

Introduction of HD465-7/605-7 Dump Trucks in GALEO Series

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The DX Series that was put on sale in 1989 was completely remodeled for the first time in 13 years. As the first GALEO Series of rigid dump trucks, we have introduced Models HD465-7 and HD605-7 to the market.

These new models incorporate many of Komatsu's most advanced technologies to meet the customer needs that were identified by in-depth surveys of the relevant markets. This paper describes the salient features of the new models.

Key Words: *Rigid Dump Trucks, Response to Tier 2 Emissions Regulations, Enhancement of Safety, Reduction of R/M Cost, Gearshift Interlock Control, ARSC/ASR/VHMS.*

1. Introduction

Since introduction, the DX Series of dump trucks had been popular among many users because of high work efficiency, good riding quality, etc. However, more than 10 years had passed since the last remodeling and hence, a thoroughgoing review of the DX Series that had no rivals for years was being called in the face of the change in user needs, the introduction of new models by competition, etc.

On the other hand, as exemplified by the enforcement of stringent emissions regulations and the mounting cry for control of noise in recent years, growing attention is being paid to protection of the environment and respect for humanity. It was, therefore, necessary to positively review the DX Series.

Under those conditions, Komatsu developed and introduced to the market Model HD465-7 and HD605-7 dump trucks which are safe and friendly to the environment and which incorporate many advanced technologies (**Photo 1**).



Photo 1 Model HD465-7

2. Objective of development

In launching development of Model HD465-7/605-7 dump trucks, Komatsu carried out an extensive market survey in Europe, North America, and Southeast Asia which are the most promising markets for Komatsu's dump trucks. The survey results showed that many users were strongly calling for a higher degree of safety and a higher cost performance ratio. Therefore, we decided to develop Model HD465-7/605-7 dump trucks – the first GALEO Series of products – with 'safe, profitable dump trucks' as the watchword (Table 1).

Table 1 Objectives of development

Selling point (development concept)	
Item	Content
Positive response to environmental protection/regulations	<ul style="list-style-type: none"> Meeting Tier 2 Emissions Regulations
High work efficiency	<ul style="list-style-type: none"> Improving acceleration/hill climbing performance by increasing engine torque Securing outstanding maneuverability
High cost performance ratio	Reducing cost of periodical maintenance
	Reducing cost of overhaul
	Facilitating management of machines
	Facilitating changing tires
Outstanding safety	Improving brake reliability and durability
	Improving braking performance markedly
Cab amenity	Improving riding quality and reducing transmission shock
	Quiet cab interior
	Reducing shock made by lowering of dump body

3. Selling points and means of attaining them

The means of attaining the objectives set for the first models of the GALEO Series rigid dump trucks shall be explained below in the order in which they are listed in Table 1.

3.1 Positive response to environmental protection / regulations

- (1) Clean, powerful SAA6D170E-3 engine
 - ① Equipped with an electronically-controlled, high-pressure fuel injection (HPI) system, an air-cooled aftercooler, a high-efficiency turbocharger, etc., the SAA6D170E-3 engine boasts outstanding fuel efficiency and exceptionally low levels of exhaust emissions while securing a very large output per machine weight as compared with other engines of the same class.
 - ② The engine has met the Tier 2 Emissions Regulations of the Ministry of Land, Infrastructure and Transport (Japan), of the EPA, and of the EU (Photo 2).

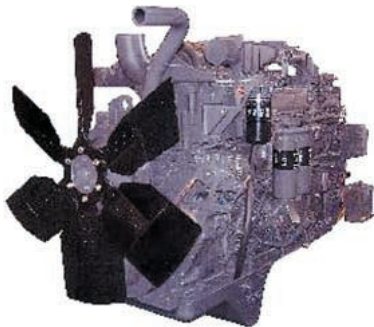


Photo 2 SAA6D170E-3 engine

3.2 High work efficiency

- (1) Compared with the former models which had a reputation for their work efficiency, the new models which are equipped with an SAA6D170E-3 engine have been given a higher torque rise (24% vs. 14%). As a result, their acceleration and hill-climbing speed have increased. This in turn has appreciably raised the work efficiency at hilly construction sites (Fig. 1).

