

Development of Pianta Gas Canister-fueled Compact Cultivator for Kitchen Garden

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ABSTRACT

A compact cultivator called the Pianta that uses a gas canister was developed for use in kitchen gardens.

The butane in the gas canister undergoes phase transition between vapor phase and liquid phase at approximately 0°C under atmospheric pressure, so that fuel supply control and removal of fuel from the gas canister become theoretically difficult at an air temperature of around 0°C. The gas supply system uses the method of removing butane in the liquid phase. It also has a vaporizer placed between the cylinder head outlet and the muffler so that users can start and operate the cultivator during the planting season from March to April, when they start working with the cultivator in outside air temperatures of 5°C.

Compared to the FG201, a gasoline-fueled compact cultivator with the same engine displacement (49.4 cm³), the Pianta showed an approximately 10% reduction in CO₂ emissions. The Pianta's emission performance also met EPA Phase II regulation levels and Japan Land Engine Manufacturers Association self-regulating levels.

The overall width between the outer tines was reduced by 22% relative to the FG201 in order to make the Pianta easier to maneuver in the garden. However, the plow power was raised approximately 15% relative to the FG201 by the adoption of the new model tines and enhancement of the drag bar. The issue of noise when using the cultivator close to residential areas was also addressed by reducing the noise level at the operator's position by 1.5 dB(A) during operation.

1. Introduction

The population in Japan that engages in gardening and kitchen garden work has shown an annual increasing trend in recent years, bolstered by the active senior population, referred to as the baby boom generation, as well as by users who engage in these activities for pleasure or other such reasons.

Most of these people, however, have practically no experience in using engine-driven agricultural machinery, including cultivators. Although they may have the desire to purchase a cultivator, they hesitate to purchase one for some reasons. The followings were found to indicate the prioritized needs for which these people seek solutions in the cultivator.

- “High performance as a work machine”
- Ease of handling of fuel (acquisition, refueling, storage)
- Ease of storing and transporting the cultivator
- Consideration for the surrounding environment when operating near residential areas

It was our desire to respond to these demands in order to provide a cultivator to users who do not yet have a

cultivator and have not yet used one.

Given this kind of background, development of the present product was carried out with a focus on using a gas canister that is easy to acquire and easy to handle, and with attention to the key phrases of “threefold simplicity” and “going from a work machine to a gardening tool.”

Mounting a gas engine also enabled reduction of CO₂ emissions relative to a gasoline engine. This makes the product environmentally friendlier, as well.

However, this was Honda's first attempt to develop a product that uses a gas canister, much less one that uses a butane canister. It was therefore necessary to build a new gas supply system.

This is to introduce the Pianta, a compact cultivator for use in kitchen gardens.

2. Development Guidelines and Issues

2.1. The Pianta Concept

2.1.1. Product orientation and name

Figure 1 shows a design sketch of the Pianta.

“Pianta” in the Italian language has the meanings of

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vegetation and plants. The Pianta was named to express the desire to sow new seeds and bring flowers to bloom, in Japanese domestic kitchen gardens and in its gardening market. It is an affectionate nickname for Honda's first gas cultivator and it conveys the image of the great future growth that is envisioned for this product.

The Pianta is built on the base of the FG201⁽¹⁾, a compact cultivator with a gasoline engine, which has the following advantages:

- (1) A highly reliable engine
- (2) A compact transmission
- (3) Mass distribution appropriate for cultivation work
- (4) A large air cleaner with long maintenance intervals and superior cleaning efficiency

Development proceeded in emulation of these points while refining the focus on target users and following the previously mentioned key phrases of "threefold simplicity" and "going from a work machine to a gardening tool." "Threefold simplicity" refers to simplicity of fuel, simplicity of transport and storage, and simplicity of operation.

2.1.2. "Threefold Simplicity"

(1) Simplicity of fuel

In the case of cultivators equipped with a conventional gasoline engine, acquiring fuel, storing it, and carrying it from place to place ordinarily required the use of a special carrying can. Refueling was done using a nozzle or other such device to transfer fuel from the carrying can to the gasoline tank. This operation generally appeared troublesome, and was one reason why customers who had never used a cultivator found it difficult to take the step towards purchasing one.

Commercially available gas canisters were used for the Pianta's fuel with the intention of heightening the users' convenience. In other words, people have to go to a gas station to buy gasoline, but gas canisters can be bought at convenience stores and other such establishments, and the use of replaceable gas canisters further allows people to refuel without getting their hands dirty by switching



Fig. 1 Design sketch

canisters (Fig. 2).

(2) Simplicity of transport and storage

It is very hard work to pick up and move a cultivator that weighs nearly 20 kg by hand, even for just a short distance. This is not just true of the Pianta. Up to now, therefore, either the cultivators moved by the power of their own engine, using the tines in place of wheels, or optional travel wheels could be attached and the cultivator pushed by hand. The former method, however, consumes fuel while the latter requires the separate purchase of wheels. With the Pianta, therefore, it was decided to resolve this issue by including a stand to keep the machine upright and a travel wheel as standard equipment.

One change that has been taking place in the environment of compact cultivator use is an increase in use in allotment gardens and other such locations in suburban areas in addition to their use around people's own homes. There have also been survey results showing that approximately 50% of the people use automobiles as their means of travel to allotment gardens, indicating that the frequency of loading cultivators into automobiles is increasing. When cultivators are stowed on board an automobile, it is desirable to minimize their exterior silhouette as much as possible. The target values for this cultivator were therefore set so that the total height with the handle folded would be equal to or lower than the FG201.

