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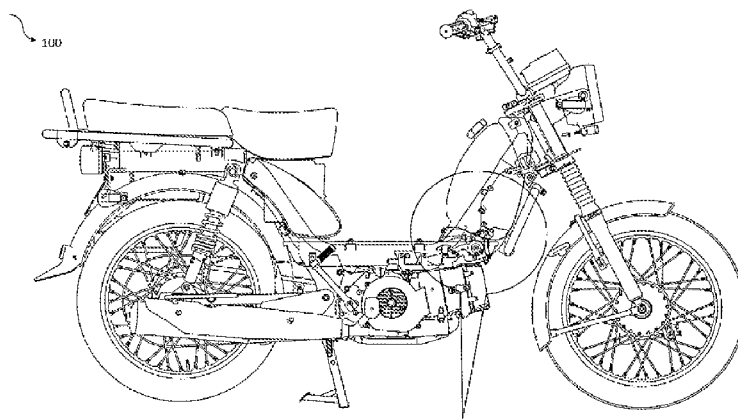


Fig.3

(57) Abstract: The present invention relates to a step through type vehicle (100), where said vehicle (100) comprises a mono tube type frame (101), power unit (125), cylinder head (123), cylinder (124), throttle body (301), injector (306). The frame assembly includes a main tube (101b), a down tube (101c). The injector (306) is mounted on the intake pipe (305) and orthogonally with respect to the cylinder axis (C-C'), thereby, ensures the efficient combustion in the vehicle and reduced the deposition of hydrocarbon on the wall of intake port.



Injector Mounting

5 [0001] The present subject matter relates to a step through type vehicle. More particularly, the present subject matter relates to the injection system for a vehicle.

BACKGROUND

10 [0002] The operation of four stroke spark ignition internal combustion power unit is done by burning a mixture of fuel and air in a cylinder having piston. The power is provided by the continuous cycle that takes place inside the power unit. The process inside the power unit completes in four steps: when the piston moves downward, an inlet valve opens and air fuel mixture enters into the cylinder chamber. Further, the valve closes and piston moves up to compress the mixture. The spark is produced by an electric spark plug that ignites the fuel and forces the piston down. The final step includes the outlet valve which
15 opens and the piston rises to release the exhaust gases out of the cylinder.

[0003] Further, in order to achieve efficient control of the air fuel ratio and in addition, to provide better performance with improved fuel economy, the existing carburetor vehicles are typically replaced by the Electronic Fuel Injection (EFI) system. The Electronic Fuel Injection system includes the components like accumulator, fuel injection, fuel metering
20 etc. where the airflow and fuel mixture is optimized by the engine control unit. The airflow and fuel mixture determine the length of time the fuel injector sprays fuel into the intake port. The conversion of the carburetor to EFI involves different types of electrical and mechanical modifications, thereby, it leads to potentially increased combustion efficiency of power unit (IC engine), reduced exhaust discharge while maintaining the
25 original dimension of the vehicle.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] The detailed description is described with reference to the accompanying figures.
30 The same numbers are used throughout the drawings to reference like features and components.

[0005] **Fig.1** is a side view of a step through type vehicle as per one embodiment of the present invention.

- 5 [0006] **Fig.2** is a perspective view of a frame of step through vehicle.
- [0007] **Fig.3** is a right side view of the step through as per one embodiment of the present invention.
- [0008] **Fig. 3a** is an exploded view of the step through vehicle as per one embodiment of the present invention.
- 10 [0009] **Fig. 3b** is an exploded view of the injector as per one embodiment of the present invention.
- [00010] **Fig.3c** is an exploded view of the injector with the predetermined distance as per one embodiment of the present invention.
- [00011] **Fig. 4** is a top view of the step through vehicle as per one embodiment of the present invention.
- 15 [00012] **Fig.5** is a sectional view of the injector with pip as per one embodiment of the present invention.

DETAILED DESCRIPTION

- 20 [00013] The conventional carburetor fuel systems lack in the several major aspects like lacks efficiency in terms of fuel consumption and performance of the power unit. Also it is majorly responsible for the emission of harmful gases which are the main cause for polluting the environment which is typically undesirable.
- 25 [00014] However, the typically mechanical carburetor-based fuel supply system cannot monitor or vary the air to fuel ratio to account for different operating or atmospheric condition & is calibrated or tuned to a predetermined optimal setting. Further, the improper air-fuel mixing provided by carburetors leaves various un-burned particles inside the combustion chamber of an internal combustion engine which leads to improper propagation of combustion flame due to which engine malfunctioning phenomenon known as knocking or detonation takes place.
- 30 [00015] Hence, in order to achieve efficient control of the air fuel ratio and in addition, to provide better performance with improved fuel economy, the existing carburetor vehicles are replaced by the Electronic Fuel Injection (EFI) system, where the fuel injection atomizes the pressurized fuel through an injector. Further, Fuel injectors are electronically controlled mechanical devices that are responsible for spraying

5 (injecting) the right amount of fuel into the engine, so that a suitable air/fuel mixture is created for optimal combustion.