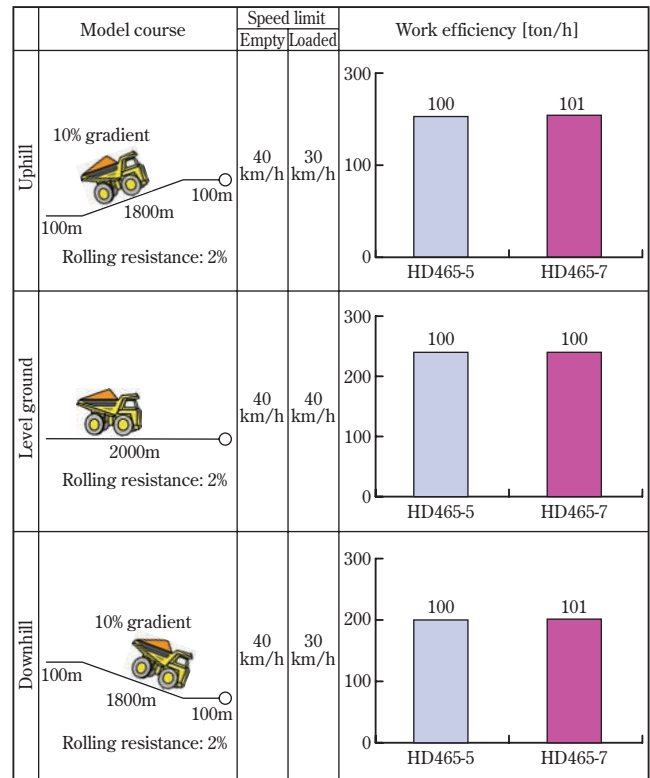


Fig. 1 Comparison of work efficiency

3.3 High economical efficiency

As compared with the former models, the overall cost of repair and maintenance has been reduced by about 30% through extended time interval of overhaul, reduced periodical maintenance cost, facilitated machine management, etc.

- (1) Reduced periodical maintenance cost

The cost of periodical maintenance has been reduced by the following measures.

 - ① Modifying the hydraulic circuit to reduce the amount of oil required
 - ② Extending the time intervals of oil drain and lubrication and reducing the number of oil filters
 - ③ Employing a fully hydraulic brake control system
 - ⑤ Making the parking brake free of maintenance
- (2) Reduced overhaul cost

The cost of overhaul has been reduced not only by extending the time intervals of overhaul of the main components but also by making the disassembly/reassembly of components easier through the use of a split-type rear axle, etc.
- (3) Facilitated machine management

The new models are equipped with a vehicle health monitoring system (VHMS) as standard. This system, which

is effective for preventive maintenance, facilitates failure diagnosis and machine management. The VHMS controller performs a centralized, real-time control of the individual controllers which control the main components of the vehicle. By downloading data collected from the individual controllers to a personal computer and analyzing the data on a continual basis, it is possible to implement preventive maintenance of the vehicle.

In addition, the satellite communication capability (option) permits obtaining vehicle information on a real-time basis through the Web CARE.

Since this system also offers as an option the conventional payload meter (PLM) function, it is possible to analyze and control the vehicle operating condition even without the PLM controller (Fig. 2).

