

Development of RC213V-S

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ABSTRACT

The RC213V-S was developed aiming at a creation of a motorcycle, which can be legally driven on a public road, based on the MotoGP racing machine RC213V while succeeding its mechanisms and detailed specifications. To comply with regulations and to apply necessary equipment needed for practical use, some of the parts manufacturing processes were changed. However, the basic configurations and exterior styling design were maintained within a limited range of changes, minimizing its weight increase to achieve the dry weight of 170 kg. Consequently, it was made possible to have ordinary riders enjoy the attractive feature of maneuvering feeling that is so called “excellence of maneuverability,” which is a crucial element needed for RC213V to win the races.

1. Introduction

The RC213V, a MotoGP racing machine (Fig. 1), started to participate in MotoGP races in 2012, and won the triple crown of the rider’s title, the constructor’s title and the team title in consecutive two race seasons of 2013 and 2014. One of the most important features of this machine, which is dedicatedly developed for winning races, was “excellence of maneuverability.” That is to say, the RC213V can be recognized as the easiest racing machine to maneuver in the world. The developed motorcycle of the RC213V-S (Fig. 2) is vehicle legally drivable on public roads while inherited

most of the mechanisms and the detailed specifications of the RC213V. The objective of the development was to share the fascination of “excellence of maneuverability” with ordinary riders. In other words, the RC213V-S is not for applying the technologies that Honda has gained through races to ordinary production motorcycles, which Honda has sometimes done so far, but for making an unprecedented challenge to have a machine developed for MotoGP legally driven on a public road.

In this paper, the concept of the development, the applied engine technologies and the vehicle control technologies are introduced.



Fig. 1 RC213V



Fig. 2 RC213V-S

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2. Development Concept

Having an engine that cranks out a maximum power more than 175 kW mounted in the motorcycle as light as approximately 160 kg, the RC213V has an overwhelming engine performance as well as having excellent handling characteristics to allow for use of the full performance. In the RC213V-S, which is a commercial motorcycle for use on public roads, the main target of development is set to have the rider enjoy the maneuverability of high quality rather than the engine performance. The “fun to riding” attainable from the maneuverability can be experienced by ordinary riders regardless of speed even if he is unable to ride like a MotoGP racer. The development concept therefore is to fully reproduce the maneuverability while maintaining the racing machine package.

3. Overview

Figure 3 shows the position of the RC213V, the RC213V-S and the RCV1000R, which is a commercially-available racing machine based on the RC213V for races in the open category of MotoGP. Major specifications of the RC213V-S are shown in Table 1. The complete motorcycle packaging, basic specifications and the mechanism that constitutes basic configuration of the RC213V are maintained wherever possible in the RC213V-S. Just like the RC213V, the masses are thoroughly centralized and the friction in various moving parts is minimized to enhance maneuverability. The weight saving and high precision of component parts, which the overwhelming difference between a MotoGP machine and a commercial motorcycle



Fig. 3 Positioning of each model

Table 1 Specifications of RC213V-S

Engine type	Liquid-cooled 4-stroke 4-valve DOHC V-4
Fuel supply system	PGM-DSFI electronic fuel injection
Engine displacement (cm ³)	999
Frame type	Diamond
Dry weight (kg)	170
Kerb weight (kg)	188
Caster angle (deg)	24.6
Dimensions (L×W×H) (mm)	2110 × 770 × 1115
Ground clearance (mm)	115
Seat height (mm)	830
Trail (mm)	105
Wheelbase (mm)	1460

is attributable to, are also emulated. To ensure even higher quality, this motorcycle is produced by expert technicians having excellent skills. In the meantime, some modifications have been made to allow service in the general maintenance environment as well as for law compliance by addition of minimum necessary parts to make it street legal. The following are the modifications and additions from/to the RC213V.

- (1) Presuming service in the general maintenance environment, the valve system has been modified from the pneumatic system to the coil spring type while maintaining the gear-train driven camshafts. The transmission has also been modified from the seamless type to the conventional dog clutch type. These modifications are common to the RCV1000R.
- (2) To make the motorcycle street legal, the lighting instruments, rear view mirrors, speedometer, muffler with catalyst, license plate holder, horn, etc. are added without making big changes to the basic configuration and styling of the RC213V.
- (3) To make the motorcycle practical for use on public roads, the Honda smart key system, starter motor, side stand, etc. are added as well as modifying the specifications of tire, brake disks, pads and the steering stopper angle.

3.1. Coloring

The RC213V-S is offered only in the traditional tricolor scheme, which is the corporate color of HRC (Honda Racing Corporation) inaugurated in 1982, as well as a typical color of Honda factory machines. The red represents passion of the persons committed to winning, the blue for the high technology based on theories, and the white symbolizing all customers fond of motor sports. A motif of Japanese flag is displayed on the sides of front fairing as a symbol of manufacturer's passion and challenging spirit of R&D members who play important part of precision manufacturing in Japan.

3.2. Packaging

In the packaging of the RC213V as a complete motorcycle, the masses are thoroughly centralized to enhance maneuverability. While setting the wheelbase longer than a general super-sport motorcycle to cope with the high power output, a priority of weight reduction is given to the wheels and suspension parts located far from motorcycle's center of gravity (CG). In addition to that, the fuel tank is located near motorcycle's CG to reduce inertia moment of vehicle body as a complete motorcycle and to minimize shift of CG from changes of fuel volume. The packaging as a complete motorcycle along with the basic specifications from the materials to the manufacturing methods of frame components of the RC213V is maintained in the RC213V-S. Considering use on public roads, the battery capacity is increased and electrical components such as the lighting instruments are added to the RC213V. Regarding these modifications and addition, the parts are laid near the CG of complete motorcycle to prevent increase of inertia moment of the complete motorcycle to achieve desired maneuverability.

In the meantime, the sport kit, which is exclusively for use in a closed course such as a race track, has also been developed. By removing the lights and other equipment for street use and installing the kit parts, the body inertia moment becomes the same level as the RC213V, allowing emulation of the riding experience in the speeds closer to the world of the RC213V.

3.3. Frame Body

In the RC213V, each and all frame body component parts are ground-fit by specialists, and then welded together using Tungsten Inert Gas (TIG) welder. Consequently, a high precision and welding quality are maintained despite the need of large number of welding. In the RC213V-S at this occasion, the materials and the manufacturing methods employed in the RC213V are also maintained wherever possible.

Moreover, the machining bolts made of titanium alloy are employed for tightening of frame body parts of the RC213V-S just like in the RC213V to reduce weight. When assembling, the molybdenum grease is applied to the threads to obtain consistent axial force, and all bolts are hand-tightened to the specified torque which is different from that of an ordinary steel bolt.