There was also a common issue involved when loading the cultivator on an automobile and when storing it at home: That dirt and mud on the tines would come off and soil the vehicle interior and the storage location. It was therefore decided to create a dedicated storage case that would help prevent dirt from falling off.

(3) Simplicity of operation

With conversion to a gas-fueled engine, it was no

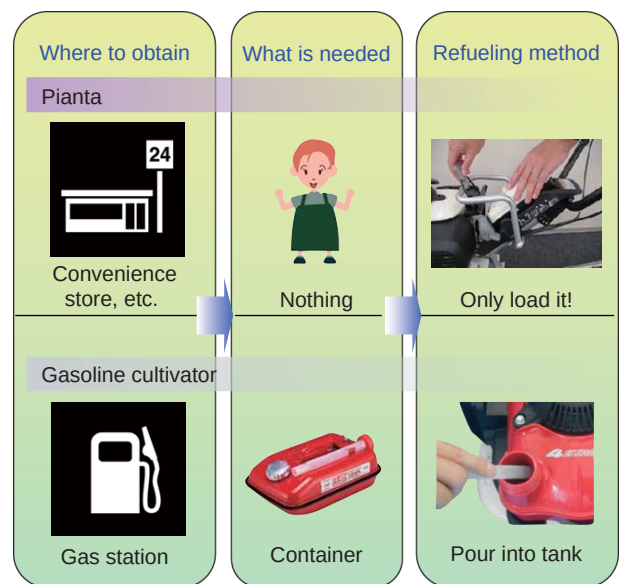


Fig. 2 Comparison between gas canister and gasoline

longer necessary to have a conventional choke operation. Further aims were to have a structure that allows users to fold the handle and to unlock the drag bar to adjust its height, which regulates plowing depth, without using tools. A system that allows cultivator operation using only the throttle lever was also adopted with the aim of simplifying operation.

2.2. Target Users

The population that engages in gardening and kitchen garden work is trending upward every year, without regard to age or gender, due to such factors as the increasing number of baby boomers who enjoy these activities as “a new interest” as well as the growing concern for food safety among the broader population. Among the population that does not own a cultivator and is inclined to take up agricultural work in the future, there are approximately 680 000 people (in Japan) who are interested in working on fields that are 9.9-105.8 m² in area, the appropriate size for a compact cultivator. These customers have been defined as the main target.

2.3. Pianta Styling Design

The basic concept of styling design is that of “going from a work machine to a gardening tool.”

(1) A simple bean form that is not intimidating

Taking the adzuki bean as a motif, the styling design was aimed to achieve a rounded effect to the greatest extent possible (Fig. 3). The exterior silhouette of the Pianta engine is larger than that of the FG201, on which it is based, but the styling design was further aimed at conveying an overall impression of compactness.

(2) An emblem that conveys quality

A fabrication technique known as potting was used for greater thickness and transparency of the mark compared to ordinary marks. The font and color used for the logo were also intended to give the impression of a step higher in high quality (Fig. 4).

(3) A cute, stylish white for the body color

The white keynote conveys a sense of cleanliness and sprightliness. This was intended to free the Pianta from the general image of work machines as heavy and dirty.

2.4. Butane Gas Engine Issues

Figure 5 shows a vapor pressure diagram^{(2),(3)} of the butane filling the gas canister and the gasoline and propane that have generally been used as engine fuels. As will become clear, butane undergoes a phase transition between vapor phase and liquid phase at approximately 0°C under atmospheric pressure. Consequently, there is concern that it will become difficult to exert control to feed the necessary amount of fuel to the engine at around 0°C. In other words, the question whether the limit temperature for fuel control on the low temperature side will be able to support the operating environmental temperature range envisioned for the cultivator becomes

an issue. The fact is that the lower limit of the theoretical operating temperature, as noted above, is an air temperature of 0°C, but there is a tendency for startup to become unstable even in the vicinity of temperatures as high as 10°C in actual operation.

In portable gas stoves, the butane is removed from the gas canister in the vapor state. In that case, the butane is vaporized inside the gas canister, and the temperature of the gas canister drops to a level lower than 0°C because of the latent heat of evaporation. The pressure inside the gas canister then drops to atmospheric pressure or lower. If left in this state, the canister becomes unable to discharge the fuel, and the fuel supply is interrupted. Therefore, a plate known as a heat panel is installed to transmit heat from the burner to the gas canister and prevent this from occurring. An engine, however, is unlike a portable gas stove that constantly carries on a certain level of combustion. In an engine, the amount of heat



Fig. 3 Bean-form design



Fig. 4 New emblem

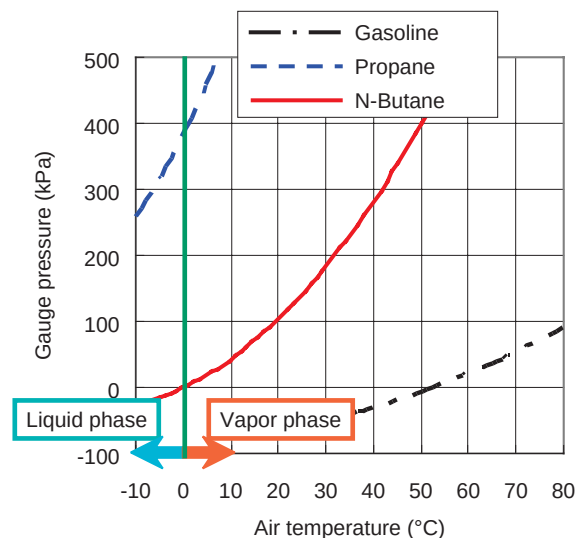


Fig. 5 Vapor pressure curve

generated will vary according to the work load, making temperature control difficult so that the gas stove approach cannot easily be adopted.