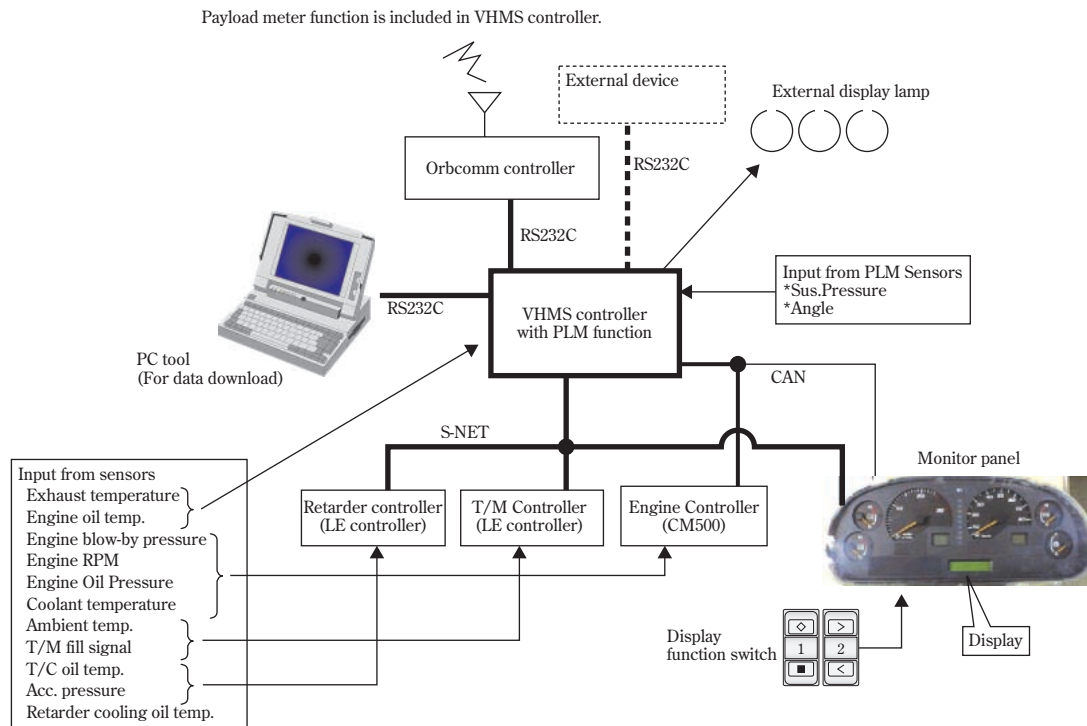


Fig. 2 Scheme of VHMS configuration

(4) Facilitated tire replacement

The rim fitting method has been changed (from wedge ring fitting to flange fitting) to facilitate the tire replacement work (Fig. 3).

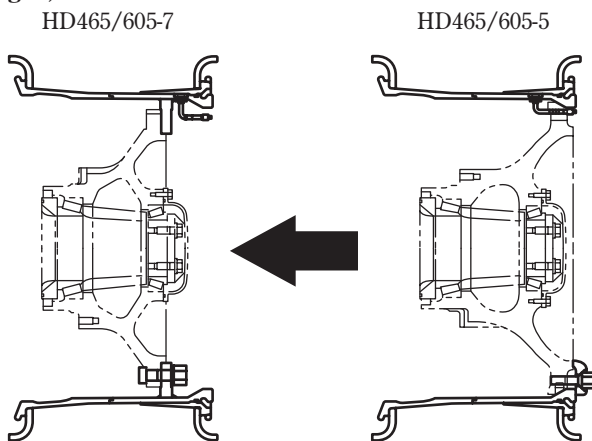


Fig. 3 Rim fitting method

(5) Facilitated vehicle transportation

A model of CS (civil engineering work's special) specification for safe, easy split transportation has been made available to meet the request from many subcontractors that often transport their vehicles from one construction site to another.

3.4 Outstanding safety

Compared with the former models, the new models have been markedly improved in safety by enhancing the reliability and durability of their components, mainly those of the brake system which is one of the most important parts to ensure safe operation, and adopting a high-rigidity cab to better protect the operator.

- (1) Improved brake reliability and durability
- ① Adoption of a fully hydraulic brake control

A fully hydraulic brake control has been adopted to reduce the time lag in and improve the response of braking. In addition, the pneumatic devices have been abolished to improve the system reliability dramatically.

Each of the front, rear, and parking brakes consists of an independent circuit provided with an accumulator. The parking brake is a spring-applied, large-capacity, enclosed multi-disc type whose design assures a very high degree of safety. The emergency brake control that is used if any of the brake circuits fails has been changed from the lever type to a pedal type so as to improve the ease and speed of control operation (Fig. 4 and Fig. 9).