3.4. Swingarm

The swingarm of the RC213V is that of an under-brace type to cope with the shape of fuel tank aimed at reduction of inertial moment of the motorcycle, and the torsional stiffness and the lateral stiffness are properly balanced to achieve necessary maneuverability. The swingarm is composed of the press-molded aluminum arm, the end piece and cross body which are entirely machined from an aluminum billet. The parts are welded together by skilled expert technicians using a TIG welder

to ensure maneuverability while reducing weight. The same configuration and manufacturing method of the RC213V are maintained in the RC213V-S wherever possible.

4. Engine

4.1. Overview and Basic Specifications of Engine

The engine of RC213V is designed with an aim at mass centralization, weight saving and compactness to enhance maneuverability of the complete motorcycle. The engine of the RC213V-S succeeded to the basic design concepts of the original engine of the RC213V. In addition, specifications and production methods for mass production were implemented even though expected production volume was quite limited. Despite the application of those methods, the engine kept the size that fits in the frame of the original RC213V as well.

Compared to the same 90-degree V type four-cylinder (V4) engine of the mass-production motorcycle VFR800, the weight is less by 10 kg, the length between the crankshaft and the output shaft is shorter by 51.5 mm, and the engine width is less by 40 mm. The engine sizes of the RC213V and the VFR800F are compared in Fig. 4.

The external view of the RC213V-S engine is shown in Fig. 5, and the transparent view in Fig. 6. The engine specifications are given in Table 2.

This paper mainly concerns the technical features that contribute to the lightness and compactness of the RC213V-S engine while permitting service in general maintenance environment.

4.2. Crankcase

When designing the crankcase with integrated cylinder blocks, a breather chamber having an adequate volume is incorporated in the area between two banks to separate oil

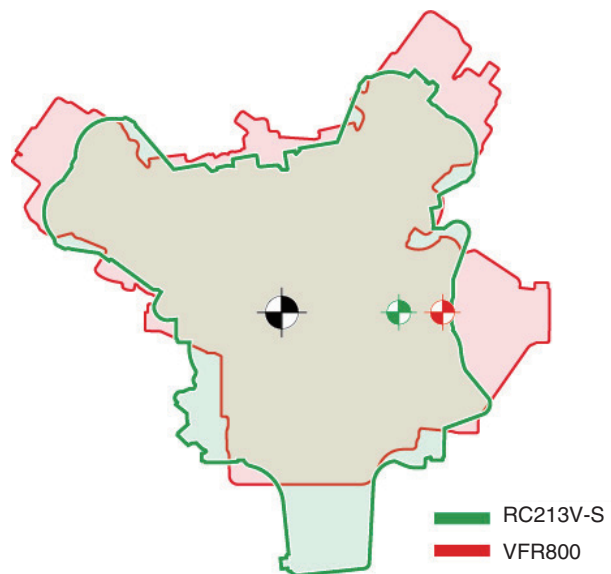


Fig. 4 Comparison of engine sizes

from the blow-by gas to achieve a breather performance necessary for use on public roads. As the breather chamber is that of a construction having a complex labyrinth, the crankcase is made of sand-cast aluminum that permits casting of a hollow product. The cylinder block is that of a closed deck type from which a high stiffness is attainable around the cylinder bores to cope with a high power output. In this method, cast-out holes remain on the deck surface due to the core print for securing of the sand core for the water jacket. Such a cast-out hole causes a loss of stiffness of the deck surface. Accordingly, aluminum plugs are pressed into holes at the time of machining except the ones for coolant passage as shown by Fig. 7 to prevent lowering of stiffness of the deck surface. The Ni-SiC



Fig. 5 External view of engine

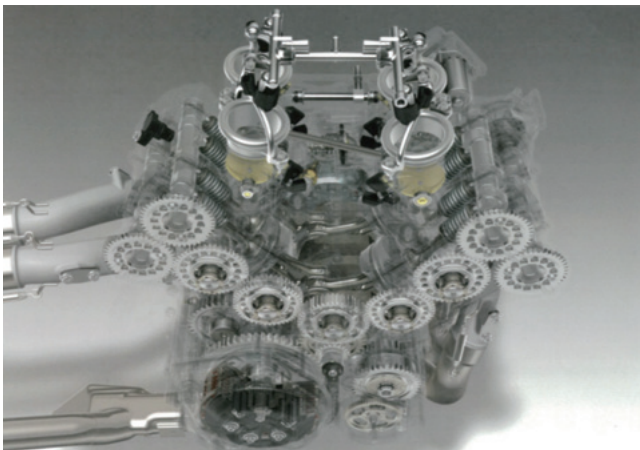


Fig. 6 Transparent view of engine

Table 2 Specifications of engine

Engine type		Liquid cooled 4-stroke 90° V transverse 4 cylinder
Engine displacement	(cm ³)	999
Bore × Stroke	(mm)	81.0 × 48.5
Combustion chamber Shape		Pentroof
Compression ratio		13.0
Valve train		DOHC 4 valve cam gear train
Valve Dia. (mm) × Number / Cyl.	Intake	32.5 × 4
	Exhaust	28.5 × 4
Max. power	(kW/rpm)	117/11000
Max. torque	(Nm/rpm)	102/10750
Clutch type		Dry multi-plate type
Transmission		6 speed constant mesh

compound plating is applied on the cylinder bore to reduce friction from sliding of the piston while enhancing seizure resistance.

The same semi-dry sump construction as in the 2002 year-model MotoGP machine RC211V is employed in the crankcase as shown by Fig. 8 to reduce pumping loss. It is of such a construction in that the crankcase is of a dry sump type using the transmission housing as an oil tank⁽¹⁾. The reed valves are incorporated in the pump case of the

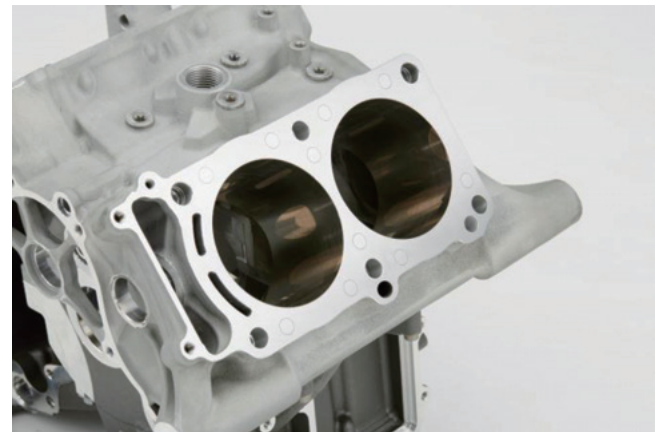


Fig. 7 Closed deck type cylinder block

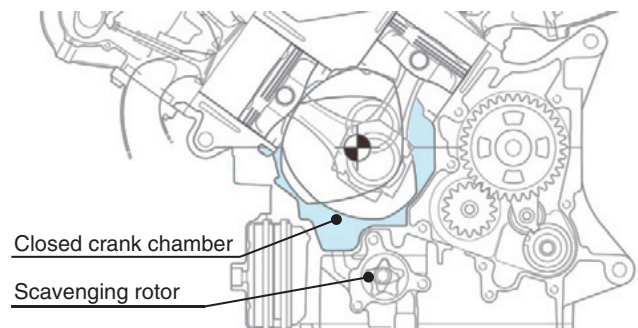


Fig. 8 Structure of closed crank chamber

scavenging pump that has a rotor per two cylinders to ensure its function. This construction permits reduction of pressure in the crankcase and efficient extraction of oil from the crankcase (Fig. 9).