[00016] Further, the injectors through which the fuel is sprayed are typically fastened or screwed, nozzle-first, into either the inlet manifold or the cylinder head and are angled so that the spray of fuel is fired towards the inlet valve. Moreover, when the injector is energized, an electromagnet moves a plunger that opens the valve, allowing the
10 pressurized fuel to spray out through a tiny nozzle. The function of the nozzle is to atomize the fuel i.e. to make as fine mist as possible so that it can burn easily. However, in known art, the injector is typically placed in the cylinder head which leads to exposure of the injector to high temperatures & thereby vulnerable to failure. To overcome this
15 problem, a separate air intake passage is configured to cool down the cylinder head as the cylinder head is typically placed in front of a vehicle to augment the cooling using air cooling. All of this, increases the cost of the vehicle as more number of components are required. Further, owing to the thermal management challenges & layout space limitations, if the fuel spray is misaligned, the fuel spray tends to hit other surfaces increasing wall wetting and generating undesired fuel film pools. This issue is
20 particularly important during cold start when the valve is the first surface to warm up. Further, incidentally the back portion of the intake valves and ports are coated with the hydrocarbon and the deposition of hydrocarbon causes rough idling, stumbling on acceleration, stalling, increased fuel consumption and a overall lack of power output. There is always a contradicting challenge of providing a stable mounting structure of the
25 injector without compromising with the layout, meeting thermal requirements and components of the low-cost vehicle like as maintaining the improved utility space and at same time providing ease of assembly and access for manufacturing, service and increased combustion efficiency. With increasing demand of better power as well as efficiency of the powertrain at low cost with compact layout & high utility of the vehicle,
30 the requirements are conflicting in nature leading to compromise in one of the aspects of the vehicle & its performance. Typically to enable high utility for a saddle type two or three wheeled vehicle, there is often paucity of space to package such peripheral systems e.g. Throttle body, air filter etc. Such vehicles are often designed to have a floorboard space to enable adequate utility space in form of a step through form of the vehicle. This
35

5 leads to forced disposition of the powertrain on the rear side of the vehicle with a swinging powertrain in form of scooters. Alternatively, the powertrain is disposed below a step through floorboard backbone frame type structure of a saddle type vehicle. Also, from best efficiency point of view, the throttle body needs to be as close as possible to the intake port of the engine with the injector in between which further crowds the space
10 available for a stable mounting structure of the injector. Mounting away from the intake port can only aggravate the pressure loss of the system thereby deteriorating its function. Also, for efficient operation, there is a need to have the conical diameter of the mist to be enabled to enter completely inside the intake valve without interfering or wetting any undesirable areas. The mounting structure also needs to withstand vibration loads from
15 the vehicle as well as roads & be able to function despite being in close vicinity of the high temperature zone of the powertrain which can lead to durability failures of the system. The injector mounting structure also needs to cater to an ease of service & repair requirements within the compact layout of the vehicle. There exists a technical challenge of mounting & incorporating a fuel injector for such a vehicle without leading to
20 compromise on the lateral width of the vehicle or the longitudinal length / wheelbase of the vehicle. The powertrain is typically disposed with a longitudinal axis of the cylinder along the forward rearward orientation below the step through space formed by the frame structure. The fuel injector system as per known art tends to eat away into the front wheel well space if disposed in the front side which a preferred yet compromised disposition is considering air cooling advantages. Lateral disposition on the cylinder head or the intake
25 passage tends to undesirably increase the width of the vehicle in addition to poor wetting & throw of the mist into the intake passage. Disposition in the vertical space above is almost ruled out owing to the utility space requirements from the step through configuration & its comfort to the user. Disposition below towards the ground can lead to
30 undesirable breakage owing to impact with external objects like stone, hump etc. as well as poor ground clearance & exposure to mud. The space around the intake port of the cylinder head is significantly crowded & can lead to undesirable increase in the size of the engine which is further detrimental from compact packaging of the vehicle for all of the above cited reasons. Thus, there exist conflicting requirements for a compact fuel

5 injector mounting structure for a saddle type vehicle with a substantial floor board space in form of a step through.

[00017] Therefore, there is a need to have an improved mounting of injector which overcomes all of the above problems and other problems known in the art.

10 [00018] Hence, it is desirable to design the mounting of injector in the step through vehicle to facilitate the simple and easy mounting to the intake pipe with improved combustion, by maintaining the higher utility area, maintaining narrow width of the vehicle and cost effective.

15 [00019] With the above objectives in view, the present subject matter relates to the electronically controlled fuel injection and more particularly to the improved mounting of the injector on the intake pipe which can supply fuel fumes / mist directly to the combustion chamber in power unit to improve the combustion efficiency with the minimal adverse changes in the vehicle layout, thereby being cost effective at the same time.

20 [00020] As per one aspect of the present invention, the power unit which is low in torque and low rpm is mounted in the horizontal direction with respect to the down tube and includes cylinder head, cylinder, intake valve, exhaust valve etc. and further the throttle body of the induction system (which includes the throttle body as well as the actuator receiving actuation force from the throttle input) is disposed above cylinder head and in between down tube and front wheel, with respect to the main tube longitudinal axis W-W'. Further, the actuator actuated with the throttle wire is disposed in right hand side of the throttle body, projecting outward, thereby, ensuring the compact structure of the vehicle.

25 [00021] As per one aspect of the present invention, the intake pipe is mounted with respect to the throttle body, where the intake pipe is in curved shape, which ensures the proper & stable mounting of the injector and reduce the pressure loss. Further, as per one aspect of the present invention, the throttle body is mounted with respect to the main tube longitudinal axis W-W' and in between the down tube and front wheel projected at a predetermined angle C, providing curved shaped to the intake pipe, which ensures the flow of air from the tube outlet to the combustion chamber with the minimum pressure

5 loss. Further, as per one aspect of the present invention, the injector is mounted in an orthogonal direction with respect to the horizontal plane (cylinder axis) and inclined with respect to the intake port axis at a predetermined range of angle Y, which ensures the effective spray of fuel fumes in the power unit. As per an embodiment, the angle Y is in the range of 15degrees to 30 degrees. Less than or more than angle Y, will deviate the
10 spray target of the injector deteriorating its function.