The method adopted with the Pianta, therefore, is always to take the fuel from the gas canister in its liquid phase and then to vaporize it. With this method, less of the fuel vaporizes inside the gas canister so that there is virtually no drop in the temperature of the gas canister, making it less likely that fuel-feed instability will occur. Specifically, this system will require a device to remove butane in its liquid phase, then to heat it to convert it to the vapor phase. This device is the vaporizer.

One further issue is that the butane in the gas canister contains some residue, though in extremely small amounts. This residue is separated out when the butane vaporizes and remains as a deposit within the butane pathway. Systems that remove fuel from the gas canister in the vapor phase, such as with portable gas stoves, do not experience this phenomenon because the residue remains inside the gas canister. When the fuel is removed from the gas canister in its liquid phase, however, the residue may block narrow places along the pathway, be deposited in valve seats, or the like, which may have a negative impact on fuel supply control. Therefore, it becomes necessary to have a mechanism that will separate the residue from the vaporized butane and store it.

2.5. Pianta Operating Environmental Temperature Range on the Low Temperature Side

It was found from a survey of general cultivator use in kitchen garden and similar applications that the time when people begin working with cultivators is concentrated in March and April, when they are sowing. Comparison of the average air temperature⁽⁴⁾ in the areas concerned at that time in Fig. 6 shows that the outside air temperature when sowing takes place is 5°C or higher, and the objective for the Pianta was defined accordingly as the capability to start and operate in an outside air temperature of 5°C.

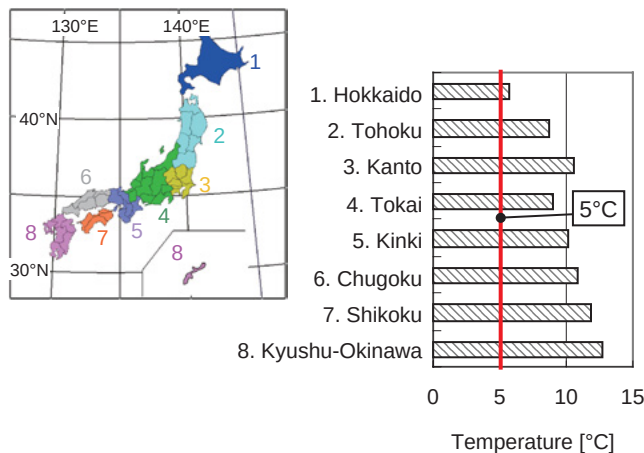


Fig. 6 Average temperature of various places from March to April

Table 1 Major specifications

Items	Developed engine
Engine type	4-stroke, single-cylinder
Displacement	49.4 cm ³
Bore × Stroke	41.8 × 36.0 mm
Compression ratio	8
Maximum power	1.2/5000 (kW/rpm) (1.6/5000) (PS/rpm)
Mixer	Side draft
Fuel	Butane

3. Overview and Features of the Gas Fuel Supply System

3.1. Gas Supply System

The engine used as the base was the gasoline-fueled GXV50 with the same displacement (49.4 cm³) as the Pianta engine. Table 1 and Fig. 7 show the major specifications and engine performance of the engine converted to burn gas.

New gas supply system parts were developed to support the use of gas canisters for fuel. Taking the flow of gas in the downstream direction, the main components in order are:

- (1) Gas canister adapter
- (2) Vaporizer
- (3) Regulator
- (4) Mixer

The layout of parts in the engine is shown in Figs. 8 and 9. Of these parts, only the gas canister adapter is attached on the frame side. The other parts are installed onto the engine itself. It is also apparent from these figures that the parts designed for compactness in order to realize the bean form are efficiently located inside the fan cover.

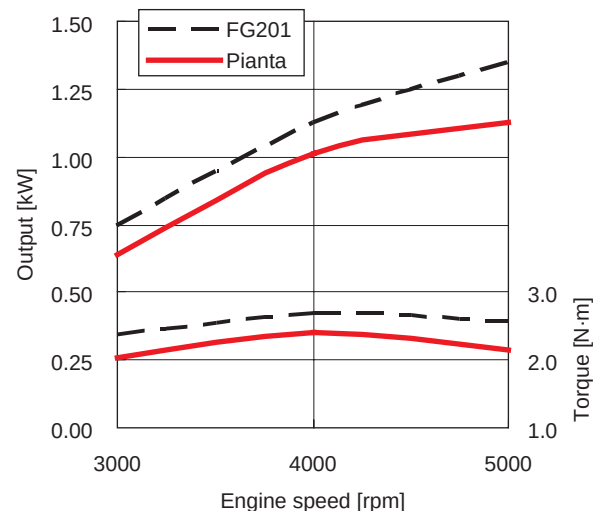


Fig. 7 Engine performance

This gas supply system also has the following two functions as its features.

(1) Fuel shutoff mechanism operated by the pressure of the fuel

...pressure detection valve

(2) Fuel cock that makes use of vacuum in the crankcase

...shutoff

The functions of the various parts are explained in greater detail in the following section.