A comparison of total friction loss with the commercial in-line four-cylinder (L4) engine of the same displacement is shown in Fig. 10. The friction loss of the RC213V-S engine is less than that of the L4 engine by 25% at 12000 rpm. The reduced friction loss is considered attributable to the sealed crankcase construction and the latter-mentioned gear-train driven camshafts.

4.3. Reciprocating and Rotating Parts

The crankshaft is made of high-cleanliness steel with vacuum degassing process having a high fatigue resistance. To avoid interference of the counter weight with the piston at the bottom dead center, the center of machining of the outer circumference of counter weight is offset toward the crank pin from the center of journal. When compared to

the case without offset, the offset design permits reduction of length of connecting rod, which allows reduction of cylinder head height. Separately prepared weights made of a heavy metal (specific gravity: 18.1 g/cm^3) are pressed into the counter weights. This construction is aimed at retention of appropriate inertia moment, which is necessary to ensure throttle linearity and traction characteristics, while achieving compactness. The appearance of crankshaft is shown in Fig. 11.

The connecting rod is made of the titanium alloy Ti-64A. As shown in Fig. 12, the cross section is of an X shape made by hot forging to attain a high torsional stiffness. Compared to the conventional titanium alloy connecting rod of the VFR750R, the weight is less by 6.8%.

The piston is made of the high strength aluminum alloy A2618-T6 which has a high strength at high temperatures. As shown in Fig. 13, the connection of right and left piston pin bosses with a bridge permits reduction of weight and increase of stiffness.



Fig. 9 External view of oil pump assembly

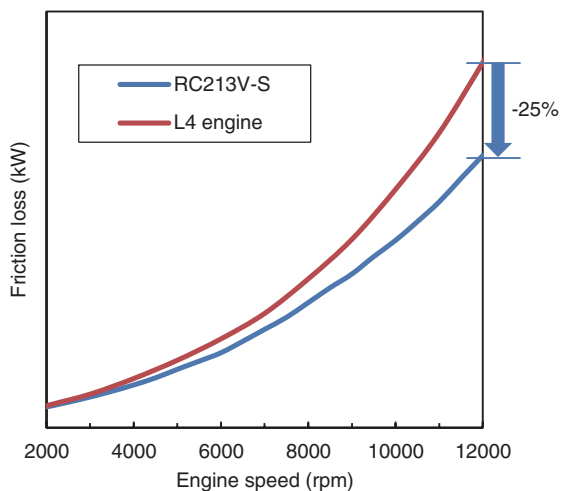


Fig. 10 Effect of friction reduction

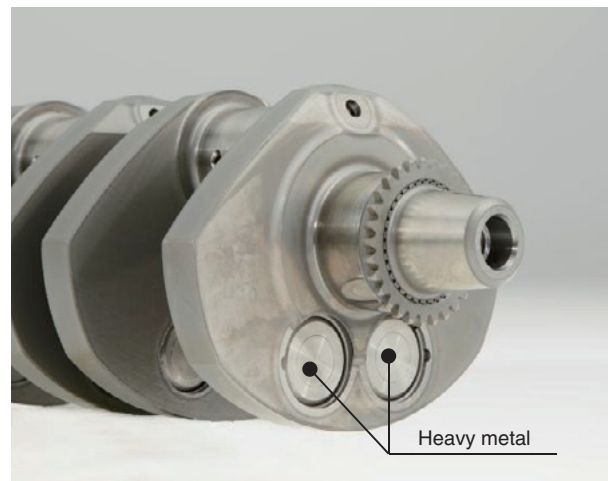


Fig. 11 Crank shaft

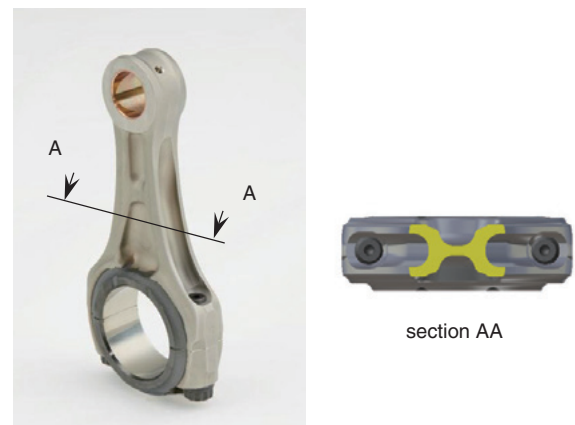


Fig. 12 Connecting rod with X-shaped cross-section

4.4. Camshaft Drive System

The gear train is employed in the camshaft drive system for accurate valve actuation at high revolutions and reduction of friction in the cam drive system. The gear train is shown in Fig. 14.

The gear train, which is composed of a total of 10 gears in the front and rear bank, has a backlash adjuster using an eccentric shaft as shown in Fig. 15 in the second, third and fourth idle gear shafts. The inside of the eccentric shaft is splined. The idle gear rests on the off-centered outer circumference of the eccentric shaft, allowing backlash adjustment by turning the eccentric shaft. After adjusting