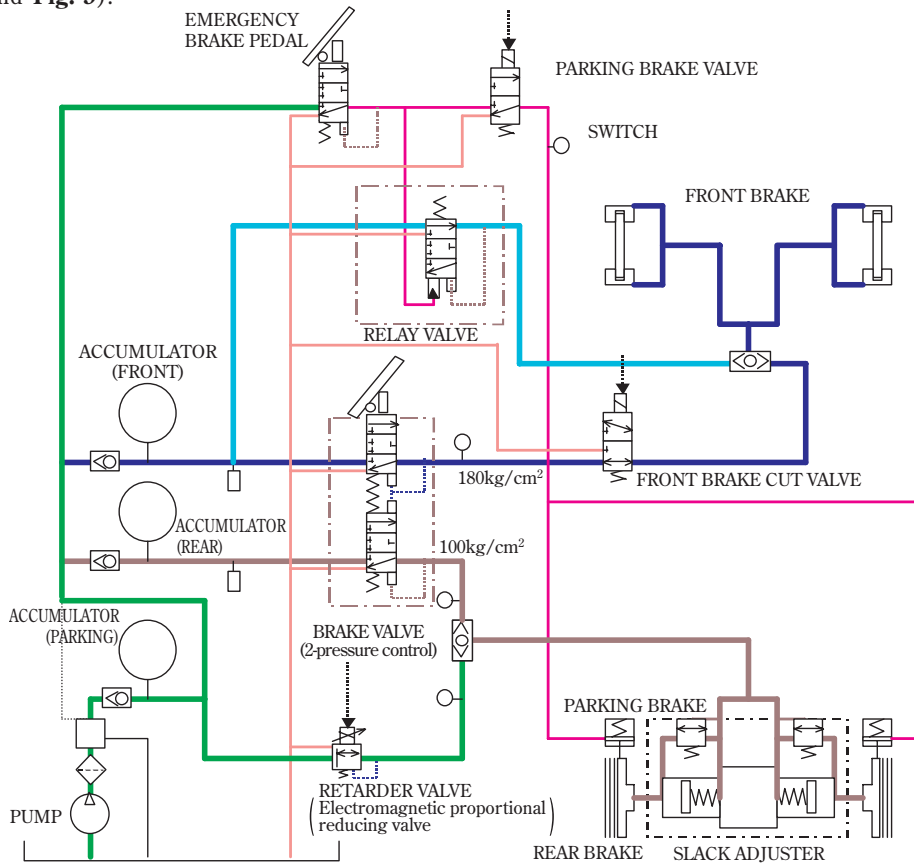


Fig. 4 Fully hydraulic brake control circuits (HD465-7)

- ② Adoption of a built-in parking brake
- As mentioned in the preceding paragraph, the parking brake has been built in the rear axle to make it free of maintenance and improve its reliability significantly (Fig. 5).

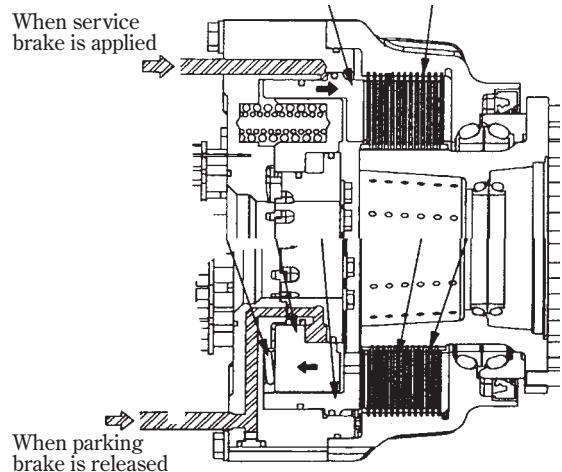


Fig. 5 Structures of rear and parking brakes (HD465-7)

- (2) Improved brake operation
- ① Adoption of ARSC as standard

The automatic retard speed control (ARSC) is similar in function to the automatic cruise control of a passenger car. When the vehicle is running downhill, the ARSC automatically keeps the vehicle at a preset speed. Thus, the ARSC permits the operator to drive the vehicle down the hill at a constant speed without manipulating the speed retarder by hand (Fig. 6 and Fig. 7).

The main functions of the ARSC are shown below.

- (a) The vehicle descending speed can be set at the touch of a lever (setting range: 10 to 55 km/h).

