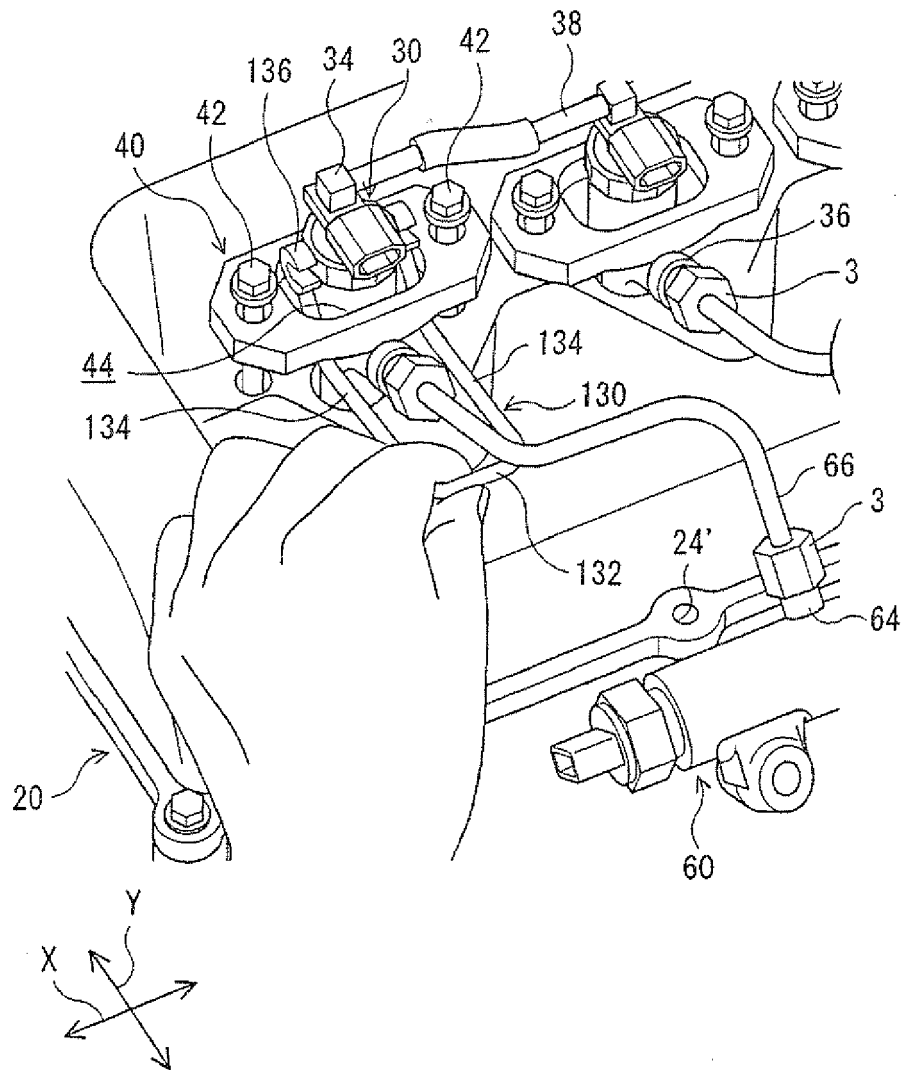


Fig. 5