[00022] Further, as per one aspect of the present invention, the injector mounted on the intake pipe sprays the fuel fumes directly to the valve, ensures the less unburnt fuel at the wall of the intake port and cylinder. Further, as per one aspect of the present invention, the injector is mounted at a predetermined distance D with respect to the intake valve,
15 which ensures the conical diameter of the fuel fumes be smaller than the conical diameter of the intake valve to reduce the deposition of the unburnt hydrocarbon on the wall of the intake port,. This there by ensures the efficient fuel fumes in the combustion chamber. The fuel fumes sprayed by the injector takes place in both the conditions i.e. when the power unit and the intake pipe is cold, the injector will spray the fuel fumes inside the
20 valve as per the timing of the ECU, which ensures the less unburnt hydrocarbon collection on the wall of the intake port and when the vehicle is in running condition, the power unit is heated up and the fuel fume is injected by the injector in the valve, which ensures the less unburnt hydrocarbon at the wall of the intake port since during this event the power unit is heated up owing to which the fuel evaporates or vaporises readily.

25 [00023] Various other features of the invention are described in detail below with reference to an embodiment of a two wheeled saddle type vehicle with the accompanying drawings. In the drawings, like reference numbers generally indicate identical, functionally similar, and/or structurally similar elements. The drawing in which an element first appears is indicated by the leftmost digit(s) in the corresponding reference
30 number. With reference to the accompanying drawings, wherein the same reference numerals will be used to identify the same or similar elements throughout the several views.

[00024] Further “front” and “rear”, and “left” and “right” referred to in the ensuring description of the illustrated embodiment refer to front and rear, and left and right

5 directions as seen in a state of being seated on a seat of the saddle type vehicle. Furthermore, a longitudinal axis refers to a front to rear axis relative to the vehicle, while a lateral axis refers to a side to side, or left to right axis relative to the vehicle. Also, it is to be understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting.

10 [00025] Fig. 1 illustrates a left side view of an exemplary two-wheeled step through type vehicle, in accordance with an embodiment of present subject matter. The vehicle (100) has a mono-tube type frame (101), which acts as the skeleton for bearing the loads and is also referred to as backbone frame as (shown in Fig 2). Instrument cluster (119) is mounted on handle bar assembly (126). The handle bar assembly (126) is pivotally
15 disposed through the head tube where it includes brake levers (113). The handle bar assembly (126) is connected to a front wheel (129) by one or more front suspension(s) (130). A front fender (131) is disposed above the front wheel (129) for covering at least a portion of the front wheel (129). A leg shield (112) is provided on the vehicle (100). A fuel tank (103) having fuel cap (114) is mounted to the main tube (101b) (as shown in
20 Fig. 2) of the mono-tube type frame (101) and it is disposed in the front portion F of a step-through space of the mono-tube type frame (101). The vehicle (100) having lighting means which includes Head lamp (127), Tail lamp (106), Turning indicators includes front side indicators (111) and rear side indicator (102) respectively and daytime running lamp (104). The power unit (125) is mounted to the lower portion of said mono-tube type
25 frame (101). In an embodiment, the power unit (125) is an IC power unit. The fuel tank (103) is functionally connected to the power unit (125).

[00026] In an embodiment, cylinder axis (C-C') inclined to a front of said vehicle (100) in a substantially forward rearward direction. A swing arm (134) is swingably connected to the mono-tube type frame (101). A rear wheel (133) is rotatably supported by the swing
30 arm (134). One or more rear suspension(s) (135) connect the swing arm (134) at an angle, to sustain both the radial and axial forces occurring due to wheel reaction, to the mono-tube type frame (101). A license plate (105) and reflector (116) mounted on a rear fender (128) is disposed above the rear wheel (133). A seat assembly (132a, 132b) is disposed at a rear portion (R) of the step-through space. In an embodiment, the seat assembly (132)
35 includes a rider seat (132a), and a pillion seat (132b). The vehicle (100) is provided with

5 the grab rail (109). Further, the seat assembly (132a, 132b) is positioned above the rear wheel (133). The vehicle is supported by a center stand (120) mounted to the frame assembly. A tool box (110) is provided on the left side of said vehicle (100). A cover member (118) is mounted on down tube (101c) (as shown in Fig. 2). The cover member (118) covers at least a portion of the powerunit (125).

10 [00027] The powerunit (125) includes an, an air intake system (not shown), an exhaust system (not shown), and a starter system (not shown). The starter system includes an electric starter mechanism or a mechanical starter mechanism. The electrical starter system is powered by an auxiliary power source, for cranking the powerunit. Power generated by powerunit is transferred to the rear wheel (133) through a transmission system (not shown).

15 [00028] The powerunit (125) comprises a cylinder head (123), a cylinder (124) and a chain cover (121) in order from the front to the rear direction of a powerunit assembly (122). The cylinder (124) protrudes in a forward direction from the front end portion.

20 [00029] Fig. 2 illustrates a perspective view of the backbone frame structure which is generally of a convex shape, where main tube (101b) extending rearwardly and downwardly from a head tube (101a) of the mono-tube type frame (101), further a down tube (101c) of the mono-tube type frame (101) extends rearward forming a substantial floorboard space for utility & step through, along a longitudinal axis (L-L') of the vehicle (100) from a rear portion of the main tube (101b).

25 [00030] The powerunit (125) (as shown in Fig. 1) is a four-stroke air-cooled powerunit where the center portion of the powerunit is supported to the mono-tube type frame (101) via a front bracket (204), and the rear portion thereof is supported by the rear bracket (202). Further, both front bracket (204) and rear bracket (202) brackets are positioned on the lower portion of the down tube (101c) when viewed from the left or right side of the vehicle (100).