3.2. Functions of Parts

3.2.1. Gas canister adapter

Figure 10 shows an exterior view of the gas canister adapter. The major functions of the gas canister adapter are:

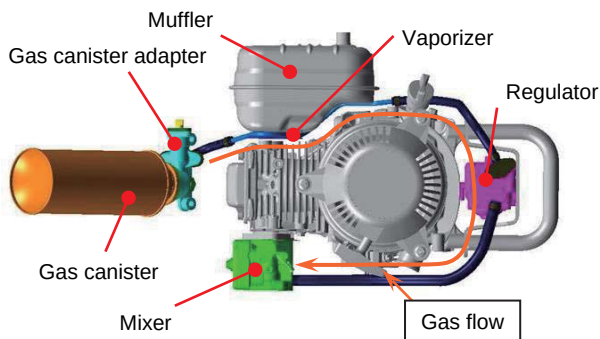


Fig. 8 Arrangement of parts

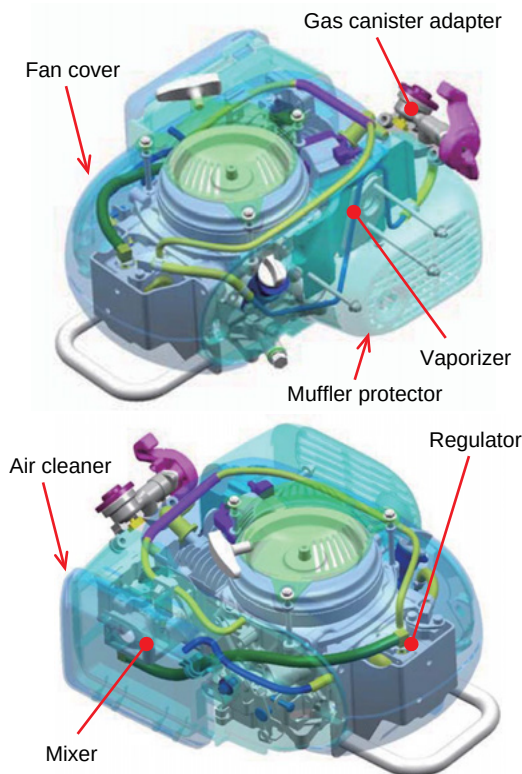


Fig. 9 Perspective view of engine

(1) Connection with the gas canister

By connecting with the gas canister, the butane is retrieved from inside the gas canister in a liquid state. The method of connection with the gas canister will be described later in connection with the gas canister connecting mechanism. The structure of the portions that connect with the gas canister and retrieve the fuel were modeled after the structures used in portable gas stoves.

(2) Manual fuel cock

Turning the knob clockwise causes the supply of fuel to be turned on and turning it counterclockwise shuts off the supply of fuel.

(3) Pressure detection valve

When the pressure in the gas canister and the tubing rises to 0.6 MPa or higher, the fuel passageways are shut down, the supply of fuel is stopped, and the engine is turned off. Figure 11 shows a conceptual image of the mechanism in operation. It is set up so that when the pressure in the tubing rises above a set level, the coned disc spring inverts and a shutoff valve shuts down the passageway. This is released by pressing the reset button. If the pressure in the tubing remains high, however, the mechanism will operate again, so the cause of the rise in tubing pressure has to be removed in order to restart the

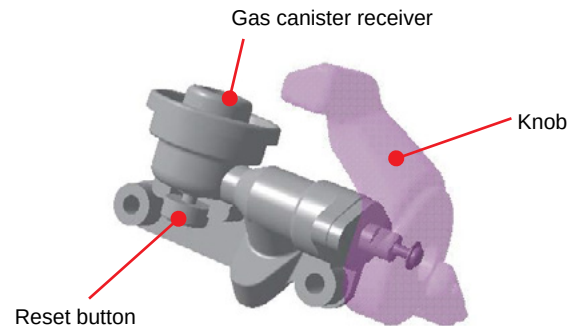


Fig. 10 Appearance of gas canister adapter

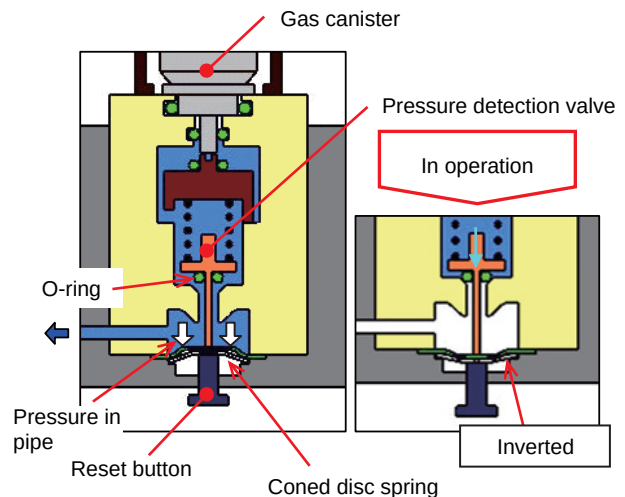


Fig. 11 Image of pressure detection valve in operation

engine. This valve mechanism was also taken from the portable gas stove system.

3.2.2. Vaporizer

The function of the vaporizer is to use the exhaust heat from the engine to vaporize the liquid phase butane retrieved from the gas canister. Figure 12 shows its external appearance. The vaporizer was placed between the cylinder head exhaust port and the muffler in order to transmit the exhaust heat efficiently (Fig. 8). Although this is a simple device, with piping attached by brazing to a steel plate formed by press piercing, it is intended to raise the temperature of the piping rapidly and promote vaporization of the butane, and this has enabled cultivator starting and operation when the outside air temperature is 5°C.

3.2.3. Regulator

Figure 13 shows an external view of the regulator. The pressure of the butane gas that is vaporized by the vaporizer becomes approximately equal to the pressure inside the gas canister (the butane vapor pressure) at the outside air temperature. The reason that it does not rise to a high pressure due to the exhaust temperature is that the vaporizer is connected to the gas canister by means of the gas canister adapter, and the vapor phase portion inside the gas canister has a damping effect. However, to have the pressure constantly fluctuating with the outside air temperature is disadvantageous in terms of supplying the proper mixture of fuel to the engine, so the fuel

pressure is adjusted to 9-11 kPa in the regulator before the fuel is sent to the mixer.