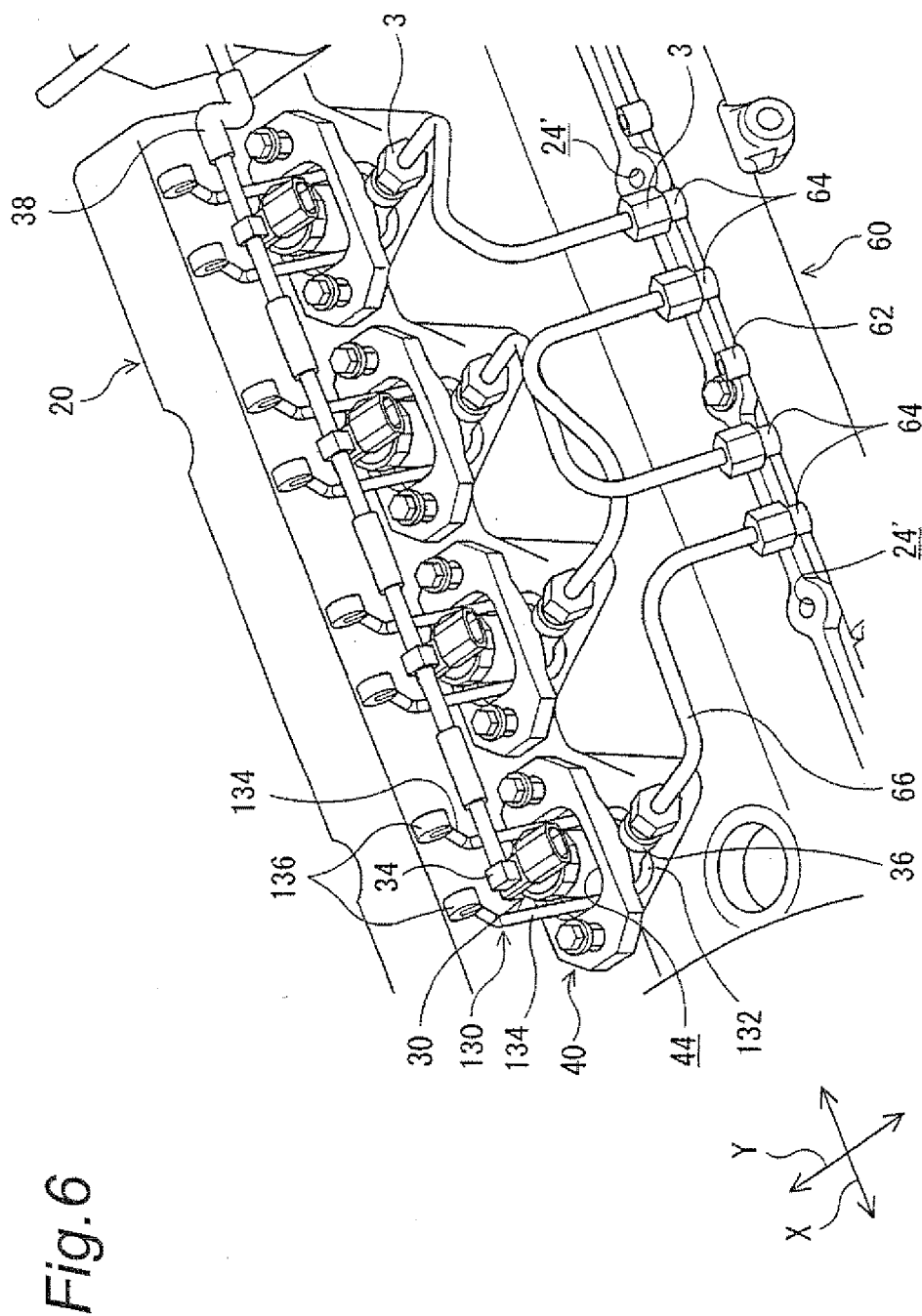
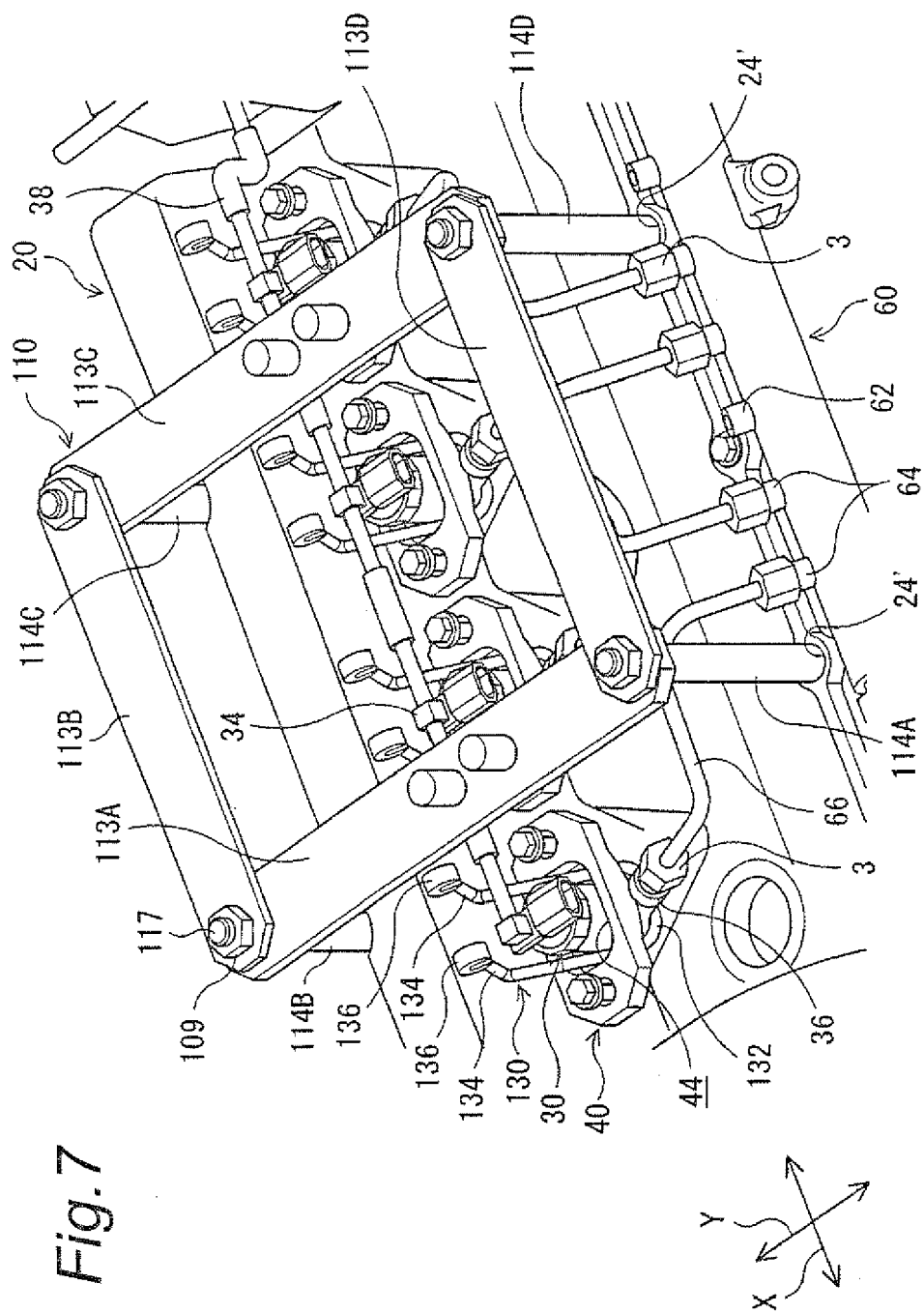


Fig. 6