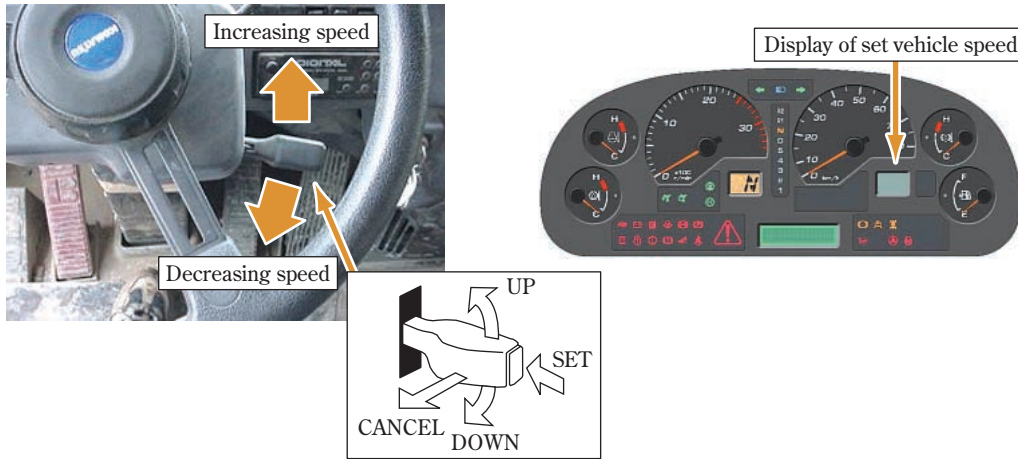


Fig. 6 ARSC manipulator and display

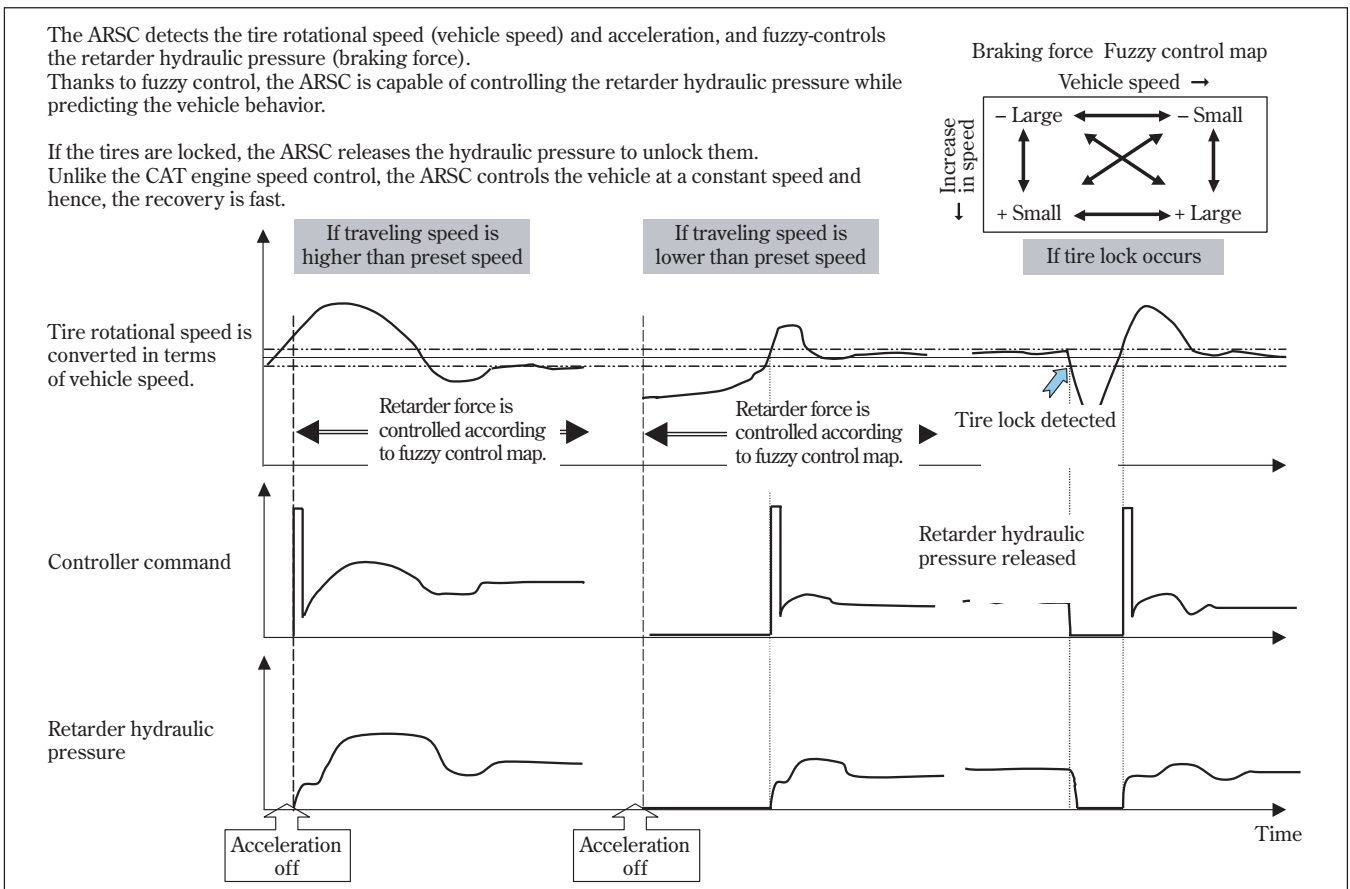


Fig. 7 Outline of ARSC operation

(b) ASR (automatic spin regulator)

When either of the driving wheels slips on a soft ground, etc., the ASR automatically applies the brake to the slipping wheel and transmits the driving force to the other wheel. This is effective to maintain stable run of the vehicle and prevent the vehicle from getting stuck in the mud (Fig. 8).

③ Motor-operated retarder lever and emergency brake pedal

A motor-operated retarder lever was adopted and the emergency brake control was changed from the conventional lever-operated type to a foot-operated (pedal) type to improve the ease of braking work (Fig. 9).

3.5 Improved operator comfort

All the dump trucks of Komatsu have long had a reputation for their comfortable cabs. The new models are provided with a wide, noise-insulated cab with built-in ROPS/FOPS. In addition, the new functions “engine-transmission interlock control” and “skip shift” that are performed during transmission have been added to improve the riding quality. Furthermore, an electronic hoist control has been adopted to significantly reduce the shock that is applied to the vehicle body during soil discharging work.

(1) Improvement of riding quality and reduction of transmission shock

① Engine-transmission interlock control

The “engine-transmission interlock control” function has been newly added to the electronic full-range modulation system K-ATOMiCS whose performance has been proved by the former models. This new function synchronizes the engine and transmission speeds during transmission to allow for smoother transmission and reduce the peak torque and thereby prolong the life of the power train (Fig. 10).