In addition to butane, there is also residue inside the gas canister. This residue remains after the gas evaporates. The labyrinth structure shown in Fig. 14 was located inside the regulator chamber so that the residue that separated out inside the regulator would accumulate in a separate chamber below it. Figure 15 shows the residue accumulated in a cup after the cultivator has been in operation for 50 hours. There was no outflow of the residue to any point past the regulator, confirming the effectiveness of the labyrinth.

There is also a fuel cock known as a “shutoff” built into this regulator. This is a so-called negative pressure cock. A tube that connects to the crankcase communicates the vacuum from the crankcase to operate a diaphragm that opens the valve while the engine is in operation. When the engine stops, the valve closes and shuts off the supply of fuel.

3.2.4. Mixer

Figure 16 shows an external view of the mixer. The butane gas, with its pressure adjusted by the regulator, is supplied to the engine from the mixer. There is a zero governor built into the mixer, and this zero governor regulates the volume of gas supplied to the engine according to the size of depression at engine manifold. A combustible gas mixture is supplied to the engine by this mechanism.

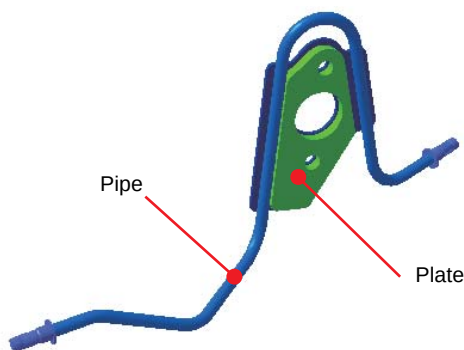


Fig. 12 Appearance of vaporizer

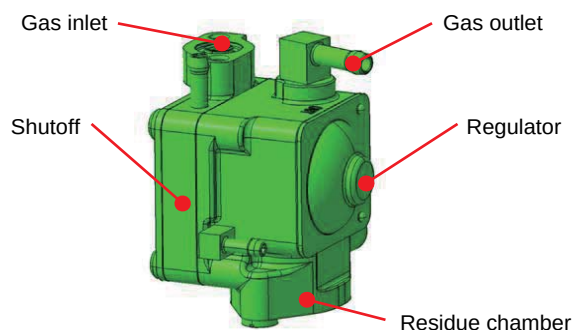


Fig. 13 Appearance of regulator

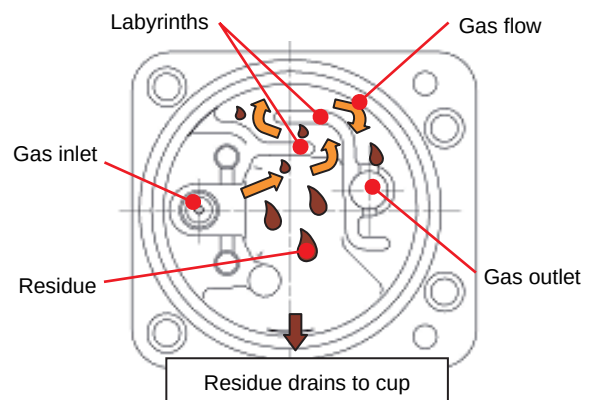


Fig. 14 Labyrinth structure in regulator chamber



Fig. 15 Residue that drained into cup (use for 50 hours)

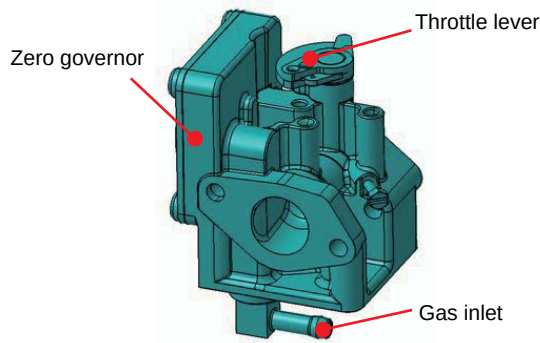


Fig. 16 Appearance of mixer

Table 2 CO₂ emission

FG201	Pianta
1.5 kg/(kW·h)	1.3 kg/(kW·h)

Table 3 Emission regulation

EPA Phase II · LEMA	Pianta
CO : 610 g/(kW·h)	286 g/(kW·h)
HC + NOx : 50 g/(kW·h)	24 g/(kW·h)

3.3. Environmental Performance

Tables 2 and 3 show CO₂ emissions and emission performance of the Pianta. The conversion to a gas-fueled engine has reduced CO₂ emissions by approximately 10% relative to the FG201 equipped with a gasoline engine. In terms of emission performance, the Pianta engine met the EPA Phase II and Japan Land Engine Manufacturers Association (LEMA) self-regulating levels.