Fig.7



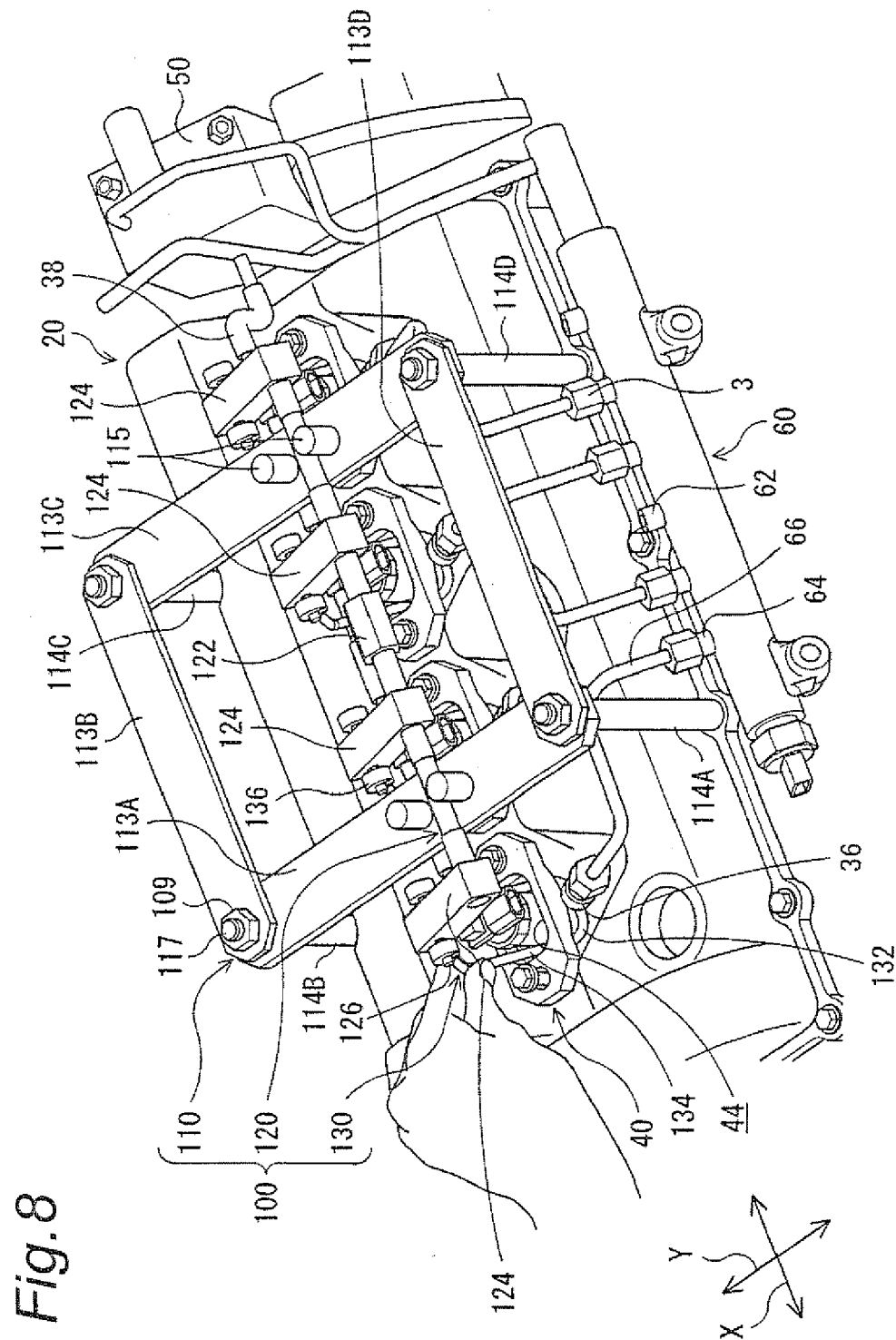


Fig. 8

Fig. 9