30 [00031] The cover member (118) is disposed above the down tube (101c) using attaching means. The attaching means includes two floor mounting brackets (201) attached to the down tube (101c) of the mono-tube type frame (101) to support the cover member (118).

35 [00032] Fig.3 is a right-side view of the step through vehicle. As per one embodiment of the present invention, the power unit (125) (as shown in fig. 1) is mounted in the

horizontal direction with respect to the main tube (101b). Further, as per one embodiment, power unit (125) (as shown in fig.1) includes cylinder head (123) (as shown in fig.1), cylinder (124), intake valve (303) and the air filter (304) is mounted in between the frame (101) & fuel tank (103). Further, as per one embodiment of the present invention, throttle body (301) is disposed with respect to the main tube longitudinal axis (W-W'), above cylinder head (123) enclosing cylinder (124), and in between the down tube (101c) and front wheel, and further, actuator (302) actuated with the throttle cable is disposed in right hand side of the throttle body (301), projecting outward, thereby, ensuring the best use of the space below the main tube (101b) and ultimately ensuring the compact layout structure of the vehicle. Further, as per one embodiment of the present invention, the injector (306) is mounted substantially orthogonally (A) with respect to the cylinder axis (C-C') (horizontal axis) (as shown in figure 3a) and further, the injector is mounted with respect to the intake port axis (XX') at an angle Y as shown in Fig 3b. As per an embodiment, the predetermined angle Y is in the range of 15-30 degrees (as shown in fig. 3b). This minimizes the unburnt hydrocarbon on the wall of the intake port where the intake port is mounted away towards the front wheel. Further, as per one embodiment of the present invention, the tip of the injector (306) is at predetermined distance D with respect to the intake valve (303) as shown in Fig 3c. The predetermined distance as per an embodiment is in the range of 70-100 mm which ensures the conical diameter of the fuel fumes to be lesser than the conical diameter of the intake valve opening, thereby, ensuring the effective spray of fuel fumes in the intake valve without wasting the fumes of the fuel on the wall of the intake port. , This effectively reduced the amount of fuel wastage, reduces the deposition of hydro carbon and also helps in achieving the effective spray. Less than or more than 70-100mm will reduced the effective spray of the fuel fumes in the intake valve as when the injector is mounted close to the intake valve, the efficiency of the injector will be reduced because of the heat generated during the process and when the injector will be mounted far away from the intake valve, the deposition of unburnt hydrocarbon on the wall of the intake port will increase.

[00033] **Fig. 4** is the top view of the step through vehicle. As per one embodiment of the present invention, the throttle body (301) is mounted with respect to the main tube longitudinal axis W-W' of the step through vehicle at an predetermined angle C. As per

5 an embodiment, the predetermined angle is in the range of the **90-120** degree and intake pipe (**305**) is curved in shape, ensures the minimization of the pressure loss by keeping the air path free from any obstacles and ultimately increases the vehicle efficiency.

[00034] **Fig. 5** is the exploded view of the injector. As per one embodiment of the present invention, the injector cap (**502**) is mounted on the injector (**306**), further, the injector cap (**502**) locks with the extended pip (**501**) to ensure the poka yoke assembly which restrict the anti-rotation of the injector (**306**), thereby, ensures the rigid mounting of the injector on the intake pipe (**305**) & adequately protects the critical injector device from external object impact, accidental service damage etc.

[00035] The embodiments explained in Fig. 3. Fig. 3a, Fig. 3b of the present invention helps in overcoming the problem of space constraints, minimizing the use of new components, increasing the combustion efficiency of the vehicle while maintaining the overall weight and width of the vehicle and ultimately make it cost effective.

[00036] Advantageously, the embodiments of the present invention, describes the potential modifications in the mounting of injector on the intake pipe and orthogonally with respect to the cylinder axis. This facilitates the simple and easy mounting of the injector which efficiently increases the combustion in the cylinder.

[00037] Many other improvements and modifications may be incorporated herein without deviating from the scope of the invention.

List of reference symbol:

Fig. 1:

100: Step Through Vehicle.

126: Handle Bar Assembly

119: Instrument Cluster

127: Head Lamp

30 111: Front Side Indicator

104: Daytime Running Lamp

112: A leg Shield

- 5 131: A front Fender
 - 129: Front Wheel
 - 130: Front Suspension
 - 113: Brake Lever
 - 103: Fuel Tank
- 10 114: Fuel cap
 - 118: Cover Member
 - 123: Cylinder Head
 - 124: Cylinder
 - 122: Power unit Assembly
- 15 125: Power unit
 - 132 (132a, 132b): Seat Assembly
 - 101: Mono tube frame
 - 109: Grab Rail
 - 106: Tail Lamp
- 20 105: License Plate
 - 102: Rear Side Indicator
 - 128: Rear Fender
 - 116: Reflector
 - 135: Rear Suspension
- 25 133: Rear Wheel
 - 134: Swing Arm
 - 121: Chain Cover
 - 120: Center Stand

5 110: Tool Box

C-C': Cylinder Axis

Fig. 2:

101: Mono Tube Type Frame

101a: Head Tube

10 101b: Main Tube

101c: Down tube

201: Floor Mounting Brackets

202: Rear Bracket

204: Front Bracket

15 **Fig. 3a**

301: Throttle Body

302: Actuator

303: Intake Valve

304: Air Filter

20 305: Intake pipe

306: Injector

A: Angle projection of Injector with respect to cylinder axis (horizontal axis)

Fig. 3b:

X-X': Intake Port Axis

25 Y: Angle of injector with respect to the intake port axis.

Fig. 3c:

D: Distance between the injector port and intake valve.

Fig. 4:

5 C: Angle of throttle body with respect to the main tube

Fig. 5

501: Pip.