4. Overview of Gas Canister Connecting System

4.1. Gas Canister Interior Structure and Liquid Phase Supply

The gas canisters that are commercially available for use with portable gas stoves have JIS-specified⁽⁵⁾ shapes, dimensions, content gas constituents, and the like, and the Pianta uses these canisters. As shown in Fig. 17, the interior of a gas canister has an L-shaped nozzle that is

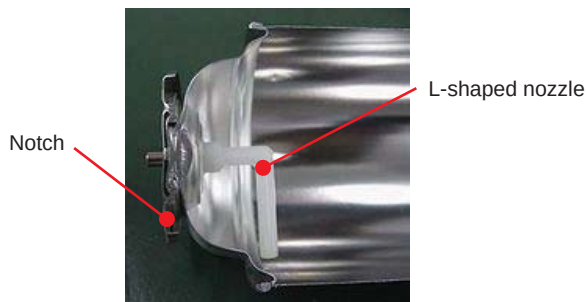


Fig. 17 Internal structure of gas canister

located in the same direction as the notch in the gas canister flange. In order to remove butane in its liquid phase, the cartridge needs to be connected with the nozzle (and notch) facing down, as in Fig. 17. This allows removal of fuel in its liquid phase.

4.2. Overview of Connecting System and Method of Attachment

A cultivator may sometimes be left outside. Therefore, it requires a system for connecting the gas canister that is better suited to outdoor environments than the method found on portable gas stoves.

For the Pianta, therefore, a gas canister case was devised into which the gas canister is placed (Fig. 18). This protects the gas canister from direct sunshine, rain, and other such factors, and allows users to make sure that the notch is oriented properly. The gas canister adapter intake is also protected by a shutter mechanism. This structure was adopted to make the intake dustproof, even when stored with the gas canister removed.

The gas canister is inserted into the gas canister case. When the case is slid into the receiver and the fastener is affixed, the gas canister connection is complete. Figure 19 shows the connected gas canister.

With this connecting system, the gas canister is

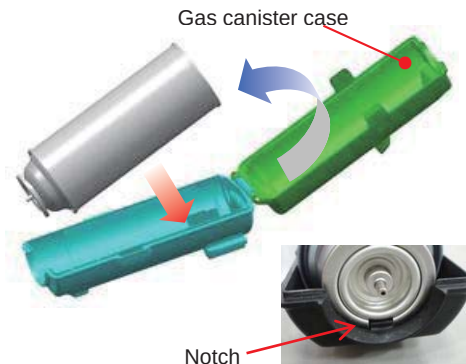


Fig. 18 Method of connecting gas canister

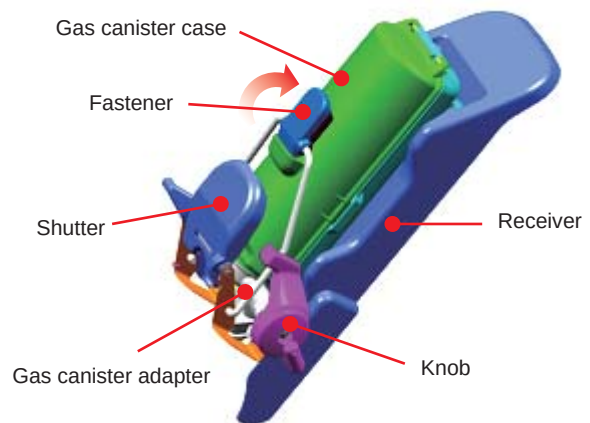


Fig. 19 Gas canister connected

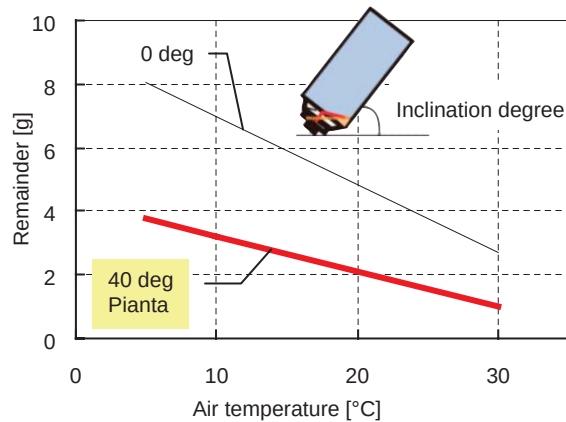


Fig. 20 Amount of gas remaining at various air temperatures

connected at an angle of 40° from the horizontal. This enables complete use of the gas down to a remainder of 3.7 g (liquid phase) even when the outside air temperature is 5°C (the lower limit of the operating temperature). Figure 20 shows the relationship between the amount of gas remaining in the gas canister when the engine runs out of fuel and the outside air temperature for canister inclinations of 0° and 40°.

5. Component Technologies on the Cultivator Side

5.1. Reduction of Body Size and Simplification of Operation of Various Parts

Figure 21 and Table 4 show the external appearance and major specifications of the Pianta, respectively. In keeping with the Pianta's development concept, the simple bean form and white color were adopted, conveying the intended image as a gardening tool.

The Pianta tines were made approximately 4% shorter



Fig. 21 Appearance of Pianta

Table 4 Comparison between Pianta and FG201

Items	Pianta FV200	FG201
Overall length (mm)	1055	1050
Overall width (mm)	485	475
Overall height (mm)	990	995
Storage height (mm)	530	635
Dry mass (kg)	20	16.5
Tine speed (rpm)	135	135
Tilling width (mm)	350	450
Tine diameter (mm)	φ 250	φ 260
Starting system	Recoil starter	Recoil starter
Main clutch type	Centrifugal clutch	Centrifugal clutch
Transmission speeds	1Forward	1Forward

and 22% narrower in total than the tines on the gasoline-fueled FG201 compact cultivator. This was done to make the body more compact and more easily maneuverable during operation. In addition to these changes, the layout of the handle column components was also revised so that the total height with the handle folded was reduced from 635 mm to 530 mm, a reduction of approximately 17% (a reduction of 20% when the stand is not used) (Fig. 22).