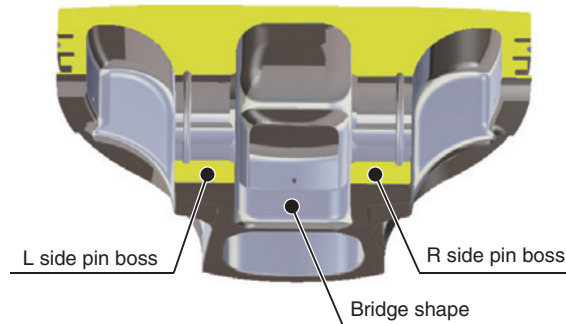


Fig. 13 Piston cross-section

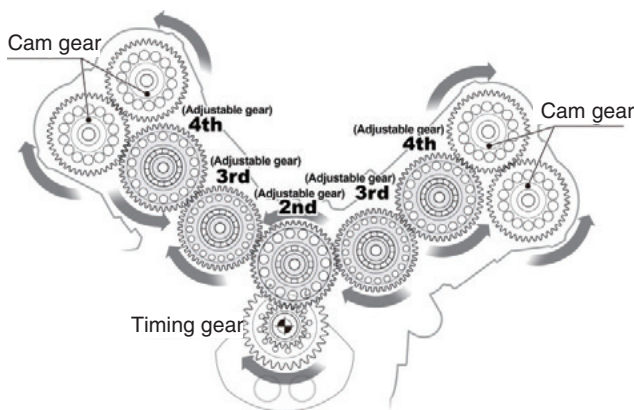


Fig. 14 Gear-driven camshaft

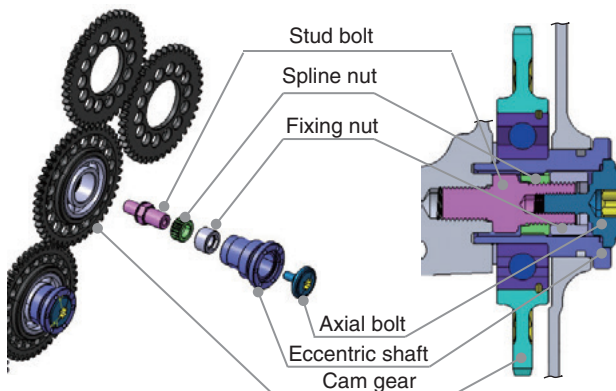


Fig. 15 Backlash adjustment mechanism

backlash, the eccentric shaft is locked from turning by tightening the fixing nut. Then, the axial bolt is tightened to lock the eccentric shaft, which locates the idle gear in the axial direction. This construction allows proper adjustment of gear backlash to control gear noises such as rattle or whine as well as preventing resonating vibrations in the cam drive system. For fine adjustment of valve timing, such a construction is employed in the cam gear/camshaft retaining system that allows selection of a set of retainer bolt holes from the seven sets of holes having a slightly varying orientation referenced from the center of gear tooth.

In the engine assembly process, the backlash and the valve timing are adjusted unit by unit.

4.5. Oil Feed System

The oil passages to feed oil to the crankshaft are shown in Fig. 16. The oil is fed from right and left ends of crankshaft to the big ends of connecting rods through the crankshaft. Independently from that, the oil is fed to the crank journals via the passages in the cylinder block. The passages are created independently to feed optimum amount of oil to each system. The oil is also fed to the piston from the piston jet located in the exhaust side exclusively for each cylinder. The piston jet shown in Fig. 17 has four outlet holes having various directions to allow efficient lubrication and cooling.

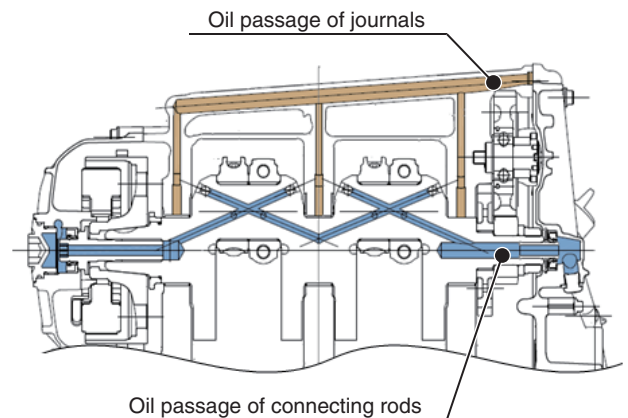


Fig. 16 Oil supply for crankshaft

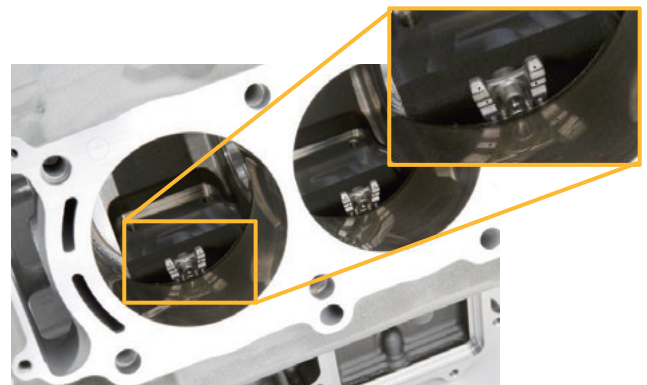


Fig. 17 Piston oil jet

4.6. Clutch

To reduce operating effort of clutch lever and to control excessive torque in the reverse direction, the dry clutch having an assist-slipper system is employed. The clutch facing is made of the heat-resistant and wear-resistant sintered material. The structure of clutch is shown in Fig. 18. The clutch center, which is a solid piece in a conventional design, is split to the center A and the center B. The sub springs are incorporated between the center A and B. The spring load acts in such a manner that lifts the pressure plate via the center B. Accordingly, when the clutch lever is pulled, the force from the sub-springs is added to the clutch lifting load which pushes the pressure plate, thus reducing lever effort. The assist cams and the slipper cams are also incorporated between the center A and B, and the both

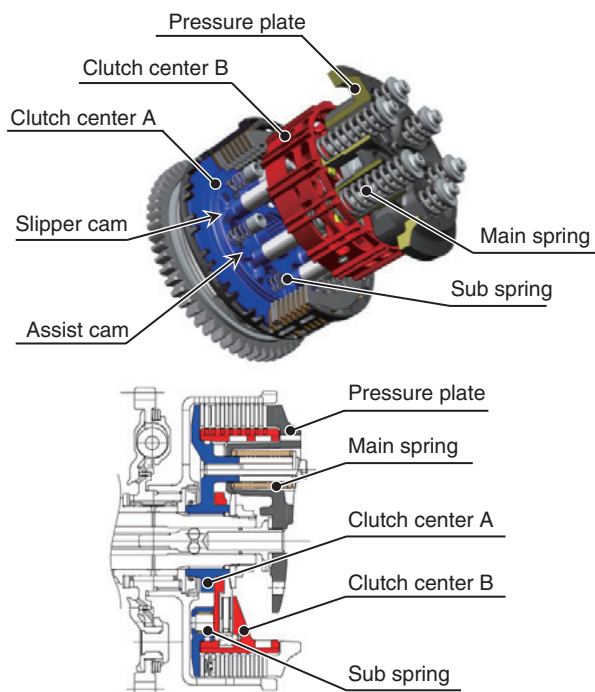


Fig. 18 Structure of assist-slipper clutch

clutch center are engaged via either type of cams.