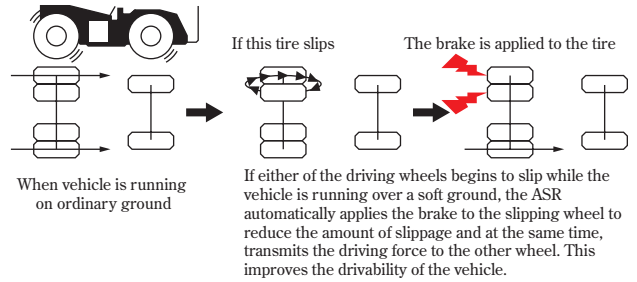


Fig. 8 Explanation of ASR operation



Fig. 9 Arrangement of brake pedal and levers

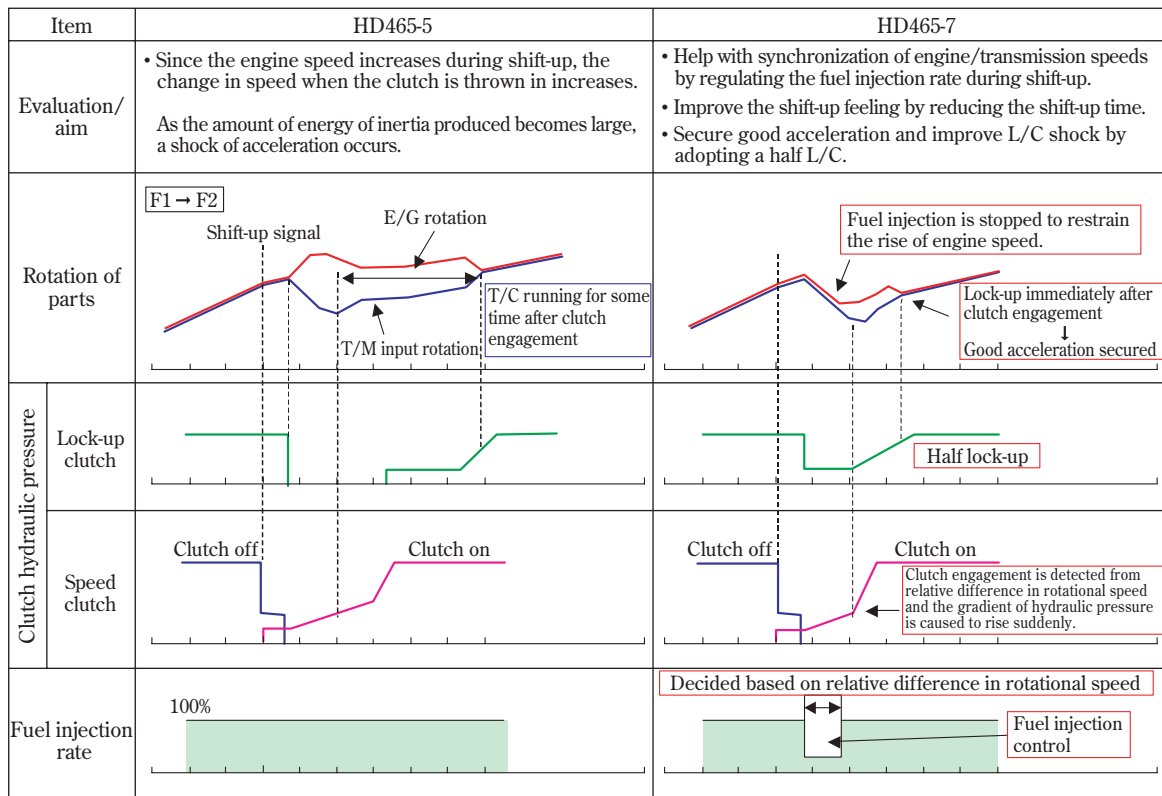


Fig. 10 Engine-transmission interlock control (example of control during shift-up)

② Skip shift

This function shifts down the engine speed directly to the optimum speed stage according to the load applied during hill-climbing in order to reduce the frequency of shift work, improve the riding quality, and prevent excavated soil from spilling from the vehicle (Fig. 11).

New model

At the time of a shift-down while the throttle valve is fully opened, the target speed stage is changed according to the speed reduction rate (deceleration rate) and the current speed stage is maintained till the vehicle speed drops to a level at which the skip shift can be done. It should be noted, however, that even while the current speed stage is maintained for the skip shift, if the deceleration rate varies due to a change in gradient of the slope, etc. and the skip shift is judged unsuitable, the vehicle speed is changed

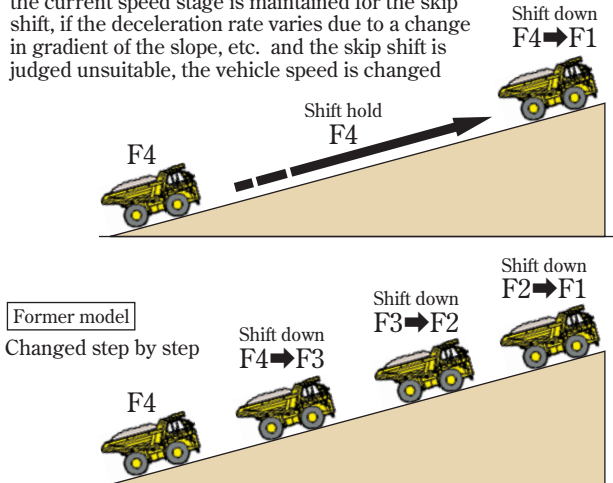


Fig. 11 Image of skip shift function

③ Viscous cab mount

The cab mount is a viscous mount employing rubber and silicone oil. This new mount reduces the mechanical vibration and noise coming from the vehicle body and mitigates the operator fatigue, thereby increasing the work efficiency (Fig. 12).