Manually loosening a bolt with a large knob was adopted as the method of releasing the lock when folding the handle. The mechanism for releasing the lock when changing the height of the drag bar is also a knob to be pulled out (Fig. 23). This allows both operations to change configuration to be carried out without using tools.

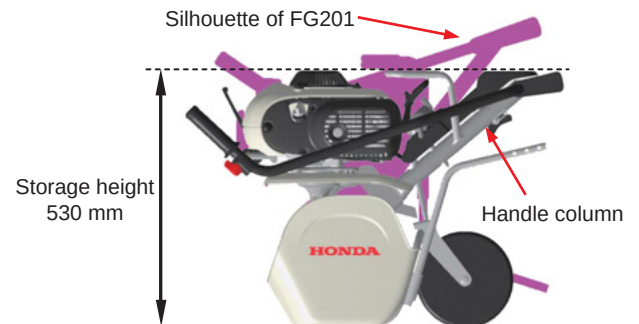


Fig. 22 Appearance of storage configuration



Fig. 23 Height adjustment mechanism

The system was also made so that the only operation that has to be performed in order to begin working with the cultivator after starting the engine is to grip the throttle bar. Specifically, gripping the lever causes the engine speed to increase. At approximately 2700 rpm, the centrifugal clutch engages, the tines begin to rotate, and work can be done.

The adoption of mechanisms such as those above realized simplification of controls for “simplicity of operation.”

5.2. The Carry Stand and Travel Wheel Integrated with the Stand

The Pianta was equipped with a dedicated carry stand (Fig. 24). With this, users can put down the cultivator in a more stable position even though the overall width between the outer tines is narrower than on the FG201. This stand can also be configured to raise the body of the cultivator, making it easier to perform maintenance on the tines, wash the cultivator, and carry out other such operations. The stand is also equipped with an integrated travel tire, to help reduce the frequency with which the cultivator body must be lifted up and moved by hand. Furthermore, a storage holder for the drag bar was also placed on the left side of the stand. Enabling this integration of the stand, travel wheel, and drag bar with the main body makes the cultivator even more convenient to put away.

5.3. Manufacture of a Carry Box

A carry box as shown in Fig. 25 was devised for the Pianta. The box was shaped so that the cultivator could be placed in and removed from the box from in front while on its stand, without having to lift up the cultivator. As a result, the box is distinctive for how easy it is to fit onto the Pianta (Fig. 26). With this approach, dirt on the tines or other parts of the cultivator can be kept from soiling the surroundings when the Pianta is loaded into a vehicle or placed in storage at home.

The carry box is also made so that the tines are in contact with the inside surface of the box. This means that

the box will not be unsteady or shift balance, and it does not require buckles or other such attachment devices to keep it on the cultivator. As shown in Fig. 27, this carry box also serves as a protective cover that keeps the tines from hitting against the user’s leg when the user is carrying the cultivator by hand.

5.4. Adoption of New Model Tines and Enhancement of Drag Bar

The tines were made shorter and narrower, as discussed earlier, but ordinarily changes like these would also cause some loss of plow power (the power to move forward while breaking the earth). Therefore, the cutting angle at the tips of the tines was made larger on the Pianta than on the FG201, and the projected area of the tines was increased by approximately 6%. This increased the amount

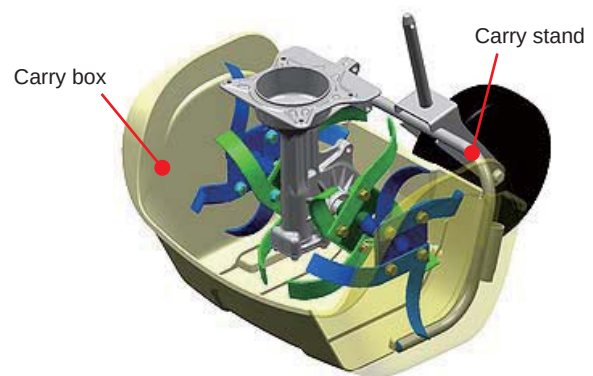


Fig. 25 Cutaway view of carry box



Fig. 26 Method of fitting on carry box

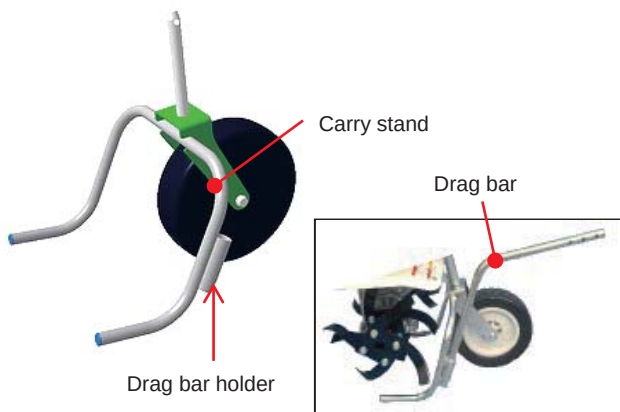


Fig. 24 Appearance of carry stand



Fig. 27 Pianta configuration for carrying by hand

of soil that is able to be scraped out by the tines and provided plow power equal to or greater than the FG201 (Fig. 28). The shape of the drag bar was also given a bending angle 3.4° greater to lessen resistance from the soil. Combined with the change in the tine shape, this enhanced the Pianta's plow power (Fig. 29).