How the assist-slipper system functions is explained in Fig. 19. When acceleration, the center B is pulled in toward the center A by the thrust force from the assist cam, allowing only the main clutch spring load to act on the pressure plate. Accordingly, the normal torque transmission capacity is obtainable from the clutch. When deceleration, the thrust force from slipper cams acts in the direction that lifts the clutch center B and the adjacent pressure plate. The force from the main spring acting on the pressure plate decreases, causing the clutch capacity to lower. Thus an excessive torque transmission in the reverse direction occurring at the time of a quick down shift is moderated by the slipping of clutch. This helps to reduce rear wheel hopping and rear tire slippage.

To allow push starting of the engine, the plunger system (Fig. 20) is employed to control travel of the clutch center by the thrust force of slipper cam. The plunger is installed in the clutch center B in such a manner that allows travel in the radial direction. When the engine is not running, the clutch center B is locked by the plungers while contacting with the clutch center A to maintain the normal clutch capacity, which prevents clutch slippage to allow push starting. As soon as the engine starts running, the centrifugal force moves the plungers toward the outer circumference to allow the clutch center B to travel to the axial direction.

4.7. Intake System

All the intake air passages in the cylinder head and in the throttle body are machined to obtain precision of port shape for steady flow of intake air. The length of intake manifold is maintained same as that of the RC213V by the use of insulators having only a face-sealing function instead of conventional plug-in type insulators for connection of the throttle body to the cylinder head. For connection, the rubber-mount construction is employed to reduce vibrations in the entire throttle body. Two injectors are incorporated in each cylinder to supply optimum amount of fuel across the broad engine speed and throttle opening ranges. One of the two injectors is located after the throttle valve to allow

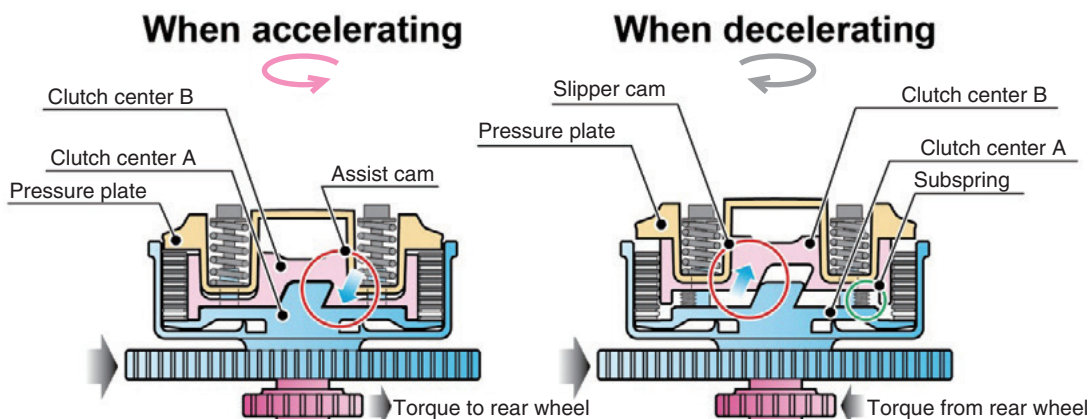


Fig. 19 Operational diagram of assist-slipper clutch

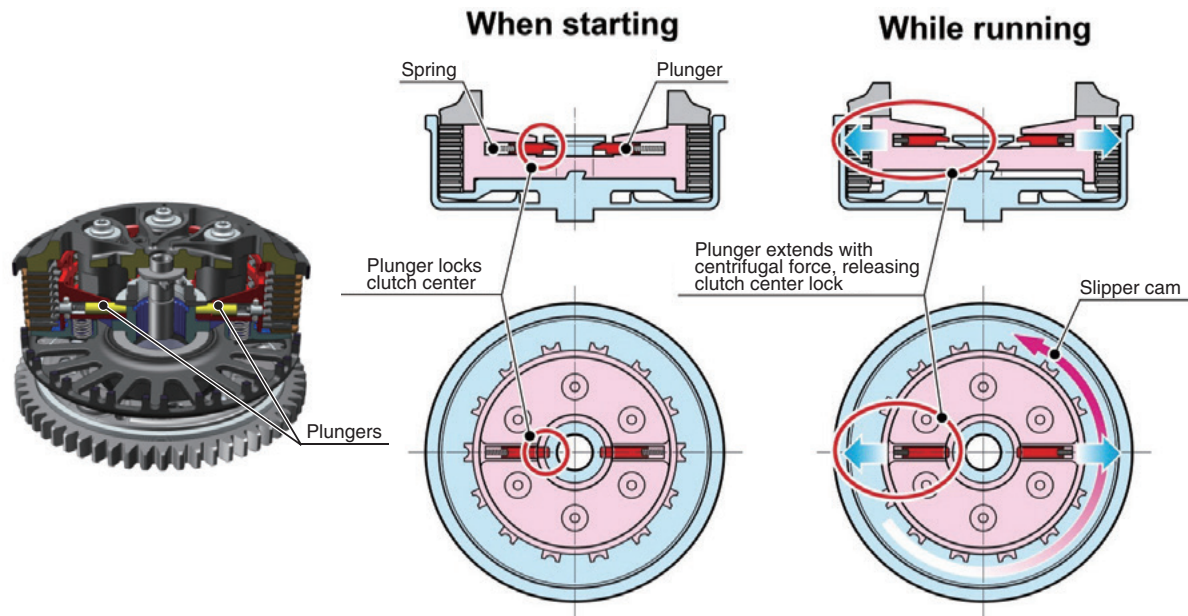


Fig. 20 Slipper cancellation mechanism for push-start

spraying of fuel on the back of intake valve faces. Another one is located above the bellmouth. Optimum injection volume and injection timing are selected for each injector. The configuration of intake system is shown in Fig. 21.

4.8. Exhaust System

There are the following issues in the exhaust system of a V4 engine.

- Front bank exhaust pipes interfere with radiator cooling fan
- Rear bank exhaust pipes interfere with rear shock and frame member

To cope with these issues, the separate color, in which the cross section gradually changes from an oval at the start of exhaust port to a true circle, is incorporated. By the employment of oval shape at the position directly under the exhaust port, the above-mentioned interference is avoided. The separate exhaust color is made of cast stainless steel SCS13 by lost-wax casting.

To make the motorcycle street legal, an expansion

chamber having a volume larger than the RC213V is required to comply with the noise regulation. However, if the expansion chamber is laid outside of the cowling, an increase of air drag and/or lowering of maneuverability due to an increase of inertia moment will result. To cope with this issue, the uniquely-shaped, independent expansion chambers are employed for the front and rear cylinders. The one for the front cylinders is laid in the lower right side of motorcycle, and the one for the rear cylinders inside of the tail cowl to keep the expansion chambers within the cowl. The configuration of exhaust system is shown in Fig. 22.