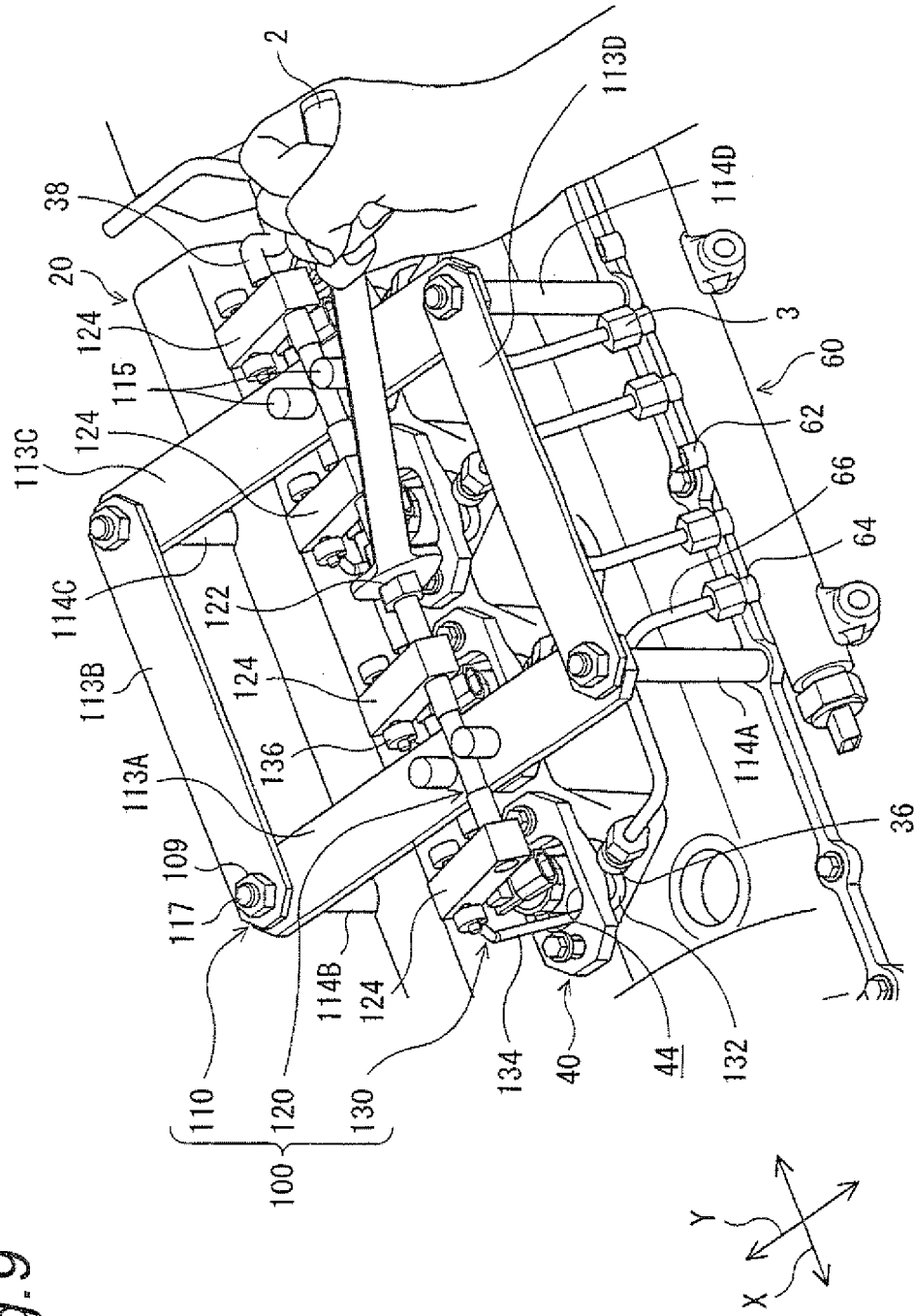


Fig. 10

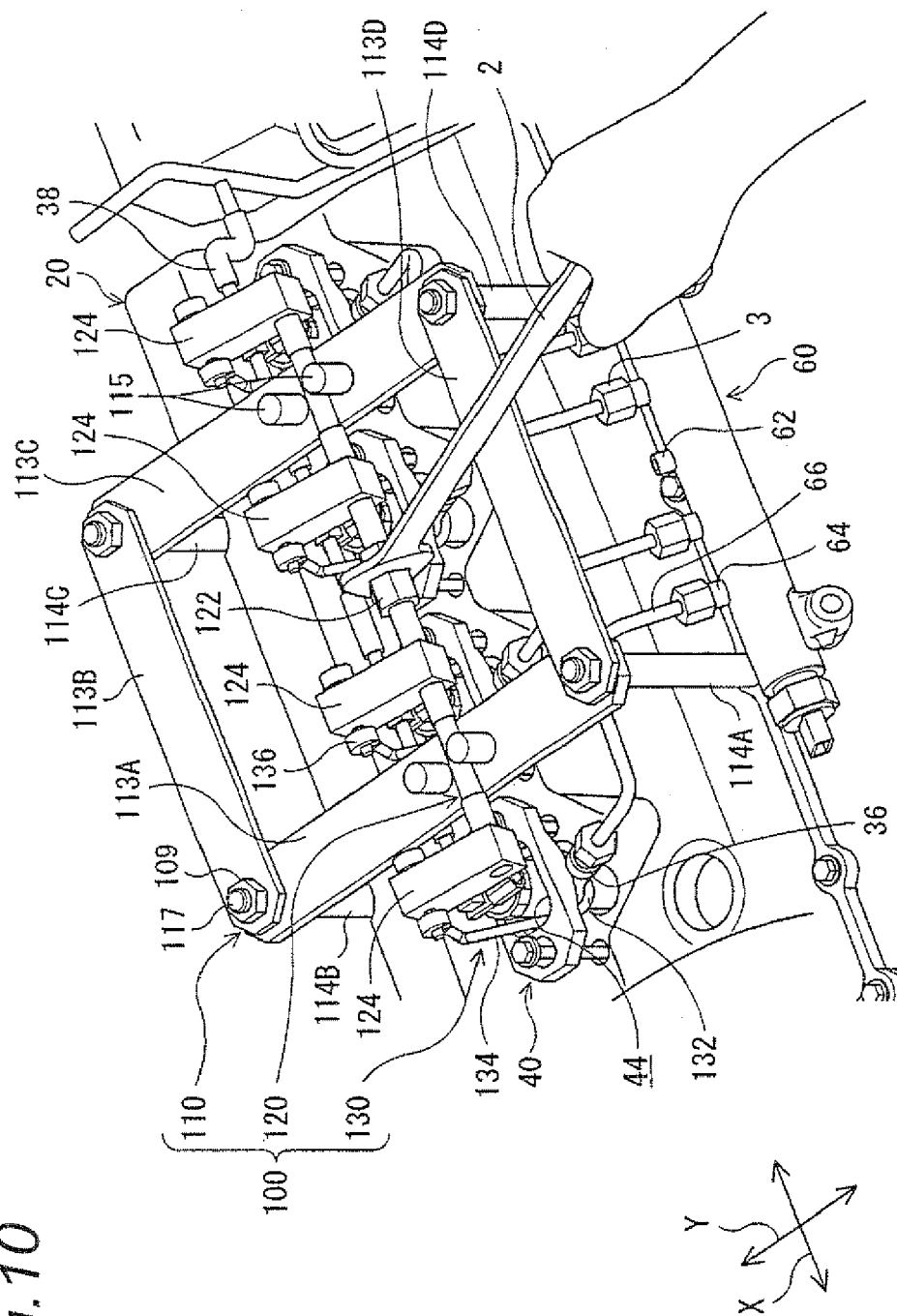