Figure 30 shows the results from measurement of work speed for different plowing depths. The Pianta has

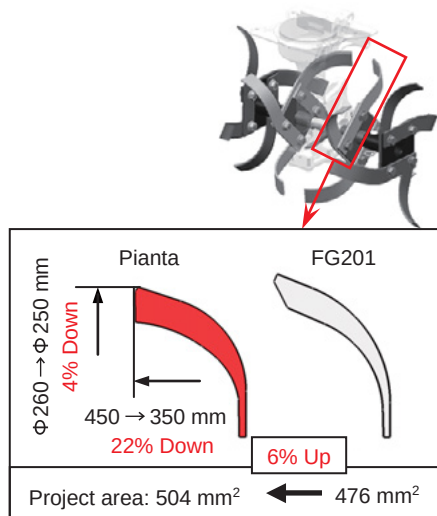


Fig. 28 Comparison of tine project area

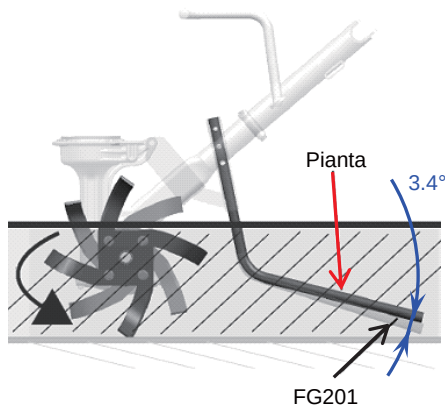


Fig. 29 Drag bar angle comparison

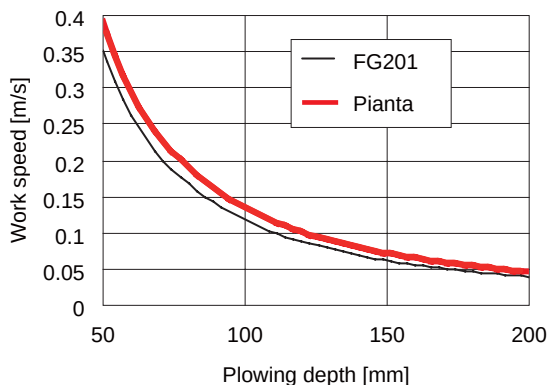


Fig. 30 Work speed

working speeds, on average, approximately 15% greater than those of the FG201, regardless of plowing depth.

5.5. Noise

The envisioned use of the Pianta is in kitchen gardens about 9.9-105.8 m² in size, commonly adjoining residential areas, so that consideration of noise heard in surrounding areas is necessary. The capacity of the Pianta's muffler was increased from the 370 cm³ of the FG201 to 790 cm³, approximately a twofold increase. The engine was also fully covered. Figure 31 shows the resulting 1.5 dB(A) decrease in noise level at the operator's position while the cultivator is in operation.

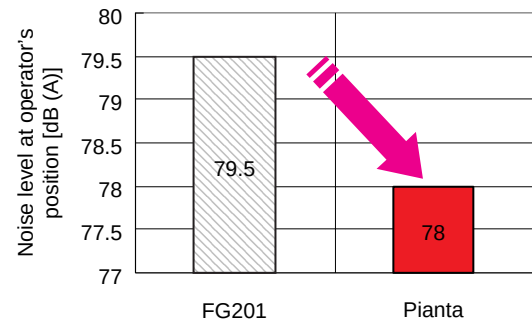


Fig. 31 Comparison of noise

6. Conclusion

The Pianta compact cultivator was developed with a gas supply system that presupposes that butane will be removed from the gas canister in its liquid phase.

(1) Realization of simplicity of fuel

The use of a gas canister reduced the time and trouble of acquiring, storing, and transporting fuel.

Furthermore, a labyrinth structure was located inside the regulator chamber to separate and remove the residue that is left after butane vaporizes.

(2) Realization of simplicity of transport and storage

An integrated travel wheel and carry stand was devised to allow stable placement of the cultivator during storage and to reduce the labor in lifting and carrying the cultivator. A carry box was also devised to keep dirt and mud from falling off the cultivator in the storage location.

(3) Realization of simplicity of operation

The conversion to a gas-fueled engine made choke operation unnecessary. The Pianta also allows the handle to be stored and the plowing depth to be changed without any need for tools. Moreover, a method of operation was devised that, once the engine has been started, only requires the throttle bar to be gripped in order to begin working. A new gas canister connecting mechanism that is suited to use in an outdoor environment was also created.

(4) “Going from a work machine to a gardening tool”

The adoption of a simple bean form and white color convey the intended image as a gardening tool.

(5) Environmental performance

The Pianta has CO₂ emissions approximately 10% lower than the gasoline-fueled GXV50, and the CO, HC+NO_x emissions met EPA Phase II regulation levels and LEMA self-regulating levels. Changes to the muffler and other changes also achieved a reduction of 1.5 dB(A) in the noise level at the operator’s position when working with the cultivator relative to the FG201.

(6) Engine startup at low temperature and removal of residue

The vaporizer was placed between the cylinder head outlet and the muffler to warm the piping more quickly and enable starting and working with the cultivator when the outside air temperature is 5°C.

(7) Increased plow power

The adoption of new model tines, with a projected area approximately 6% larger, together with enhancement of the drag bar increased the Pianta’s plow power, on average, approximately by 15% relative to the FG201.

7. Epilogue

The adoption of gas canisters for fuel and other such measures were taken in order to develop a cultivator that would be easy to use and not intimidating. As a result, Honda believes that even users who have never worked with a cultivator before will find this product more approachable. The appearance of this product will enable further market expansion, and it is the developers’ profound hope that the Pianta will increase the number of customers who feel “the joy of using the product” even if just by one.

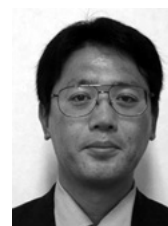
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