502: Injector Cap

10

5 We Claim

1. A step through type saddle vehicle (100), said vehicle (100) comprising:
 - a monotube type frame (101) providing floor board utility space
 - Said frames (101) includes a head tube (101a), a main tube (101b), a down tube (101c);
 - a fuel tank (103) is mounted on said main tube (101b);
 - 10 an air filter (304) is mounted below the lower portion of said fuel tank (103) on said main tube (101b); and
 - a power unit (124) is mounted on the lower portion of said mono-tube type frame (101);
 - and
 - a throttle body (301) and actuator (302) forms a part of induction system.
 - 15 an injector (305) is mounted on an intake pipe (305) and with respect to a cylinder axis (C-C'), where the conical diameter of fuel fumes from said injector (306) is smaller than the conical diameter of an intake valve (303).
2. The step through vehicle (100) as claimed in claim 1, wherein said injector (306) is mounted with respect to the intake port axis at a predetermined angle Y with respect to the intake axis X-X'.
- 20 3. The step through vehicle (100) as claimed in claim 2, wherein said predetermined angle Y is in the range of 15 to 30 degree.
4. The step through vehicle (100) as claimed in claim 1, wherein said throttle body (301) is mounted with respect to said main tube (101b) longitudinal axis (W-W') at a predetermined angle C.
- 25 5. The step through vehicle (100) as claimed in claim 4, wherein said predetermined angle is in the range of 90-120 degree.
6. The step through vehicle (100) as claimed in claim 1, wherein said injector (306) is mounted substantially orthogonally with respect to said cylinder axis (C-C').
- 30 7. The step through vehicle (100) as claimed in claim 1, wherein said throttle body (301) is mounted between said downtube (101c) and a front wheel.
8. The step through vehicle (100) as claimed in claim 1, wherein said actuator (302) is projected outward in a right-hand side direction with respect to said throttle body (301).
9. The step through vehicle (100) as claimed in claim 1, wherein said intake pipe (305) has
- 35 curved shape projected through said air filter (304).

- 5 10. The step through vehicle **(100)** as claimed in claim 1, wherein said injector **(306)** is at a
predetermined distance D with respect to said intake valve **(303)**.
11. The step through vehicle **(100)** as claimed in claim 10, wherein said predetermined distance
D is in range of 70-100mm.
12. The step through vehicle **(100)** as claimed in claim 1, wherein said injector **(306)** is mounted
10 with the injector cap **(502)** through a pip **(501)**.