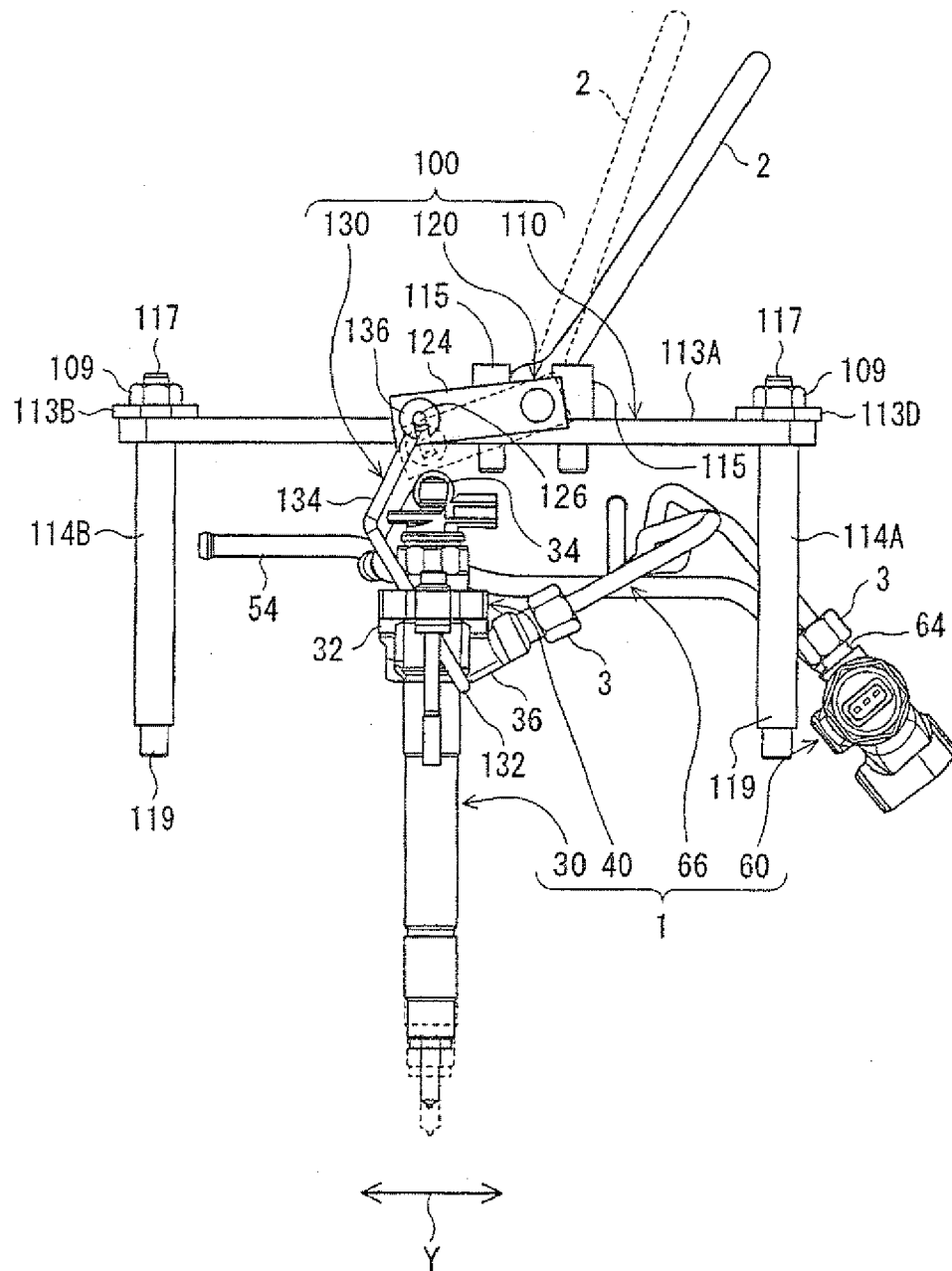