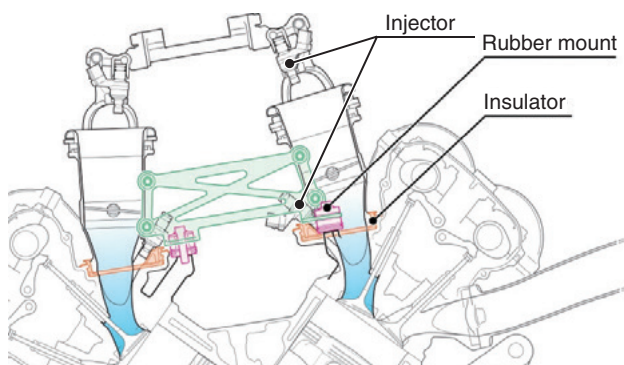


Fig. 21 Configuration of intake system

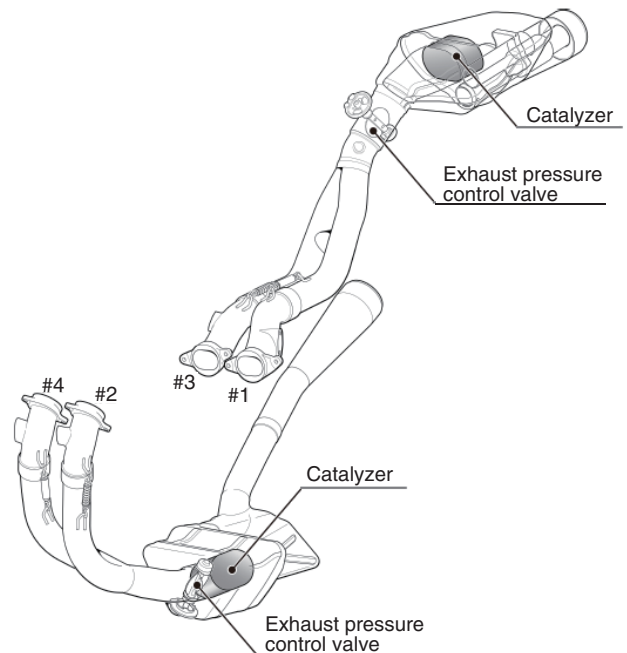


Fig. 22 Configuration of exhaust system

The variable exhaust valve, which controls pressure in the exhaust pipe, is incorporated after the exhaust pipe collector both in the front bank and the rear bank. The catalyst is located at the entrance of expansion chamber. With the above-mentioned layout employed, the same level of appearance as the RC213V has been maintained.

5. Control System

5.1. Overview of Control System

To make the RC213V “excellence of maneuverability,” which is a key to winning, various control systems are incorporated for engine power management and control of motorcycle behavior. The machine characteristics can be fine-tuned to adjust to the track conditions by altering various control parameters. Moreover, a number of combinations of such parameters can be set into various riding modes. The rider rides the machine while shifting

the mode depending on changes of road surface conditions and tire grip during the race. Such a mode shifting unique in racing machines is also incorporated in the RC213V-S so that the rider can experience the “excellence of maneuverability” characteristics of the RC213V even on public roads. The technical features are introduced hereafter.

5.1.1. Control system configuration

The configuration of electronic control system of the RC213V-S is shown in Fig. 23. The throttle by wire (TBW) system is incorporated in the RC213V-S to realize an electronic control derived from the RC213V. The Inertial Measurement Unit (IMU) is also incorporated to accurately detect dynamic conditions of motorcycle. The Accelerator Position Sensor (APS) is that of a grip-position type which uses no throttle cable from the standpoint of weight reduction and space saving. The Engine Control Unit (ECU)