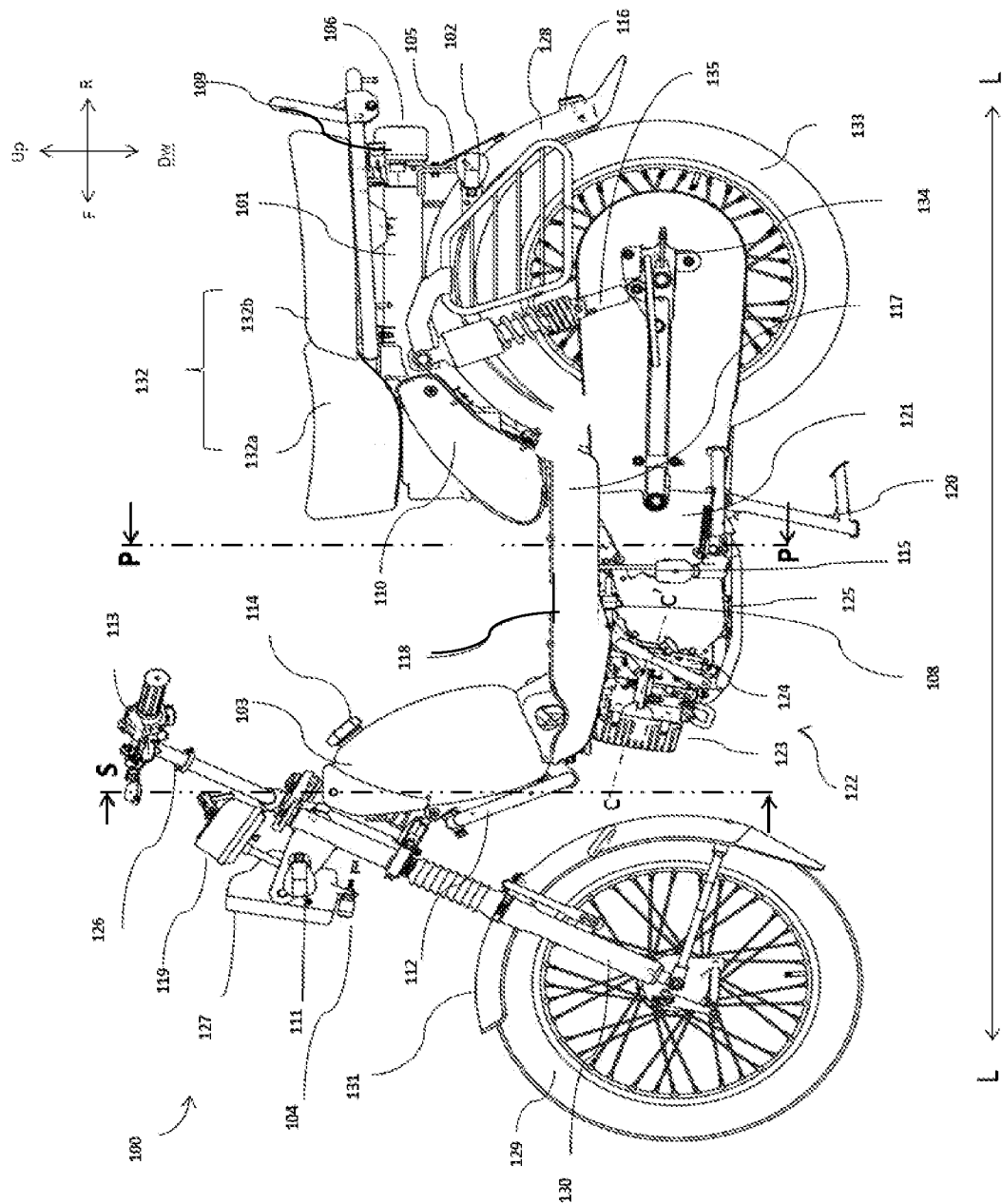


Fig. 1

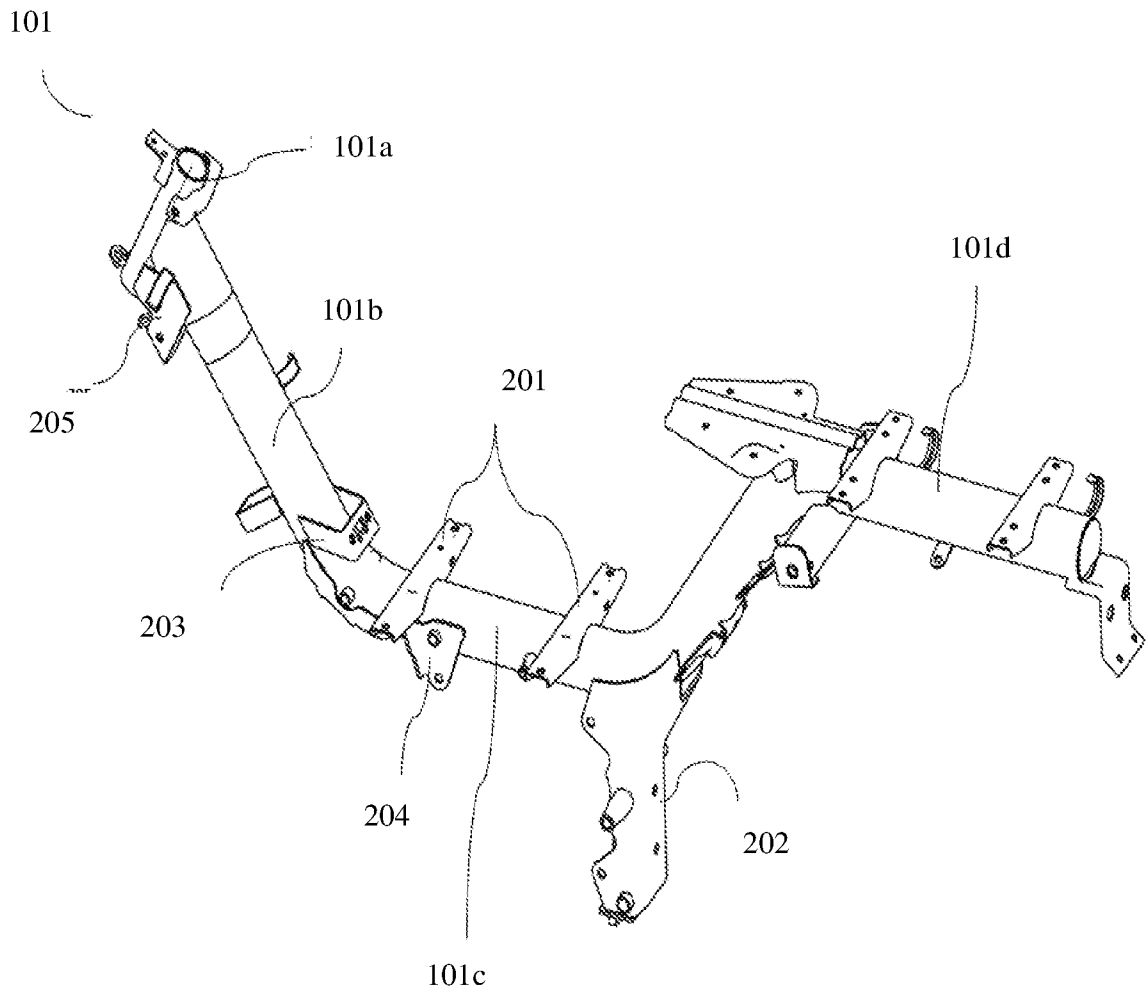


Fig. 2

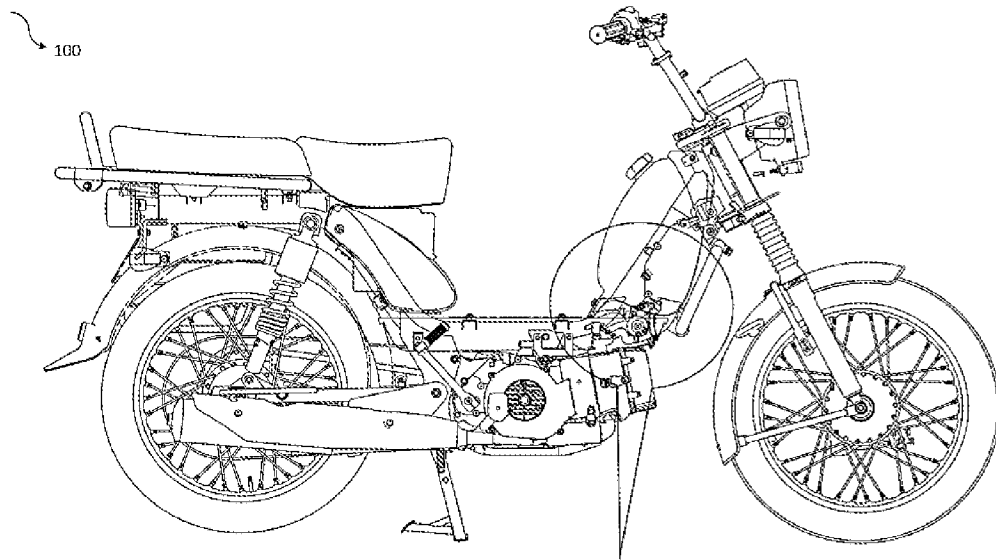


Fig.3

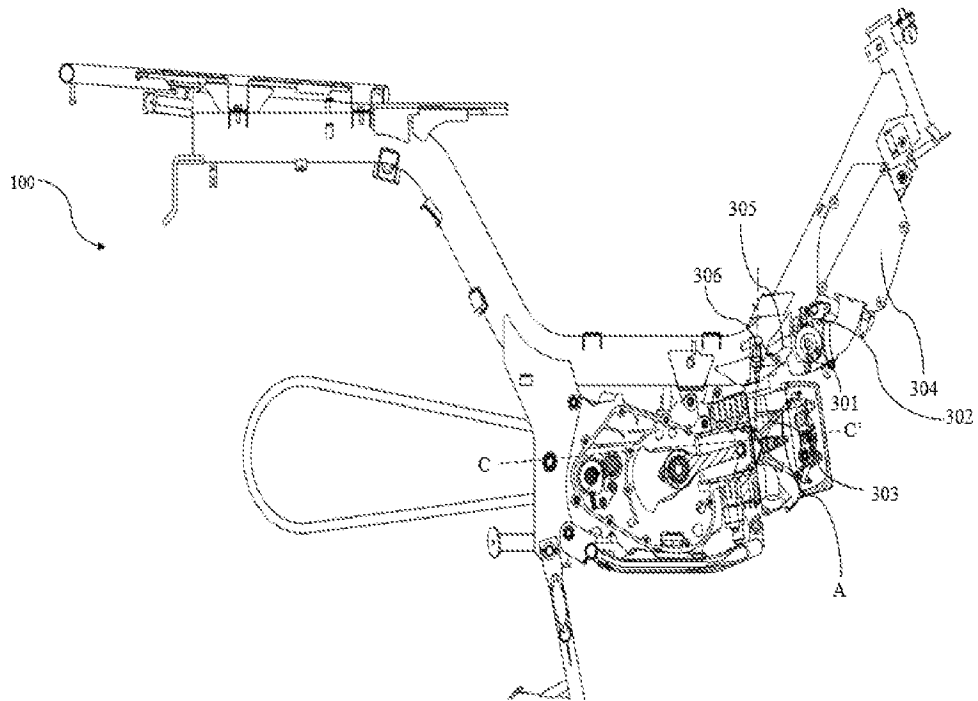


Fig. 3a

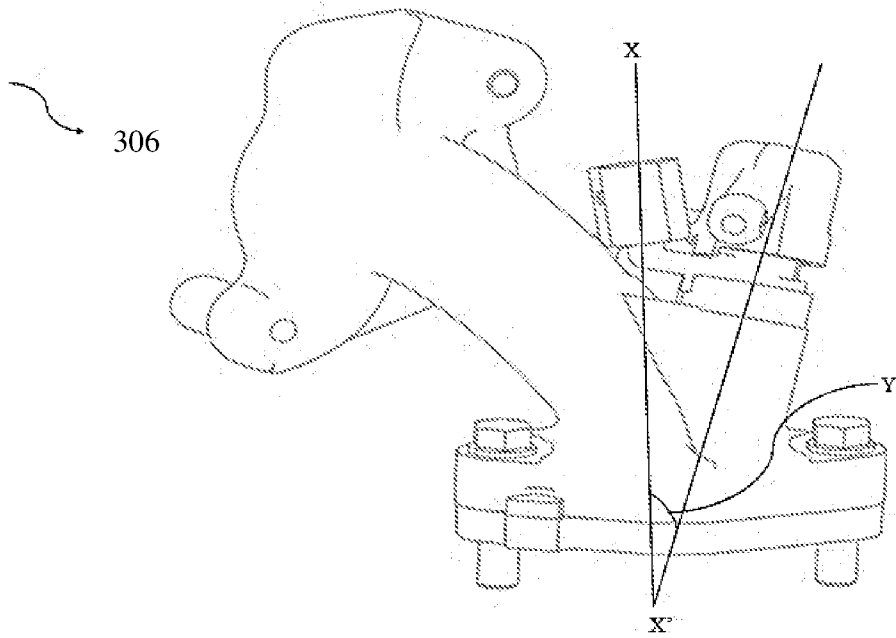


Fig. 3b

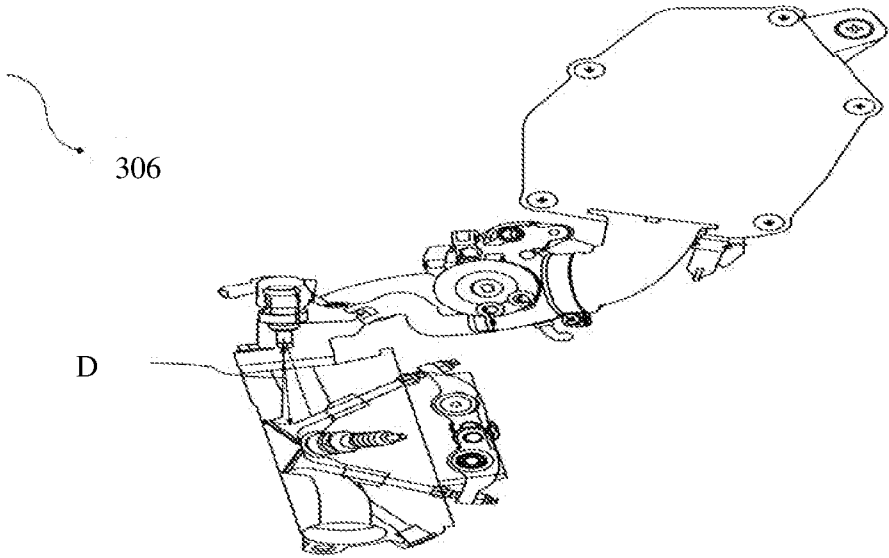


Fig. 3c

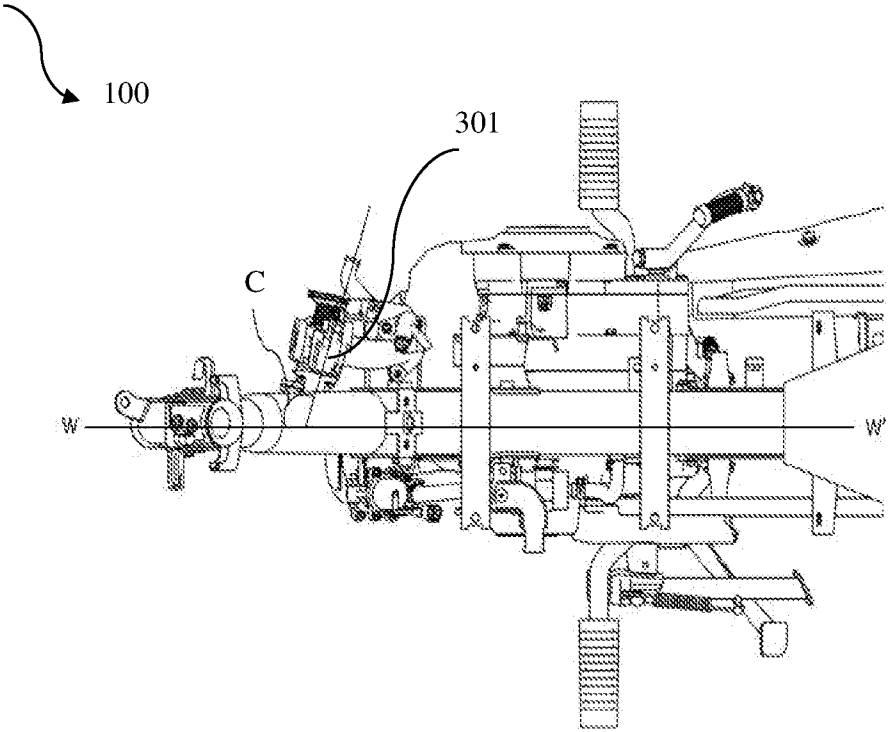


Fig. 4

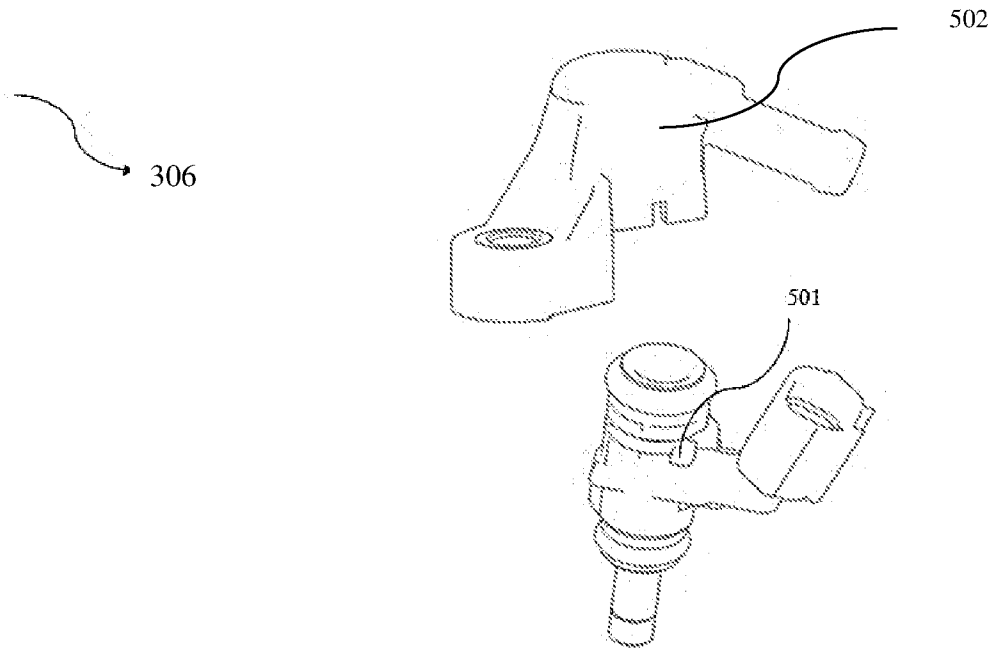


Fig. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IN2020/050535

A. CLASSIFICATION OF SUBJECT MATTER
F02M61/14 Version=2020.01

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)

F02M

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)

TotalPatent One, IPO Internal Database

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP5323519B2 (HONDA MOTOR CO LTD; 23 Oct 2013) the entire document (as per English translation on Google Patents)	1-12

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"D" document cited by the applicant in the international application	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"E" earlier application or patent but published on or after the international filing date	"&" document member of the same patent family
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search 07-10-2020	Date of mailing of the international search report 07-10-2020
Name and mailing address of the ISA/ Indian Patent Office Plot No.32, Sector 14, Dwarka, New Delhi-110075 Facsimile No.	Authorized officer Krishan Kumar Telephone No. +91-1125300200