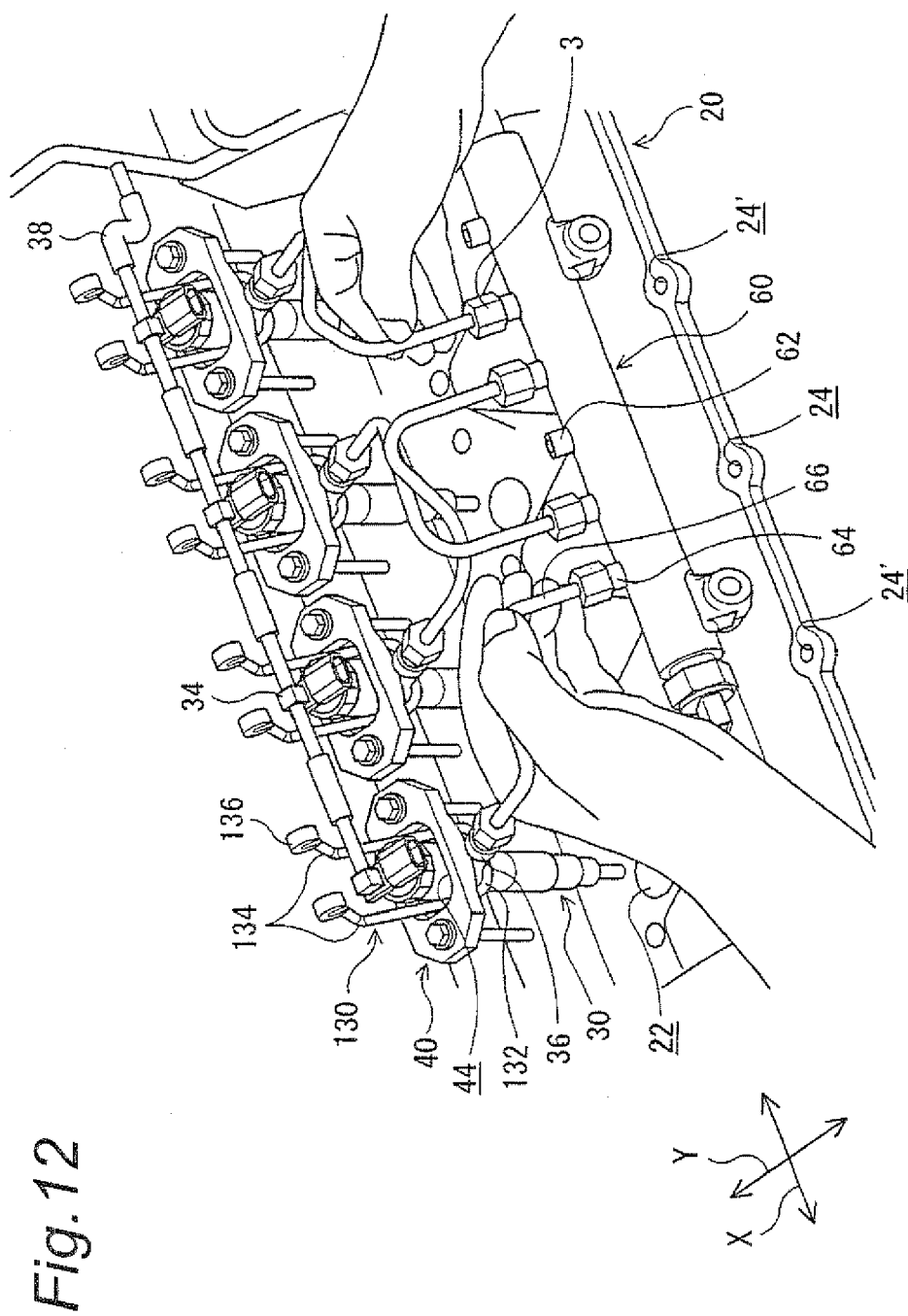


Fig. 11





REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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