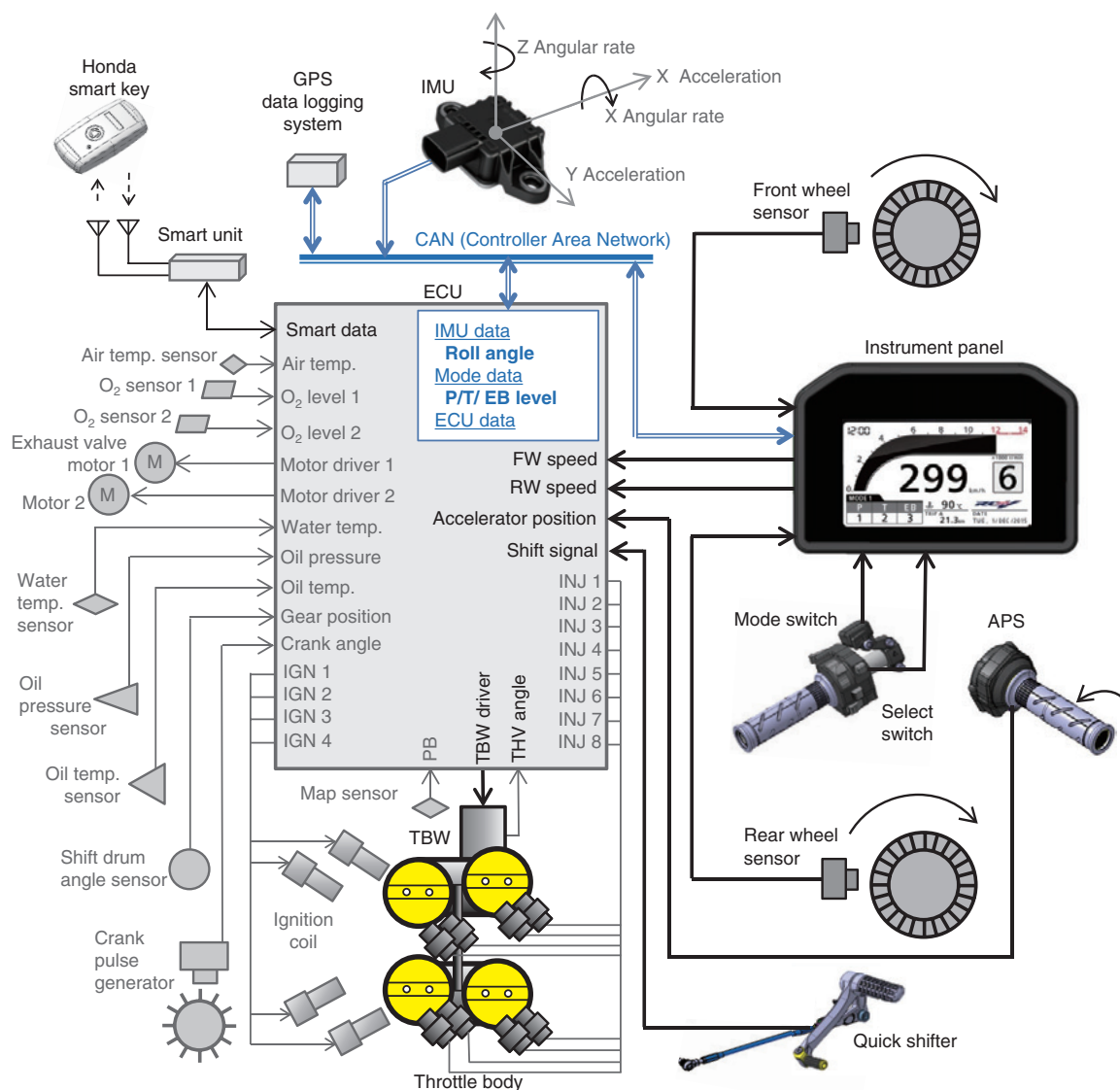


Fig. 23 Electronic control system

is newly developed from the standpoint of user-friendliness and environmental protection requirements necessary for a commercial motorcycle. Various sensors necessary for various types of control are also selected from the same standpoint.

5.1.2. Riding mode

The three systems, i.e., the power selector, the selectable torque controller, and the selectable engine brake that regulate power transmission response against rider's throttle operation are incorporated in the RC213V-S (Table 3). The system permits the rider to independently select power output characteristics from three levels (P level: 1 through 3), torque characteristics from 10 levels (T level: 0 through 9), and engine brake from 4 levels (EB level: 1 through 4). In addition to that, five riding modes in which these three parameters are preset are provided. The mode 1 is for the best surface condition with minimum intervention by the control system to take full advantage of powerful and direct engine characteristics. In the modes 2, 3, 4, and 5, the level of intervention by the control system increases in the order of number. The rider can choose any mode from 1 through 5 when riding by pressing the mode switch on the left handlebar. Moreover, the rider can freely set each parameter in each mode. This permits the rider to ride the machine to his preference in a variety of riding situation.

Table 3 Default values of riding mode

Riding mode	Engine power (P)	Torque control (T)	Engine brake (EB)
Mode 1	1	2	3
Mode 2	2	2	3
Mode 3	2	5	3
Mode 4	2	8	2
Mode 5	3	8	1
Selectable range	1 - 3	0 - 9 0: off	1 - 4

5.1.3. Power selector (P)

Image pictures of output characteristics of the power selector are shown in Fig. 24. The power selector permits selection of engine power output characteristics against throttle opening from three levels. This system achieves various levels of output characteristics by setting Throttle Valve (THV) opening characteristics against APS opening for each level. The THV opening characteristics against the APS at each power level are shown in Fig. 25.

Level 1: Allows peak power at any of the six gear positions
Level 2: Restricts engine power output by a maximum of 12% from the level 1 when APS opening is 10% or more

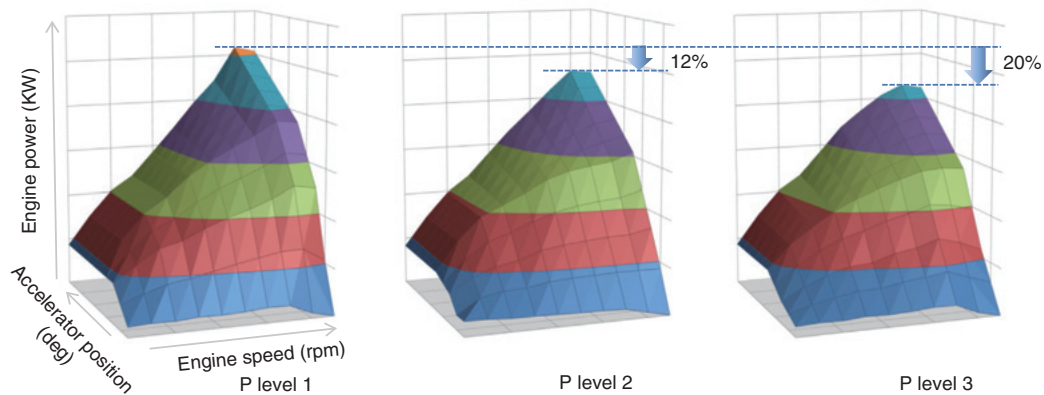


Fig. 24 Change of engine output characteristic by power selector

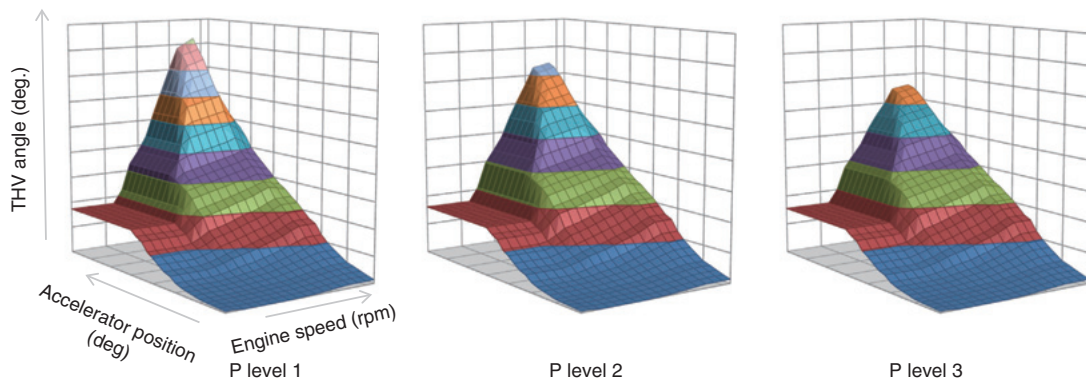


Fig. 25 Relationship between APS output and THV angle in each P level

Level 3: Restricts engine power output by a maximum of 20% in the same manner

5.1.4. Selectable torque controller

If the throttle is opened excessively when accelerating at a corner exit, the rear tire may slip causing a loss of traction and stability, which affects lap time and makes a win or loss difference. The selectable torque controller is a system that makes the motorcycle easy to ride by reducing such rear tire slippage at acceleration to maintain stability. The speed of each wheel is detected by the wheel speed sensor incorporated in the front and rear wheels. The ECU calculates rear wheel slip ratio from the wheel speeds. The ECU calculates roll angle of the motorcycle on the basis of the angular velocity and acceleration detected by the IMU, which is located in the front cowl. The ECU determines a target slip ratio from the roll angle and the APS output, and controls driving force by regulating throttle valve opening so as to converge to the target slip ratio. Thus, even if the rider opens the throttle widely, an adequate driving force as per rider's acceleration demand can be provided while controlling rear tire slippage. This system permits selection from 10 levels of torque controller intervention including OFF depending on rider's preference.