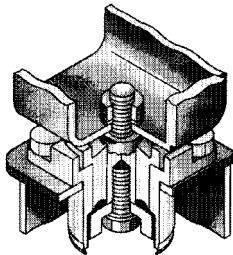


Fig. 12 Viscous mount

(2) Noise-proof cab interior

A high-rigidity cab with built-in ROPS/FOPS has been mounted on the vehicle body via the viscous mounts described in the preceding paragraph. As a result, the cab offers the operator a quieter and more comfortable space as it cuts off much of the vibration and noise from the vehicle body.

The following improvements have been made on the conventional cab to reduce the level of noise arriving at the operator's ears by 4 dB (A) (Fig. 13 and Photo 3).

- (a) Increasing the overall cab rigidity by built-in ROPS
- (b) Improving the sound-insulating performance by increasing the thicknesses of the floor plate and window glass
- (c) Improving the hermetic seal of the cab
- (d) Adding damping materials

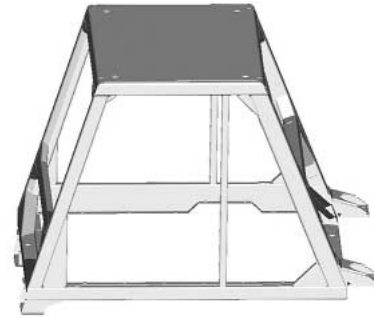


Fig. 13 ROPS



Photo 3 Cab interior

(3) Reduced body seating shock

A newly-employed electronic hoist control has reduced the force required for hoist operation. In addition, the "body seating speed control" function has appreciably reduced the body seating shock during discharge of excavated soil (Photo 4 and Fig. 14).



Photo 4 Hoist control lever

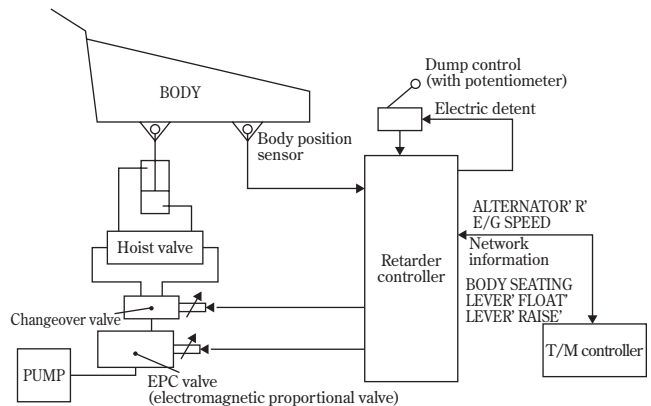


Fig. 14 Electronic hoist control system configuration

4. Conclusion

As the first ones of the GALEO Series of rigid dump trucks, Models HD465-7 and HD605-7 were developed to meet the Tier 2 Emissions Regulations.

Due in part to a delay in start-up, the development schedule was tight. Nevertheless, the new models were put into mass production almost as scheduled.

Fortunately, the two models have been very well received by many customers since they were put on the market. In addition, they are increasing their share in the dump truck market remarkably. These two facts are considered to attest to the validity of the development concept.

Introduction of the writer



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Entered Komatsu in 1971. Currently working in Construction Equipment Technical Center 2, Development Division, Komatsu.

[A few words from the writer]

In the present development project, much time and difficulty was involved in the initial process up to the preparation of a practical project proposal. After that, I feel that the project was carried out speedily and smoothly.

In order to complete the development by the time of enforcement of the Tier 2 Emissions Regulations, we worked hard to make up for lost time in the process of development.

The development of the GALEO Series of rigid dump trucks is continued in the years ahead. We intend to make the most effective use of our experience in the development of the first two models and come up with new vehicles which are loved by as many customers as possible.