5.1.5. Selectable engine brake

The selectable engine brake is a system that permits selection of engine brake characteristics from four levels when APS is fully closed. When APS is fully closed, the throttle valve opening is regulated at a prescribed level by TBW in accordance with the engine speed. The engine brake is hardest in Level 1, and weakens as the number increases. The control map of selectable engine brake is shown in Fig. 26.

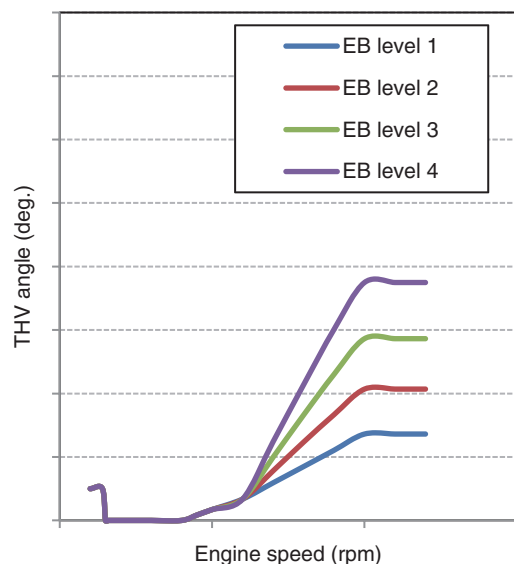


Fig. 26 Engine brake (EB) control map

5.1.6. Quick shifter

The quick shifter is employed in the RC213V-S just like in the RC213V. The quick shifter is a device that allows the rider to shift up only by a shift pedal operation without closing throttle or pulling clutch lever. When a shift up operation is detected on shift pedal, the ECU controls fuel injection volume and ignition timing. That makes possible to shift up in quick and ensured manner. The shifting operation is detected by a sensor incorporated in the shift rod. While a piezoelectric sensor is employed in the RC213V to achieve a direct feel for a racing machine, a switch is applied to the RC213V-S from the standpoint of easy maintenance.

6. Electrical Systems

6.1. Meter Display

In the RC213V, the dot-matrix, multi-function meter, which can provide necessary information only for racing upon rider's request, is employed. Meanwhile in the RC213V-S, the full-color TFT liquid crystal display (LCD) meter is employed for the first time in Honda motorcycles to allow display of abundance of information taking into account the use on public roads. The visibility in various environmental conditions is enhanced by the backlight having a maximum luminance of 1000 cd/m² and automatically adjusting luminance depending on the ambient brightness. Presuming that the rider switches LCD display depending on the situation, two display formats, i.e., the street format that displays speed in the middle, and the circuit format that indicates lap time in the middle, are incorporated. The displays of riding mode and the level of each control parameter, i.e., power (P), torque (T) and engine brake (EB) are gathered together and laid in the lower left part of screen for easy recognition when running. In addition to the lap time measurement by tapping the switch on the handlebar, the lap time can be measured and displayed automatically by the attached GPS data logging system, and recorded in the USB memory. The lap time can be retrieved and shown on the meter display after driving. After downloading recorded data to a computer from the USB memory, data of each lap including various vehicle information such as the throttle opening, engine speed etc. can be inspected using the custom application. Other functions derived from the RC213V include the mechanic format and the shift up indicator. The mechanic format permits data display when stopping by a switch operation, allowing monitoring of conditions such as the water temperature, oil temperature, oil pressure, etc. when the rider or mechanic inspects the machine or warms up the engine. The shift-up indicator is a device that notifies the rider of proper shift-up timing so that the rider can efficiently accelerate the machine. To make the indicator recognizable even when the rider is staring ahead, high-luminance LEDs are lined up horizontally in the upper part of meter. The shift-up point can be set at any engine speed

between 4000 rpm and 14000 rpm with an increment of 200 rpm. When the engine speed reaches the preset level during acceleration, the indicator turns from glowing to blinking to urge shift up. External view of the instrument panel and the display formats are shown in Fig. 27.

6.2. Honda Smart Key

The Honda smart key system for electronic identification between the vehicle and the key is employed in the RC213V-S (Fig. 28). This system allows the user to turn on ignition without using a conventional mechanical key. As a key cylinder is eliminated from the upper triple clamp, the same cockpit view as the RC213V is realized. Also, as the rider can start the engine just by a press of the start button, a series of operations to start riding has become smooth.

It should however be noted that the steering lock and the fuel filler lock are still by a mechanical key for weight reduction purposes. The mechanical keys for steering lock and fuel filler lock are stored in the Honda smart key for user convenience.

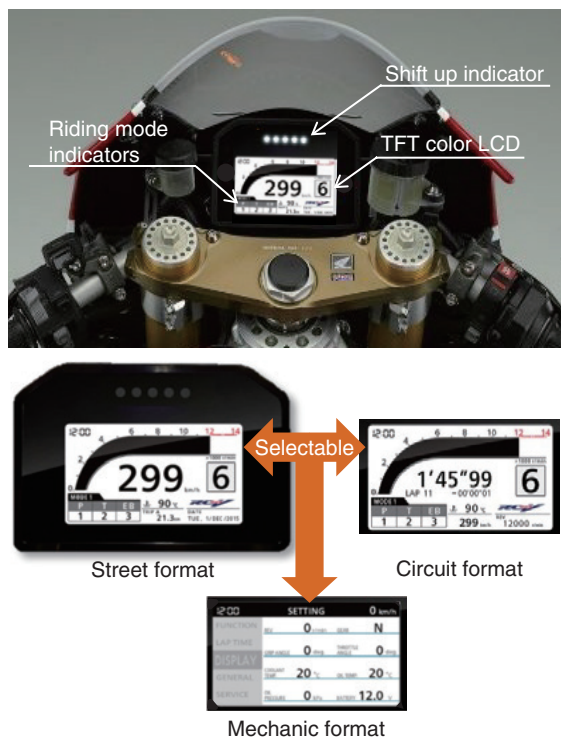


Fig. 27 Instrument panel and display formats



Fig. 28 Honda smart key

7. Conclusion

The RC213V-S fully reproduces the “fun to ride” characteristics attainable from the complete package and the handling of the MotoGP racing machine RC213V. Accordingly, it is now possible for an ordinary rider to experience its benefits on public roads regardless of the speed. Various technical innovations acquired through the development of this motorcycle can be applied to future motorcycles in due orders, thereby offering motorcycles having new features to the market.

References

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